

GLOBAL FORECAST: RAPESEED & CANOLA

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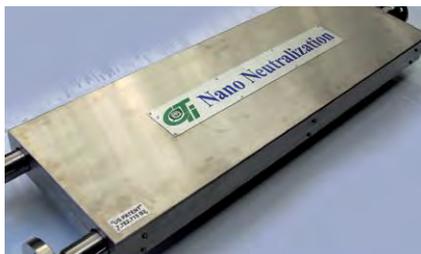
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To be a global forum to promote the exchange of ideas, information, and experience, to enhance personal excellence, and to provide high standards of quality among those with a professional interest in the science and technology of fats, oils, surfactants,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

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Calendar

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

March

March 11–16, 2012. Principles and Practice of
Cosmetic Science, Bournemouth, UK. Infor-
mation: scs.org.uk/principles-and-practice.March 11–16, 2012. Pittcon 2012 Conference
& Expo, Orlando, Florida, USA. Information:
pittcon.org.March 13–15, 2012. World Biofuels Markets
Congress & Exhibition, Rotterdam, Neth-
erlands. Information: [worldbiofuelsmar-
kets.com](http://worldbiofuelsmar-
kets.com).March 14–16, 2012. GLOBE 2012 Business
Environment Event—Conference and Trade
Fair, Vancouver, Canada. Information: 2012.
globeseries.com.March 15–16, 2012. Home and Personal Care
Ingredients Congress India, Bombay Exhi-
bition Centre, Mumbai, India. Information:
hpci-congress.com.March 18–20, 2012. 5th Workshop on Fats
and Oils as Renewable Feedstock for the
Chemical Industry, Karlsruhe Institute of
Technology, Karlsruhe, Germany. Informa-
tion: abiosus.org/kit-workshop-2012.html.March 25–26, 2012. Global Castorworld
2012, Jaipur, India. Information: [jatropa-
biodiesel.org](http://jatropa-
biodiesel.org).March 25–29, 2012. 243rd American Chemi-
cal Society National Meeting and Exposi-tion, San Diego, California. Information:
acs.org.March 25–29, 2012. XVI International Sym-
posium on Atherosclerosis, Sydney Conven-
tion and Exhibition Centre Darling Harbour,
Sydney Australia. Information: isa2012.com.March 28–30, 2012. Southeast European
Conference & Exhibition "SAVE the Planet,"
Sofia, Bulgaria. Information: [eco.viaexpo.
com/en/exhibition](http://eco.viaexpo.
com/en/exhibition).

April

April 1–3, 2012. 80th Oil Mill Operators Short
Course. Wichita, Kansas, USA.Information: Rich Clough, phone: +1 979-
862-2262; fax: +1 979-845-2744; email:
rclough@tamu.edu; foodprotein.tamu.edu.April 3–4, 2012. Advanced Biofuels Lead-
ership Conference, Washington, DC, USA.
Information: [tinyurl.com/BiofuelsLeader-
ship](http://tinyurl.com/BiofuelsLeader-
ship).April 10–12, 2012. Critical Commodities Con-
ference 2012, New Orleans, Louisiana, USA.
Information: [CriticalCommoditiesConfer-
ence.com](http://CriticalCommoditiesConfer-
ence.com).April 14–16, 2012. The 13th International
Exhibition on Surfactants & Detergents,
Shanghai, China. Information: [iesdexpo.
com](http://iesdexpo.
com) or yihanexpo@vip.sina.com.April 16–17, 2012. Global Moringa Meet
2012, Jaipur, India. Information: [tinyurl.
com/Moringa2012](http://tinyurl.
com/Moringa2012).April 17–19, 2012. Food Safety Summit Expo
and Conference, Washington DC Conven-
tion Center, Washington, DC, USA. Informa-
tion: foodsafetysummit.com.April 21–25, 2012. American Society for Bio-
chemistry and Molecular Biology Annual
Meeting, San Diego, California, USA. Infor-
mation: [asbmb.org/Meetings_01/2012mtg
/2012Annualmtghome.aspx](http://asbmb.org/Meetings_01/2012mtg
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AOCS Meeting Watch

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

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

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

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

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April 22–24, 2012. Hydrocolloid Conference, Westin Hotel, Valencia, Spain. Information: email: dseisun@hydrocolloid.com.

April 25–26, 2012. Detergents and Cleaning Products, Mainz, Germany. Information: akademie-fresenius.com/dokumente/programme/286.pdf.

April 25–28, 2012. 2nd World Congress of Bioenergy-2012, Xi'an, China. Information: bitlifesciences.com/wcbe2012.

April 25–26, 2012. 2nd ICIS World Surfactants Conference, New York, New York, USA. Information: icisconference.com/world-surfactants.

April 26–28, 2012. INAPALM 2012, Pekanbaru, Riau, Sumatra, Indonesia. Information: inapalm-exhibition.com.

April 27–29, 2012. 13th International Exhibition on Surfactant & Detergent, Shanghai, China. Information: iesdexpo.com.

April 28–30, 2012. 13th International Exhibition on Surfactant and Detergent, Shanghai Everbright Convention and Exhibition Center, China. Information: email: yihan-expo@vip.sina.com; iesdexpo.com.

April 29–May 2, 2012. 103rd AOCS Annual Meeting & Expo, Long Beach Con-

vention Center, Long Beach, California, USA. Information: phone: +1 217-693-4821; fax: +1 217-693-4865; email: meetings@aocs.org; annualmeeting.aocs.org.

May

May 6–10, 2012. Society of Tribologists and Lubrication Engineers Annual Meeting & Exhibition, Renaissance Grand & America's Center, St. Louis, Missouri, USA. Information: Merle Hedland at +1 630-428-2133 or mhedland@stle.org; stle.org.

May 7–8, 2012. LIPID MAPS Annual Meeting, La Jolla, California, USA. Information: lipid-maps.org/meetings.

May 13–16, 2012. 10th International Symposium on Supercritical Fluids, San Francisco, California, USA. Information: issf2012.com.

May 14–16, 2012. United Nations Conference on Sustainable Development (Earth Summit 2012/Rio+20), Rio de Janeiro, Brazil. Information: earthsummit2012.org.

May 14–18, 2012. 11th International Hydrocolloids Conference, Whistler Center for Carbohydrate Research, Stewart Center, Purdue University, West Lafayette, Indiana,

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USA. Information: international-hydrocolloids-conference.com.

May 16–19, 2012. 2nd International Symposium on Microbial Lipids, Bern, Switzerland. Information: eurofedlipid.org/meetings/bern2012.

May 17–19, 2012. Euro Fed Lipid 2nd International Symposium on Microbial Lipids, Bern, Switzerland. Information: eurofedlipid.org/meetings/bern2012/index.htm.

May 22–24, 2012. Vitafoods Europe, Geneva, Switzerland. Information: tinyurl.com/vitafoods.

May 23–24, 2012 Home and Personal Care Ingredients Exhibition and Conference, Istanbul, Turkey. Information: hpci-congress.com.

May 25–26, 2012. Global JojobaWorld 2012, Jaipur, India. Information: tinyurl.com/Jojoba2012.

May 26–30, 2012. 10th Congress of the International Society for the Study of Fatty

Acids and Lipids (ISSFAL), Westin Bayshore Hotel, Vancouver, British Columbia, Canada. Information: issfal.org/conferences/vancouver-2012.

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

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

June

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

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

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

June 11–13, 2012. Sensory Properties of Canola Oil and Olive Oil, Würzburg, Germany. Information: dgfett.de/meetings/aktuell/index.htm.

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

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

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

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

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

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

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

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

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

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

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

July

July 9–12, 2012. 8th Asia-Pacific Conference on Algal Biotechnology, Adelaide, Australia. Information: sapmea.asn.au/conventions/apcab2012/index.html.

August

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

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

September

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

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

October

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



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World supplies of rapeseed and canola likely to remain tight in the 2012/13 SEASON

Even if Canadian farmers harvest a record canola crop of 14.5–15.0 million metric tons (MMT) in late summer 2012, there is a high probability that world production of rapeseed and canola will remain behind requirements in the 2012/13 season—mainly due to poor winter crop production prospects in the European Union (EU) and Ukraine.

Thomas Mielke

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

Considering prospects of reduced carry-in stocks in July 2012, there is a high probability that rapeseed supplies next season will remain tight in the EU-27 as well as in Ukraine. Unusually dry conditions have prevented completion of planting intentions of winter rapeseed in several European countries. Also, an unusually large share of the planted winter rapeseed did not germinate well and will be abandoned, primarily in Ukraine.

For the EU-27, we predict that the winter rapeseed area available for harvest in the summer of 2012 will decline for the second consecutive year and be down by approximately 300,000 hectares (ha). In current Oil World estimates (see oilworld.de), it is assumed that the weather in February through June 2012 will be relatively better than last year, primarily in Germany and Poland. However, total production in the EU-27 may recover only moderately to around 20 MMT in 2012 (including spring-sown varieties), up only 0.8 MMT from last year but still down sizably from two and three years earlier. This will keep EU import requirements of rapeseed and canola very high also in the 2012/13 season.

Our current tentative production estimate for Ukraine is 1.13 MMT, a five-year low, mainly reflecting very dry conditions this autumn and winter, a further decline in winter crop plantings, and larger than usual abandonment. Contrary to earlier expectations (three and four years ago) of a further medium- to longer-term growth, actual rapeseed production has declined continuously from the peak of 2.9 MMT achieved in the summer of 2008. Winter rapeseed did not develop as favorably as expected and was decimated by unfavorable weather conditions during the past three years and again so far this winter. Instead, farmers in Ukraine expanded plantings of sunflowers and soybeans as well as grains. The net result is going



to be that Ukraine's rapeseed export supplies will again be very low in the 2012/13 season.

The global market dependence on Canadian canola will increase in the 2012/13 season

This should create favorable prices and selling opportunities for Canadian farmers, also considering the impact of the South American soybean production losses resulting from insufficient rainfall in key phases of crop development.

A further increase in Canadian canola plantings and production will be required in 2012, considering the reduced stocks at the end of this season in Europe, Canada, and elsewhere as well as the again relatively poor production prospects in Europe and the Commonwealth of Independent States countries.

In our current estimate we expect an increase in Canadian canola plantings by 3–4% to a new high of 7.9 million ha compared with 7.6 million ha last year and 6.8 million ha in the spring of 2010. Canola experienced a phenomenal development in Canada with the area virtually doubling within 10 years from 3.9 million ha in the spring of 2002.

In contrast, Canadian plantings of grains, primarily of barley and wheat, declined sharply during the past 10 years. Also, the flaxseed area

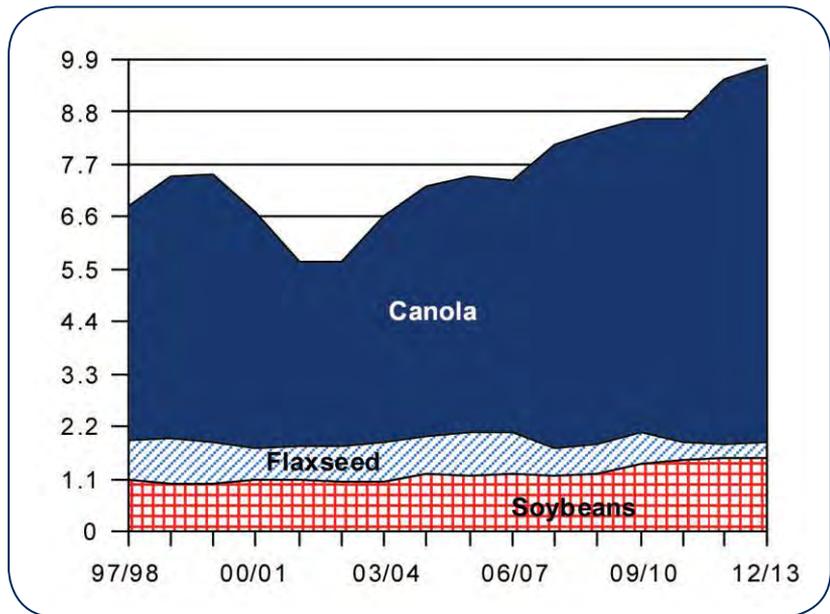


FIG. 1. Canada: Plantings of three major oilseeds (million hectares).

plummeted by more than 50% from 0.75 million ha planted 10 years ago.

Global supply outlook for 2012/13 (Table 1, page 136). According to our current tentative projections, we peg world production of rapeseed and canola at 61.5 MMT in 2012/13, representing a moderate recovery by 2.0 MMT from

CONTINUED ON PAGE 136

TABLE 1. World supply and demand of rapeseed and canola

	12/13F	11/12	10/11	09/10	08/09
Open'g stocks	5.10*	6.39	7.32	7.03	4.30
EU-27 (July 1)	1.04*	1.24	1.43	1.59	.72
Canada (Aug 1)	1.12*	1.83	2.26	1.66	1.46
Production	61.54*	59.52	60.71	61.32	58.33
EU-27	19.90*	19.11	20.59	21.73	19.08
Russia	1.00*	1.02	.65	.67	.75
Ukraine	1.13*	1.40*	1.49	1.87	2.87
Canada	14.70*	14.16	13.10*	12.89	12.64
U.S.A.	.82*	.70	1.11	.67	.66
South America	.38*	.37*	.30	.21	.24
China	12.00*	11.60*	12.20*	13.30*	12.10
India	6.90*	6.30*	7.10*	6.00*	6.20*
Australia	2.80*	3.00*	2.38*	1.90	1.88
Other countries	1.91*	1.86	1.79	2.08	1.91
Total supplies	66.64*	65.91	68.03	68.35	62.63
Crush (July/June)	58.50*	58.02*	58.89	57.84	52.08
Other use	2.84*	2.79*	2.75	3.19	3.52
Ending stocks	5.30*	5.10*	6.39	7.32	7.03

the current season. This is on the assumption of favorable weather conditions and of increased plantings made in Canada in April/May 2012 and in India in November 2012.

But owing to the comparatively small world stocks at the start of the world crop season 2012/13, the growth in world supplies of rapeseed and canola will be only marginal at 0.7 MMT or 1%, according to our current forecast.

Impacts on oil. Our early forecast points to only a limited potential for a recovery in global crushings of rapeseed and canola in July/June 2012/13. Our current preliminary crush estimate of 58.5 MMT will be only marginally 1% higher than in the current season. This will not be enough to create a more comfortable global supply outlook for rapeseed oil and canola oil in the 2012/13 season.

On the contrary, prospects of reduced global stocks of rapeseed oil and canola oil at the end of this season will probably be just offset by a slight recovery in oil output, keeping world supplies almost unchanged at the reduced level of the current season. As a result, rapeseed and canola oils are likely to be priced comparatively firm and at a premium to soybean oil for most of the 2012/13 season. Current prospects are that higher demand from the biodiesel industries of Europe and North America can be satisfied only if demand reductions are achieved in the food industry. ■

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TABLE 1. Overview of antioxidant effects in selected omega-3-enriched food products^a

	Tocopherol	Ascorbyl palmitate	Ascorbic acid	EDTA	Propyl gallate/gallic acid	Lactoferrin	Caffeic acid
Milk 1.5% fat	Weak anti	Anti	–	Anti to no	–	–	–
Drinking yogurt 1.5% fat	–	–	–	Anti	–	–	–
Dressing 25% fat	Weak anti	Pro	–	Anti	–	–	–
Mayonnaise 80% fat	Weak anti to pro	Pro	Pro	Anti	Pro	Weak anti to pro	–
Energy bars 6.2% fat	Anti to weak pro	Pro	–	Pro	–	–	Pro

^aAnti, antioxidative effect; Pro, pro-oxidative effect; –, not determined; EDTA, ethylenediamine tetraacetic acid.

Preventing lipid oxidation in omega-3-enriched foods

Charlotte Jacobsen

As consumer awareness of the beneficial effects of long-chain marine omega-3 polyunsaturated fatty acids (PUFA) increases, sales of dietary supplements and foods enriched with PUFA are growing. Unfortunately, the polyunsaturation that makes the two most important marine omega-3 PUFA—eicosapentaenoic acid (EPA; 20:5n-3) and docosahexaenoic acid (DHA; 22:6n-3)—so healthful also makes them highly susceptible to lipid oxidation, which leads to the formation of reactive free radicals, lipid hydroperoxides, and myriad volatile oxidation products such as ketones and aldehydes. These by-products may have serious detrimental health effects that can counteract the positive health effects of omega-3 PUFA. Some byproducts will also give rise to undesirable fishy and rancid off-flavors. Manufacturers of omega-3 ingredients and omega-3-enriched foods can minimize lipid oxidation in several ways.

Prevention of lipid oxidation in omega-3 ingredients

To minimize lipid oxidation, oils should not be exposed to light, they should be kept away from oxygen and metal ions, and they should be stored at a low temperature, preferably below 0°C. Because the initial quality of an omega-3 oil determines its shelf life, the quality of the fish used to produce it and the processing conditions used to extract, refine,

and deodorize it can affect oxidation. High-quality raw materials and optimal processing conditions can result in omega-3 oils with a neutral odor and flavor and a relatively long shelf life.

Shelf life can be further prolonged by adding antioxidants. Those most commonly used to protect omega-3 oils include tocopherols, ascorbyl palmitate, citric acid (or esters thereof), and propyl gallate. The relative efficacy of the different tocopherol isomers depends on the concentration in which they

are added. They are usually applied in concentrations up to approximately 1,000 mg/kg. Their relative ability to retard the formation of lipid peroxides decrease in the order α -tocopherol > γ -tocopherol > δ -tocopherol at a low level of addition (100 mg/kg), but a reverse order of activity has been found when the concentration is 1,000 mg/kg (Kulås *et al.*, 2001).

Recent data suggest that natural antioxidants such as rosemary extract efficiently protect omega-3 PUFA against oxidation. As a result, natural extracts are increasingly being used by omega-3 PUFA producers.

The oxidative stability of omega-3 oils can also be improved by microencapsulation. This may improve not only the stability of omega-3 oils before use but also the oxidative stability of the food in which a microencapsulated product is incorporated. It may also be necessary to add antioxidants to the fish oil before microencapsulation to prevent lipid oxidation during the microencapsulation process. Serfert *et al.* (2009) showed that autoxidation took place in the first stages (emulsification and spray-drying) of the microencapsulation process itself. However, efficient stabilization could be obtained by using a combination of tocopherols, rich in the δ -derivative and low in the α -derivative, with ascorbyl palmitate and lecithin. Adding

information

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rosemary extract further increased oxidative stability. Several microencapsulated omega-3 oil products are available on the market. Some are produced by spray drying of an emulsion and others are produced by complex coacervation, a colloid-based technology that involves droplet formation, wall formation, and capsule isolation.

Another way to increase the oxidative stability of fish oil is to pre-emulsify it, that is, to make an omega-3 oil-in-water (O/W) emulsion with as high an omega-3 PUFA content as possible. If properly designed, the pre-emulsification strategy can not only increase the oxidative stability of an omega-3 oil before adding it to foods but may also have a protective effect during the processing and storage of the final food product. However, for such a strategy to be successful, the emulsion must be designed with an

optimal combination of emulsifier(s), antioxidants, and, in some cases, also stabilizers. This may be more suitable for some products than for others. Several omega-3 oil manufacturers provide their omega-3 oils as a neat oil, a microencapsulated oil, or as an emulsion.

Prevention of lipid oxidation in omega-3 enriched foods

A wide range of foods enriched with omega-3 lipids is available on the market today. These include bread, dairy products, mayonnaise and dressings, beverages, and meat products. In the following discussion, examples of how various omega-3 PUFA-enriched products

CONTINUED ON NEXT PAGE

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can be protected against lipid oxidation are considered. Table 1 (see page 138) gives an overview of the antioxidant effects in some of the products discussed in the examples below.

Mayonnaise. In mayonnaise, lipid oxidation is catalyzed by the iron present in egg yolk (Jacobsen *et al.*, 2001). The synthetic chelator ethylenediamine tetraacetic acid (EDTA) can inactivate trace metals, such as iron, and is highly efficient in protecting omega-3 PUFA-enriched mayonnaise against oxidation even when added in concentrations as low as 6 mg/kg (Jacobsen *et al.*, 2008). EDTA is not widely accepted, however, owing to consumer preference for natural additives. Natural antioxidants such as tocopherol, lactoferrin, phytic acid, ascorbic acid, and its derivative, ascorbyl palmitate, have also been evaluated in mayonnaise, but none of these can efficiently protect omega-3 PUFA-enriched mayonnaise against lipid oxidation. Neither can the synthetic antioxidant, propyl gallate (Jacobsen *et al.*, 2008). Research is currently underway to identify natural antioxidants with metal-chelating properties that may work as efficiently as EDTA. Peptides and polyphenolics are good candidates.

Dressing. EDTA is a similarly efficient antioxidant in salad dressing, and is even more efficient when used in combination with ascorbyl palmitate and tocopherol—two antioxidants that cannot prevent lipid oxidation when applied alone (Let, 2007).

A study on the effect of adding omega-3 PUFA as an O/W emulsion (50% oil) prepared with whey protein as an emulsifier to dressing showed that pre-emulsification of the fish oil did not lead to increased oxidative stability as compared to adding omega-3 lipid as a neat oil (Let, 2007). This demonstrates either that pre-emulsification of omega-3 lipids may not be an advantage in all food systems or that the emulsion must be optimized for each type of food system.

Dairy products. Several studies have shown that milk is a difficult product to enrich with omega-3 PUFA. One of the reasons is that milk has a bland taste, and any off-flavors from omega-3 enrichment are difficult to mask without the help of flavoring agents. However, it is possible to obtain milk with good sensory properties and shelf life by optimizing homogenization conditions, by using high-quality omega-3 oil or a mixture

of rapeseed oil and fish oil, and by adding the antioxidant γ -tocopherol or particularly ascorbyl palmitate (Let, 2007). Ascorbyl palmitate has a good antioxidant effect when applied in a concentration of 1.5 mg/kg in milk containing 1.5% fat (Let, 2007). In contrast, EDTA or α -tocopherol cannot prevent oxidation in milk.

Research is currently underway to identify more efficient natural antioxidants or derivatives thereof to improve the oxidative stability of omega-3 PUFA-enriched milk. Peptides isolated from yogurt have been found to reduce lipid oxidation in milk. Such peptides may be good antioxidant candidates if they are made commercially available in the future (Farvin *et al.*, 2010). Adding omega-3 lipids as a pre-emulsion is another way to reduce lipid oxidation in milk, and this concept is currently used in several milk products available on the market.

Unlike milk, omega-3 PUFA-enriched yogurt is much less susceptible to oxidative flavor deterioration. This is probably due to the presence of antioxidative peptides and to the lower oxygen content in yogurt relative to milk. For these reasons, it is not necessary to

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add antioxidants to yogurt if a shelf life below four weeks is acceptable.

Fitness bars. Adding fish oil in the form of a micro-encapsulated powder offered the best protection against oxidation in fish-oil-enriched fitness bars, but pre-emulsification of the fish oil with sodium caseinate in water or packaging the fitness bars in a modified atmosphere also improved oxidative stability compared to fitness bars prepared with neat fish oil (Nielsen and Jacobsen, 2009). Among the different antioxidants evaluated in fitness bars (caffeic acid, ascorbyl palmitate, γ -tocopherol, and EDTA), only γ -tocopherol had an antioxidative effect, and this was concentration dependent. The best protection was obtained when γ -tocopherol was added in concentrations higher than 22 mg/kg energy bar (Horn *et al.*, 2009).

Fish and meat products. A number of studies have been conducted on the antioxidant effects of different antioxidants in surimi (minced, processed fish) or meat products enriched with omega-3 lipids. In some of the studies, EDTA did not have an antioxidative effect; but when omega-3 lipids were added as an O/W emulsion EDTA exerted an antioxidative effect when it was added together with a 1,000 mg/kg tocopherol mixture plus 1,000 mg/kg rosemary extract, plus 500 mg/kg ascorbyl palmitate (Park *et al.*, 2004). Some studies have also suggested that rosemary or tea extracts can reduce lipid oxidation in surimi and meat products with or without the addition of other antioxidants.

Infant formula. Omega-3 PUFA are usually supplemented to infant formula as microencapsulated oils. However, microencapsulation does not seem to be enough to prevent oxidation. Suhr *et al.* (2007) found that the highly reactive aldehydes 4-hydroxy-2-hexenal and 4-hydroxy-2-nonenal (oxidation products from omega-3 and omega-6 PUFA) were present in several commercial infant formulas containing PUFA. Whether the concentrations detected in formula could have any negative effects on human development is presently unknown and deserves further investigation. Lipid oxidation in infant formula can be reduced by adding lactoferrin

(Satué-Gracia *et al.*, 2000). Lactoferrin is most commonly used in Asia and particularly by Japanese companies, and its inclusion is now extending rapidly to other countries. However, the use of lactoferrin seems to be limited by its cost.

Risk of lipid oxidation vs. benefits of omega-3 PUFA

Generally, lipid oxidation in foods enriched with omega-3 PUFA will result in development of off-flavors even at low levels of oxidation. Because volatile oxidation products from omega-3 PUFA are more objectionable than oxidation products from omega-6 PUFA, even low levels of oxidation of omega-3 PUFA-enriched food products may lead to consumer rejection. From a health risk point of view, this may be an advantage as it will prevent consumers from eating oxidized omega-3 PUFA-enriched foods. The risk of consuming oxidized lipids is much higher for dietary supplements, as consumers may not encounter any immediate off-flavor due to encapsulation. More knowledge about the level of oxidation in both types of products is needed to determine whether oxidized omega-3 PUFA in these products pose a significant risk to consumers.

Meanwhile, oxidatively stable omega-3 enriched food products of good sensory quality can be produced provided the necessary precautions to avoid lipid oxidation are taken during all processing and storage steps. Such products can be an important vehicle to increase the intake of omega-3 PUFA to the recommended levels across a population and thereby decrease the risk of cardiovascular and mental diseases in particular.



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Omega-3 bioavailability: Is one form of omega-3 more bioavailable than another?

Bruce Holub and Jennifer Kwok Grebow

Evidence-based human studies have shown that obtaining the desired health benefits of docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) omega-3 fatty acids—including brain and visual support, cardio care, blood triglyceride lowering, and others—requires sufficient daily intake and duration (weeks to several months). (For more information, visit dhaomega3.org.) Of course, the relative bioavailability of omega-3 fatty acids from different sources (e.g., fish vs. supplements vs. functional foods) and when consumed from different structural forms (triglyceride, ethyl ester, free fatty acid, and phospholipid) is of considerable importance as well.

While the amounts of DHA/EPA in a product are often known to the consumer, no information on the relative bioavailability of the omega-3 fatty acids present is generally provided.

However, both the DHA/EPA amounts in the product and the bioavailability of the DHA/EPA are of utmost importance to ensure appropriate delivery of the omega-3 fatty acids to the bloodstream following their digestion and passage across the

intestinal wall and eventual assimilation to target tissues.

DHA/EPA forms

Most fish-derived DHA/EPA omega-3 is present in the “natural” triglyceride form, with a much lesser amount present in the phospholipid form. From fish, fish oil is derived, processed, and sold in encapsulated supplements (or bottled oils) as a source of

DHA/EPA in the triglyceride form. Further, the omega-3 fatty acids therein can be industrially converted to the ethyl ester forms of DHA/EPA, which allows for their concentration via procedures such as molecular distillation. Such oil concentrates of DHA/EPA can be sold as supplements or be converted industrially back to the triglyceride form prior to being incorporated in commercial supplements.

The term *bioavailability* generally refers to the capability of the orally ingested omega-3 fatty acids to be digested in the gastrointestinal tract and cross the intestinal wall, thereby entering the bloodstream and, subsequently, the various body tissues and organs. The bioavailability of DHA/EPA in humans has been measured via both acute studies (very short-term studies, such as a few hours after consumption) or via chronic studies (long-term daily consumption over weeks or months).

The net rise in omega-3 fatty acid levels in blood samples at the end of the study relative to baseline levels is regularly used to assess the relative bioavailability of different

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In September, Douglas Laboratories introduced a new product, QÜELL Omega-3 Fish Oil, which the company calls its “newest, most potent form of omega-3 supplementation.” According to the company in press materials: “The QÜELL difference lies in its supercritical CO₂ extraction method, providing a highly concentrated triglyceride form of omega-3. Using supercritical CO₂ extraction technology, omega-3 fatty acids are extracted without high temperatures, oxygen, or chemical solvents, ensuring that the oil is protected from oxidation, microbial contamination, solvent residue, and isomer formation. This is also the preferred extraction method as it is more environmentally responsible and also purifies and concentrates to a higher degree. Additionally, a growing body of scientific evidence supports the triglyceride (or re-esterified triglyceride) form of the fatty acids as having the greatest absorption (compared to the ethyl ester form), significantly increasing the index of EPA and DHA in the blood.”

sources/forms of omega-3 fatty acids when compared at essentially equal levels of intake.

Because of the wide variability in the results between individual subjects and other factors, acute studies appear not to be as dependable as chronic studies in making conclusions with respect to bioavailability.

Triglyceride vs. ethyl ester

There have been a number of short-term acute studies in human subjects that have attempted to determine if the bioavailability/absorption of EPA and DHA, when taken as supplements, is any different when the “natural” triglyceride form vs. the ethyl ester form is consumed. The results from such human studies appear to be somewhat influenced by the experimental designs used for such evaluations, including the doses, duration, and timing of the blood measurements for the resulting omega-3 accumulations following supplementation.

The early short-term studies by Lawson and Hughes (1,2) indicated a much better apparent human absorption of both EPA and DHA (at intake levels of 1.00 and 0.67 g, respectively) in the triglyceride form compared to the ethyl ester form. Furthermore, they reported that the marked differences in absorption between the two forms were less pronounced after a high-fat meal compared to a low-fat meal.

Subsequent studies by el Boustani *et al.* (3) reported a greater incorporation of EPA into circulating blood plasma fat (as triglyceride) when EPA (1 g) was consumed as the triglyceride form relative to the ethyl ester form.

Maximal plasma levels of DHA/EPA were also found to be significantly lower with

ethyl ester forms as compared to triglyceride forms in a German study (4).

In contrast to the previous studies, Luley and colleagues (5) found similar bioavailability for triglyceride vs. ethyl ester preparations of EPA/DHA. In support of the latter study, Nordoy *et al.* (6) provided test meals to human subjects, with very high doses of omega-3 fatty acids (28 g) as triglyceride or ethyl ester forms. Blood sampling and measurements conducted at 24 hours after consumption of the omega-3 meals indicated their concentrations to be similar. The authors concluded that fish oil omega-3 fatty acids given as ethyl ester or triglyceride form were equally well absorbed, and that EPA and DHA were also equally absorbed.

Food vs. supplements

Long-term chronic studies have compared the relative bioavailability of DHA/EPA when ingested as fish or supplements.

The early study by Visioli *et al.* (7) indicated a greater net rise in human blood plasma levels of DHA after six weeks when DHA from salmon was consumed daily, compared to DHA intakes via supplementation (as the ethyl ester form)—even when the latter DHA intakes were higher than those from fish.

A subsequent study by Harris *et al.* (8) compared blood levels of omega-3 fatty acids in subjects having similar intakes of DHA and EPA from salmon (mainly triglyceride form) or supplemental ethyl ester form. The EPA level in the red blood cells was found to rise faster in the fish group by four weeks, with

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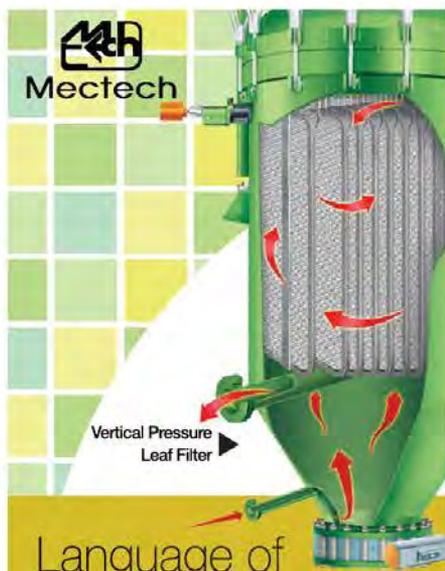
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no apparent differences in bioavailability of DHA/EPA exhibited by the end of the study at 16 weeks.

Based on a two-week chronic study that measured the rise in blood levels of DHA in subjects consuming equivalent daily intakes of DHA from cooked salmon (mainly triglyceride form) vs. supplemental DHA from an algal source (as triglyceride),

a bio-equivalence of the two DHA sources was found (9).

Phospholipid form

It should be mentioned that a well-controlled, 16-day bioavailability study in piglets showed a significantly greater rise in DHA

CONTINUED ON PAGE 172

Briefs

Green Eagle Technologies has developed the first soy-based waterproofing product for synthetic roofing surfaces, according to the United Soybean Board (USB), a trade group based in Chesterfield, Missouri, USA. Inventor Lance Niemann of Green Eagle was quoted by USB as saying that G.E.T. Biobased Mastic represents the “first and only” zero-VOC (volatile organic compound) mastic that has been certified through the ASTM Biobased Certification Program. The product reportedly has a biobased content of 37% (see tinyurl.com/SoyMastic).



In January 2012, Archer Daniels Midland Co. (ADM; Decatur, Illinois, USA) purchased three grain elevators in Slovakia, its first such acquisition in Eastern Europe. A company official told All-AboutFeed.com that the silos will enable ADM to secure additional rape and sunflowerseed, as well as corn and wheat, from new supply sources. ADM purchased the silos from Palma Group and Polnonakup Hont; they are located in the south and east of Slovakia and have a combined storage capacity of 149,000 metric tons.



Switzerland’s Barry Callebaut AG and consumer products giant Unilever signed a new long-term global partnership agreement in January 2012. Under the agreement, Callebaut will become Unilever’s “strategic global supplier and innovation partner of choice for its cocoa and chocolate needs,” according to a statement by the Swiss company.

The new global supply agreement will nearly double Barry Callebaut’s current volumes with Unilever; ultimately, Callebaut said, it will provide 70% of Unilever’s global cocoa and chocolate products. As a result of the agreement, Barry Callebaut will invest approximately CHF 22 million (\$24 million) in its worldwide factory network in order to prepare the capacity needed to fulfill the partnership agree-

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News & Noteworthy



China questions olive oil quality

China’s quality agency, the Administration of Quality Supervision, Inspection and Quarantine (AQSIQ), is scrutinizing olive oil imports from Italy. “It has urged Chinese importers to pay more attention to the quality of the Italian olive oil they are importing,” according to the *Olive Oil Times* (OOT), an online publication.

This action occurred after reports in China said that four out of five bottles of olive oil imported from Italy were adulterated with inferior quality oil from other countries, the OOT article notes. AQSIQ has requested the Italian embassy to investigate and provide the agency with more information.

“The problem came to light in December [2011] when the *La Repubblica* newspaper published the results of a probe into Italy’s olive oil exports and investigation into the conduct of 13 unnamed Italian olive oil exporters,” OOT said. “This led to speculation that about 80% of China’s olive oil imports carrying the label ‘Made in Italy’ were actually

mixed with lower qualities of olive oil from Spain, Greece, and Tunisia.”

Nearly 38% of China’s olive oil imports come from Italy, the report said, making Italy the second-largest olive oil exporter to China after Spain. In related news, the European Commission has codified its marketing standards for olive oil (EU No 29/2012). The update simply gathers together the rules as amended but does not introduce new provisions. The standards are available in PDF format at tinyurl.com/OliveOilStandards.

Soy/corn insecticide linked to honeybee deaths

Honeybee populations have been in serious decline for years, and Purdue University scientists may have identified one of the factors that cause bee deaths around agricultural fields. (For *inform*’s summary of the impact of disappearing pollinators on oilseed crops, see tinyurl.com/ABeeCs.)

CONTINUED ON NEXT PAGE

For the Purdue study, analyses of bees found dead in and around hives from several apiaries over two years in the US state of Indiana showed the presence of neonicotinoid insecticides, which are commonly used to coat corn and soybean seeds before planting. The research showed that those insecticides were present at high concentrations in waste talc that is released from farm machinery during planting.

The insecticides clothianidin and thiamethoxam were also consistently found at low levels in soil—up to two years after treated seed was planted—as well as on nearby dandelion flowers and in corn pollen gathered by the bees, according to the findings released in the journal *PLoS One* (doi:10.1371/journal.pone.0029268, 2012).

“We know that these insecticides are highly toxic to bees; we found them in each sample of dead and dying bees,” said Christian Krupke, associate professor of entomology and a co-author of the findings.

The United States is losing about one-third of its honeybee hives each year, according to Greg Hunt, a Purdue professor of behavioral genetics, honeybee specialist, and co-author of the findings. Hunt said no one factor is to blame, though scientists believe that others such as mites and insecticides are all working against the bees, which are important for pollinating food crops and wild plants.

“It’s like death by a thousand cuts for these bees,” Hunt said.

Krupke and Hunt received reports that bee deaths in 2010 and 2011 were occurring at planting time in hives near agricultural fields. Toxicological screenings performed by Brian Eitzer, a co-author of the study from the Connecticut Agricultural Experiment Station, for an array of pesticides showed that the neonicotinoids used to treat corn and soybean seed were present in each sample of affected bees. Krupke said other bees at those hives exhibited tremors, uncoordinated movement, and convulsions, all signs of insecticide poisoning.

Seeds of most annual crops are coated in neonicotinoid insecticides for protection after planting. All corn seed and about half of all soybean seed are treated. The coatings are sticky, and in order to keep seeds flowing freely in the vacuum systems used in planters, they are mixed with talc. Excess talc used in the process is released during planting and routine planter cleaning procedures.

“Given the rates of corn planting and talc usage, we are blowing large amounts of contaminated talc into the environment. The dust

is quite light and appears to be quite mobile,” Krupke said.

Krupke said the corn pollen that bees were bringing back to hives later in the year tested positive for neonicotinoids at levels roughly below 100 parts per billion.

“That’s enough to kill bees if sufficient amounts are consumed, but it is not acutely toxic,” he said.

On the other hand, the talc showed extremely high levels of the insecticides—up to about 700,000 times the lethal contact dose for a bee.

“Whatever was on the seed was being exhausted into the environment,” Krupke said. “This material is so concentrated that even small amounts landing on flowering plants around a field can kill foragers or be transported to the hive in contaminated pollen. This might be why we found these insecticides in pollen that the bees had collected and brought back to their hives.”

Krupke suggested that efforts could be made to limit or eliminate talc emissions during planting.

“That’s the first target for corrective action,” he said. “It stands out as being an enormous source of potential environmental contamination, not just for honeybees, but for any insects living in or near these fields. The fact that these compounds can persist for months or years means that plants growing in these soils can take up these compounds in leaf tissue or pollen.”

Although corn and soybean production does not require insect pollinators, that is not the case for most plants that provide food. Krupke said protecting bees benefits agriculture since most fruit, nut, and vegetable crop plants depend on honeybees for pollination. The US Department of Agriculture estimates the value of honeybees to commercial agriculture in the United States at \$15 billion to \$20 billion annually.

USDA looks at oilseed production

The January 2012 report by the US Department of Agriculture (USDA) on oilseed production and demand was generally bullish, with a few important exceptions.

US oilseed production for 2011/12 was estimated at 91.2 million metric tons (MMT), up 0.2 MMT from December 2011. Expectations of larger crops for soybeans and canola were partly offset by reductions for cottonseed, sunflowerseed, and peanuts (groundnuts). Soybean production was estimated

higher based on increased yields. The soybean crush was lowered, reflecting industry-reported data through the first quarter of the marketing year. Soybean exports were projected slightly lower than in December 2011 and down almost 18% from 2010/11. Soybean product changes included a lower soybean oil extraction rate, lower projected soybean oil exports, and increased soybean oil ending stocks.

Global oilseed production for 2011/12 was projected at 457.4 MMT, down 0.3 MMT, with lower soybean production more than offsetting higher projections for sunflowerseed and rapeseed. Global soybean production was projected at 257 MMT, down 2.2 MMT mostly owing to lower production forecasts for South America. The soybean crop in Argentina was projected at 50.5 MMT, down 1.5 MMT because of lower projected area and yields. Excessive heat and dry conditions since December 2011 throughout much of the principal growing area in that country is expected to limit soybean plantings and reduce yields from earlier expectations.

The Brazilian soybean crop estimate was reduced 1 MMT to 74 MMT reflecting hot, dry conditions in recent weeks, especially in the second-largest producing state of Paraná where planting was more than half completed by late October.

Global sunflowerseed production gains mostly reflected larger crops in Russia and Ukraine. Preliminary official harvest data from the state statistical agency indicate a higher yield for Russia, resulting in a record 9.6-MMT crop. Ukraine sunflowerseed production was projected higher at a record 9.5 MMT based on increased harvested area. Other changes included increased rapeseed production for Australia and lower cottonseed production for India.

Global oilseed trade for 2011/12 was projected at 113.1 MMT, down 0.9 MMT, mainly reflecting reduced soybean trade. Lower soybean exports for Argentina and the United States were only partly offset by an increase for Brazil. Import estimates were reduced for EU-27, Russia, Taiwan, Japan, and Turkey. Soybean import projections for China were unchanged at 56.5 MMT. Global oilseed ending stocks were projected at 74.8 MMT, down 0.7 MMT from December 2011 as reduced soybean stocks in Brazil and Argentina were only partly offset by higher US soybean ending stocks.

The monthly World Agricultural Supply and Demand Estimates reports are available online at usda.gov/oc/commodity/wasde. ■



Sustainability watch

Researchers at the University of Southern California are reporting the discovery of an improved method for removing carbon dioxide—the major greenhouse gas that contributes to global warming—from smokestacks and other sources, including the atmosphere itself. Their work reportedly achieves some of the highest carbon dioxide removal capacity ever reported for real-world conditions where the air contains moisture.

Alain Goeppert, G.K. Surya Prakash, chemistry Nobel Laureate George A. Olah, and colleagues explain that controlling emissions of CO₂ is one of the biggest challenges facing humanity in the 21st century. They point out that existing methods for removing CO₂ from smokestacks and other sources, including the atmosphere, are energy intensive, do not work well, and have other drawbacks. In an effort to overcome such obstacles, the group turned to solid materials based on polyethylenimine, a readily available and inexpensive polymeric material.

Their tests showed that these inexpensive materials achieved some of the highest CO₂ removal rates ever reported for humid air, under conditions that stymie other related materials. After capturing CO₂, the materials give it up easily so that the CO₂ can be used in making other substances, or permanently isolated from the environment. The captured material then can be recycled and reused many times over without losing efficiency. The researchers suggest the materials may be useful on submarines, in smokestacks, or out in the open atmosphere, where the materials could clean up CO₂ pollution that comes from small point sources such as cars or home heaters, which represent about half of the total CO₂ emissions related to human activity.

The research appears in the *Journal of the American Chemical Society* (doi:10.1021/ja2100005, 2011).



In January 2012, the US Environmental Protection Agency (EPA) released greenhouse gas (GHG) data reported directly from large facilities and suppliers through the EPA GHG Reporting Program. This online data publication tool allows users to view and sort GHG data for calendar year 2010 from over 6,700 facilities in a variety of ways—including by facility, location, industrial sector, and the type of GHG emitted. The information can help businesses compare and track emissions. The EPA GHG Reporting Program Data and Data Publication Tool is available at epa.gov/climatechange/emissions/ghgdata.

Briefs (continued from page 145)

ment. The additional volumes have a ramp-up period of 12 months, the company said.



Scientists from the US Department of Agriculture's Agricultural Research Service and their Peruvian collaborators conducted cacao collection expeditions in 2008 and 2009 through the Amazon Basin of Peru. The Peruvian Amazon is the heart of the center of diversity for cacao and holds great potential for finding undiscovered cacao and fungal species.

The researchers are studying 342 cacao specimens collected from 12 watersheds and are categorizing the DNA of the specimens. Fungi found in the leaves and trunks of wild Peruvian cacao trees offer the potential for biological control of cacao diseases such as witches' broom disease, they say. For more, see tinyurl.com/ARScacao. ■

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Briefs

In January, the US Coast Guard enlisted the help of Oak Ridge National Laboratory (ORNL; Tennessee, USA) researchers with expertise in fuels and engines. "The Coast Guard has decided to use biobutanol rather than ethanol to mix with gasoline in their smaller craft, and biodiesel rather than petroleum diesel in their larger engines," said Tim Theiss, group leader of the Fuels, Engines and Emissions Research Center at ORNL. During the three-year project, researchers will focus on a number of tasks, including determining the maximum acceptable level of these renewable fuels with the marine engines and infrastructure necessary to operate in a salt-water environment.



Data from the International Energy Agency (omrpublic.iea.org/current-tissues/full.pdf) show that global production of biofuels dropped from an all-time high of 1.822 million barrels a day in 2010 to 1.819 million barrels in 2011. The key reason for the decline, identified by *The Guardian* (tinyurl.com/Guardian-biofuels-drop), is the rising cost of feedstocks for most biofuels: corn, sugar, and vegetable oil.



Collectis, a genome engineering specialist headquartered in Paris, France, announced in January 2012 an agreement with Total, a multinational energy company also headquartered in Paris, to develop microalgae-based oil substitutes. The first phase, of about one year, will explore the development of genome engineering methods and tools on certain microalgal species selected for their specific characteristics. The second phase, which may last two to three years, will focus on trait engineering (specific changes to the metabolism and species) with a view to producing compounds that are currently derived from oil. Costs for the joint program, as well as ownership of the technologies and products created, will be split equally between the two partners. ■

Biofuels News



Lufthansa completes trials of biofuel

German air carrier Lufthansa completed a six-month trial of biosynthetic fuel in mid-January. From July 15 to December 27, 2011, a Lufthansa Airbus A321 completed 1,187 biofueled flights between Hamburg and Frankfurt, Germany. On each flight, one of the aircraft's engines was powered by a 50:50 blend of regular fuel and biosynthetic kerosene (see *inform* 22:497–499, 2011). According to initial calculations, using biofuels on these flights reduced CO₂ emissions by a total of 1,471 metric tons (MT). Total consumption of the biokerosene mix was 1,556 MT.

The culmination of these trials was a trans-Atlantic flight by a Lufthansa Boeing 747-400 on January 12, 2012, between Frankfurt and Washington, DC, USA. About 40 MT of the biosynthetic fuel mix were set aside for the flight, with an anticipated reduction in CO₂ emissions in this one flight of 38 MT. According to a company statement, the latter amount is equivalent to the CO₂ emissions of six scheduled flights between Frankfurt and Berlin.

The New York Times reported CO₂ emissions came down 60%, gallon for gallon, on these Lufthansa flights, whereas the cost

of the fuels was up 2.5 times over ordinary petroleum-based jet fuel (tinyurl.com/NYTimes-GreenAviation).

With the completion of the trans-Atlantic flight, Lufthansa announced it was temporarily ceasing the use of biofuels, which were made from Indonesian-grown jatropha oil, until global production increased to a level that could support routine operations. In a company statement, Project Manager Joachim Buse said, "As a next step, we will focus on the suitability, availability, sustainability, and certification of raw materials." He added, "Lufthansa will only continue the practical trial if we are able to secure the volume of sustainable, certified raw materials required in order to maintain routine operations."

Novel catalyst for producing biodiesel

Scientists at the Technische Universität München announced a new catalytic process that allows the effective conversion of bio-petroleum from microalgae into diesel fuels. According to Johannes A. Lercher and his team, previously known methods for refining oil from microalgae have various disadvantages. The resulting fuel can have too high

CONTINUED ON NEXT PAGE

an oxygen content and poor flow at low temperatures, or a sulfur-containing catalyst may contaminate the product, or the catalyst may not be sufficiently efficient.

The new catalyst is characterized as nickel nanoclusters on a porous support made of zeolite HBeta. With this, the researchers have achieved conversion of raw, untreated algae oil under mild conditions (260°C, 40 bar hydrogen pressure) to “diesel-range saturated hydrocarbons that are suitable for use as high-grade fuels for vehicles,” according to Lercher.

Microalgal oil is composed mainly of neutral lipids, such as mono-, di-, and triglycerides with unsaturated C18 fatty acids as the primary component (88%). After an eight-hour reaction, the researchers obtained 78% liquid alkanes with octadecane (C18) as the primary component. The main gas-phase side products are propane and methane.

The full article, by B. Peng, Y. Yao., C. Zhao, and J.A. Lercher, appeared in *Angewandte Chemie International Edition* at doi:10.1002/anie.201106243.

Using bubbles to collect algae

Developing microalgae as a feedstock for biofuel has many challenges, one of which is a cost-effective method of harvesting and removing the water from the algae. A team led by Will Zimmerman in the Department of Chemical and Process Engineering at the University of Sheffield (UK) reported in late January 2012 an inexpensive way of producing microbubbles that can float algal particles to the surface of the water, making harvesting easier and saving biofuel-producing companies time and money (see J. Hanotu, H.C. Hemaka Bandulasena, and W.B. Zimmerman, Microflotation performance for algal

separation, *Biotechnol. Bioeng.*, doi:10.1002/bit.24449).

Bubbles generated under oscillatory air flow had an average size of 86 µm, about twice the size of the diffuser pore size of 38 µm. In contrast, bubbles formed by continuous air flow at the same rate through the same diffusers had an average bubble size of 1059 µm. Microbubbles derived in this oscillatory manner required much less energy to generate than larger bubbles.

The researchers also varied metallic coagulant types, concentration, and pH. They found the best coagulation occurred at the highest dose (150 mg/L), applied at pH 5. Of the three metallic coagulants they studied, ferric chloride yielded the overall best result of 99.2%, followed by ferric sulfate (98.1%), and aluminum sulfate (95.2%). According to the authors, these results compare well with conventional dissolved air flotation benchmarks.

Zimmerman was awarded £250,000 (\$400,000) by the UK Royal Society in October 2010 to aid in the commercial development of this technology (*inform* 21:741–742, 2010). He is working with Tata Steel at its site in Scunthorpe to test the system.

Castor oil as biofuel feedstock

Evogene Ltd., headquartered in Rehovot, Israel, announced in early January 2012 the establishment of a wholly owned subsidiary that will focus on developing seed for second-generation biofuel feedstock. Activities that are being transferred to Evofuel by the parent company are the development and commercialization of castor bean varieties for Brazil as well as the biofuel research and development activities located in Israel.

In a company statement, Ofer Haviv, president and chief executive officer of Evogene, said, “We are reinforced by the progress and results of our castor seed in Brazil and believe that access to Evogene’s leading plant genomics capabilities will provide Evofuel with commercial advantages and opportunities. . . .”

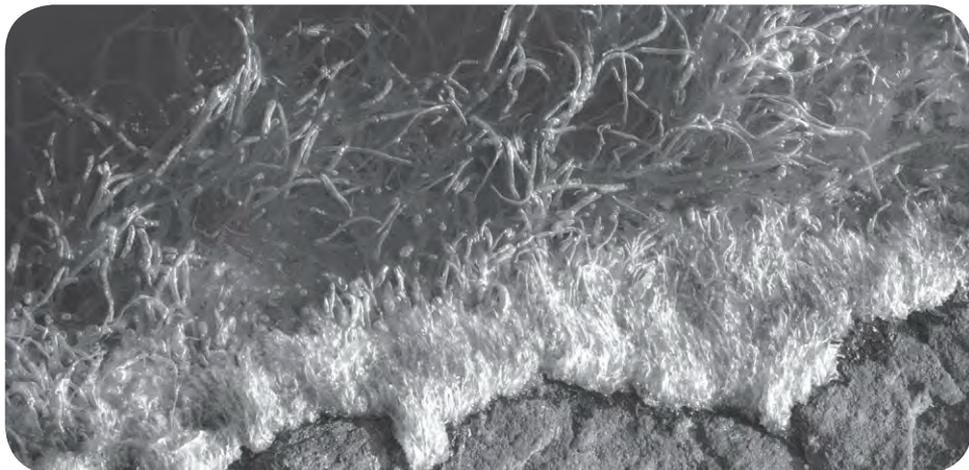
Researchers at the Benemérita Universidad Autónoma de Puebla (BUAP; Mexico) are experimenting with producing biodiesel from oil extracted from castor seeds. According to J. Mendieta López and co-workers (*Chem. Eng. J.* 178:391–397, 2011), the “castor bush grows everywhere.” BiofuelsDigest.com (tinyurl.com/BfDig-castor) reports that one goal of this project is to produce enough fuel to run the university’s transport system. The pilot plant was scheduled to start production in January 2012. The plant is designed to produce up to 72,000 liters of biodiesel daily and will process up to 300 kilograms of castor seeds per hour. The BUAP program includes feedstock cleaning and oil purification aspects.

POET, DSM form joint venture

Ethanol producer POET, LLC, located in Sioux Falls, South Dakota, USA, and Royal DSM, a global life sciences and materials sciences company headquartered in Heerlen, Netherlands, announced on January 23, 2012, that they were entering into a joint venture (JV) to demonstrate and license cellulose bioethanol commercially, based on their proprietary and complementary technologies.

POET-DSM Advanced Biofuels, LLC is scheduled to start production in the second half of 2013 at one of the first commercial-scale cellulosic ethanol plants in the United States. The two partners will produce cellulosic ethanol by using enzymatic hydrolysis of corn crop residue followed by fermentation. The first commercial demonstration of the technology will be at Project Liberty, which is in the midst of construction adjacent to POET’s existing corn ethanol plant in Emmetsburg, Iowa, USA. Plans are in the initial capacity of 20 million gallons (76 million liters) in the first year, growing to about 95 million gallons annually.

POET-DSM Advanced Biofuels intends to replicate and license the technology to additional plants to be built at the other 26 corn ethanol facilities in POET’s network and license it to other producers in the United



States and elsewhere. The US Renewable Fuel Standard requires the production of 16 billion gallons (61 billion liters) per year of cellulosic bioethanol.

The initial capital expenditure by the JV in Project Liberty will be about \$250 million. In light of its JV with DSM, POET does not plan to use the loan guarantee it was awarded by the US Department of Energy (DOE) in September 2011.

Jeff Broin, founder and chief executive officer of POET, said in announcing the JV, "The loan guarantee commitment from the DOE was an important milestone in our quest to commercialize cellulosic ethanol." He added, "We believe that the joint venture with DSM positions us well to meet our ambitious cellulosic ethanol production goals, and thus the loan guarantee has become unnecessary."

The joint venture is expected to be profitable in the first full year of production (2014) and to deliver substantial revenues with above-average contribution to earnings before interest, tax, depreciation, and amortization in the medium and longer term according to DSM (tinyurl.com/DSM-POET).

DDGS and corn oil

Both the US blenders' tax credit and ethanol import tariff expired on December 31, 2011. The former allowed ethanol blenders to save \$0.45/gallon of tax; the latter added \$0.54/gallon to any ethanol imported into the United States. Removal of the blenders' tax credit should reduce the value of corn made

into ethanol and reduce the price of corn in the long run.

Another factor may reduce the value of distiller's dried grains with solubles (DDGS), the material remaining after fermentation of corn to make alcohol, according to a review by the NationalHogFarmer.com (tinyurl.com/DDGS-HogFarmer). Ethanol plants are beginning to take interest in removing the corn oil from DDGS, to be sold for other purposes such as manufacture of biodiesel. While regular DDGS may contain 10–15% oil, the low-oil variety contains much less and has different characteristics and feeding values than regular DDGS.

Of the roughly 200 US corn dry mills that produce ethanol, about 90 have oil extraction capabilities, and 105 plants will by this summer according to the US Grains Council (tinyurl.com/USGC-CornOil). "On a production basis, about 40% of US DDGS produced today is low-oil, and 58% will be low-oil by this summer [third quarter]," said Randy Ives of Gavilon, LLC, and US Grains Council Value-added advisory team leader.

Ives explained that low-oil DDGS have higher crude protein and higher levels of amino acids. The concentrated amino acid profile is positive for monogastric animals such as poultry and swine, whereas dairy animals may be able to utilize more product thanks to the lower level of fat in low-oil DDGS.

The Council noted research is underway to help quantify the characteristics of low-oil DDGS. Results will be available later in 2012.

While buyers and sellers often add the protein and fat numbers together as part of a sales contract, that may need to change going forward.

Just five years ago, few ethanol plants had the ability to extract nonfood-grade corn oil because the equipment was expensive, and the oil had little value. Now, however, the value of nonfood-grade corn oil has increased, and plants can extract the oil more efficiently owing to improved emulsifiers and centrifuge technology, lowering the payback on oil extraction equipment to as little as six months. For example, an ethanol plant using 16 million bushels of corn (406,000 metric tons [MT]) to produce 40 million gallons (151 million liters) of ethanol can also produce 135,000 tons (122,000 MT) of low-oil DDGS and 8 to 12 million pounds (3,600 to 5,400 MT) of oil.

USDA funds cellulosic ethanol

ZeaChem receives conditional commitment to \$232.5 million. US Secretary of Agriculture Tom Vilsack announced on January 26, 2012, that the US Department of Agriculture (USDA) approved a conditional commitment of \$232.5 million to ZeaChem Boardman Biorefinery, LLC (ZBB) through the Biorefinery Assistance Program. ZBB, a subsidiary of ZeaChem (Lakewood, Colorado, USA), will operate a 25-million-gallon-per-year (GPY);

CONTINUED ON PAGE 191

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Briefs

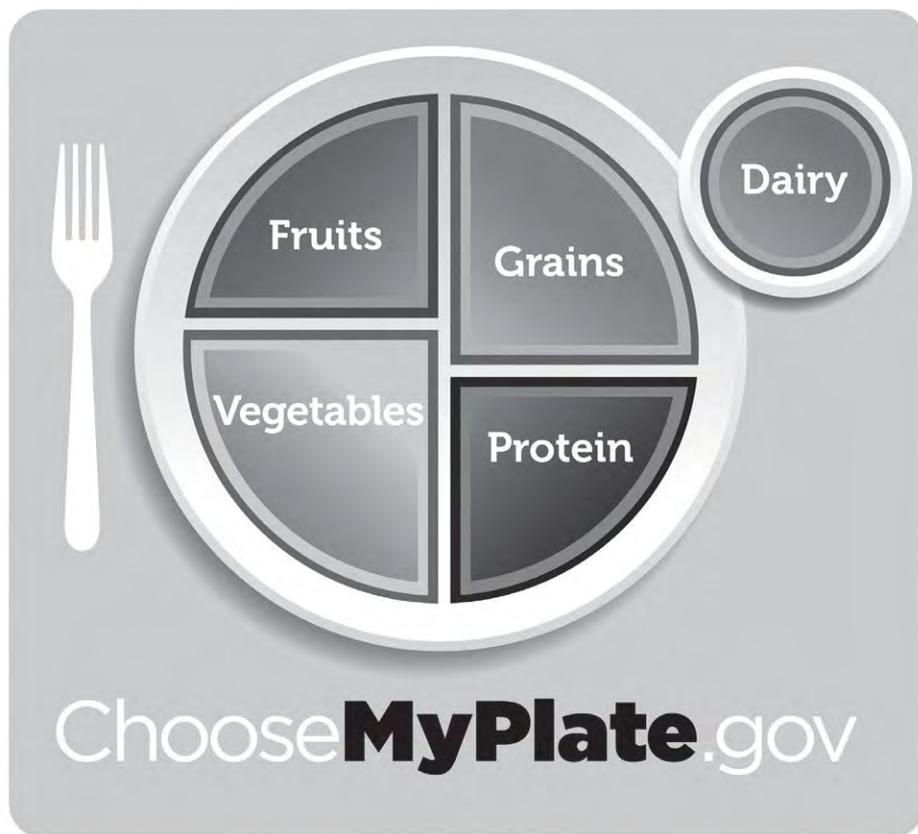
Sandrine Claus, Jeremy Nicholson, and colleagues at Imperial College in London suggest that the trillions of bacteria living in the large intestine of healthy persons may affect brown fat. (Brown fat is the “good” fat that burns calories quickly before they can be stored as fat.) In experiments that compared germ-free (GF) mice, which do not have large-intestine bacteria, and regular mice, the scientists uncovered evidence suggesting that the bacteria do influence the activity of brown fat. Brown fat in the GF mice seemed to be more active, burning calories faster than in regular mice. Large-intestine bacteria also seemed to be linked with gender differences in weight. Normal male mice were heavier and fatter than females, but those differences vanished in the GF mice. In addition, the research uncovered major differences by sex in the interactions between the animals and their intestinal bacteria that might help explain why the obesity epidemic is more serious and rapidly developing in women. Those and other findings may point the way toward approaches that stimulate the activity of brown fat in humans to prevent or treat obesity. The authors acknowledge funding from Nestlé as part of the Imperial College London-Nestlé strategic alliance. Their work appeared in the *Journal of Proteome Research* (doi:10.1021/pr200938v, 2011).



A team led by Joshua Thaler of the University of Washington (Seattle, USA) studied rodent models susceptible to diet-induced obesity in order to examine the effect of a high-fat diet on a brain region known as the hypothalamic arcuate nucleus. This area of the brain has a well-established role in feeding and energy balance. The researchers found that consumption of a high-fat diet caused an increase in hypothalamic inflammation and was accompanied by an activation of astrocytes and microglia (gliosis) that normally occurs in response to brain injury. In contrast to high-fat diet-induced peripheral tissue inflammation, which primarily occurs in response to weight gain, brain inflammation occurred rapidly following high-

CONTINUED ON PAGE 191

Health & Nutrition News



Willett and Ludwig take on US Dietary Guidelines

Walter Willett of the Harvard School of Public Health and David Ludwig of Boston's Children's Hospital (USA) have co-authored an article in *The New England Journal of Medicine* titled “The 2010 Dietary Guidelines—The Best Recipe for Health?” Although they find that some changes represent progress, they express concern that “several components” lack “scientific foundation.” These include burying a recommendation to limit sugar-sweetened beverages “deep in the guidelines” and continuing to recommend “three daily servings of dairy products, despite a lack of evidence that dairy intake protects against bone fractures and probable or possible links [of dairy intake] to prostate or ovarian cancers.”

The authors suggest that stronger, clear, scientifically sound guidelines require:

- Removing primary responsibility for their development from the US

Department of Agriculture, which they say has “conflicts of interest . . . arising from its institutional mission to promote commodities,” to the Centers for Disease Control and Prevention or the Institute of Medicine;

- Providing more funds to ensure a “comprehensive scientific review;”
- Conducting all development stages in open meetings; and
- Writing “guidelines that explicitly state which foods should be consumed less by Americans to reduce risk for chronic disease.”

Visit tinyurl.com/Willett-Ludwig to read the article.

First meta-analysis on DHA from algae and cholesterol

A meta-analysis of research on DHA (docosahexaenoic acid, 22:6n-3) and cholesterol

shows that consuming this long-chain omega-3 fatty acid in the form of algal oil supplements may provide cardiovascular support rivaling that seen from supplementation with fish oil.

In what the researchers call the “first of its kind on algal DHA,” the meta-analysis performed by researchers at the Harvard School of Public Health reviews 11 clinical trials (with a mean duration of six weeks) involving nearly 500 healthy participants. Outcomes observed by the scientists included a statistically significant decrease in serum triglycerides and statistically significant increases in LDL (low-density lipoprotein) and HDL (high-density lipoprotein) cholesterol. Although they found an overall increase in LDL, that increase was accompanied by an increase in LDL particle size—something the researchers claim represents potentially “less-atherogenic LDL particles”—thus pointing to an overall cardiovascular benefit despite the overall increase in LDL.

The meta-analysis appeared in *The Journal of Nutrition* (doi: 10.3945/jn.111.148973, 2012; see tinyurl.com/AlgalDHA).

Genetic basis of taste for fat

The human tongue recognizes and has an affinity for dietary fat, according to researchers at the Washington University School of Medicine (WUSM; St. Louis, Missouri, USA). Further, genetic variations can make people more or less sensitive to the taste of fat, the scientists say.

The study is the first, according to the WUSM team, to identify a receptor on the tongue that responds to fat, which suggests that some people may be more sensitive to the presence of fat in foods. Indeed, the investigators found that persons with a particular variant of the CD36 gene are far more sensitive to the presence of fat than others minus the variant.

“The ultimate goal is to understand how our perception of fat in food might influence what foods we eat and the quantities of fat that we consume,” says senior investigator Nada A. Abumrad, a professor of medicine and obesity research at WUSM. “In this study, we have found one potential reason for individual variability in how people sense fat. It may be, as was shown recently, that as people consume more fat, they become less sensitive

to it, requiring more intake for the same satisfaction. What we will need to determine in the future is whether our ability to detect fat in foods influences our fat intake, which clearly would have an impact on obesity.”

People who expressed more CD36 protein could easily detect the presence of fat. In fact, study subjects who produced the most CD36 were eight times more sensitive to the presence of fat than those who made about 50% less of the protein.

The researchers studied 21 people with a body mass index of 30 or more, which is considered obese. Some participants had a genetic variant that led to the production of more CD36. Others made much less. And some were in between.

Participants tasted solutions from three different cups. One contained small amounts of a fatty oil. The other two contained solutions that were similar in texture to the oil but were fat-free. Subjects then chose the cup that was different in taste.

“We did the same three-cup test several times with each subject to learn the thresholds at which individuals could identify fat in the solution,” explains first author M. Yanina Pepino, research assistant professor of medicine. “If we had asked, ‘does it taste like fat to you?’ that could be very subjective. So we tried to objectively measure the lowest concentration of fat at which someone could detect a difference.”

Her team masked input that might help participants identify fat by sight or smell. To eliminate visual cues, they lit the testing area with a red lamp. Study subjects also wore nose clips so that they could not smell the solutions.

Fat is an important component of the diet, and both humans and animals usually prefer high-fat, energy-dense foods. Previously, researchers suggested that people identify those high-fat foods mainly by texture, but this study suggests that the presence of fat can change the way our tongues perceive the food, just as it does for the tastes sweet, sour, bitter, salty, and savory (umami).

The CD36 discovery follows research that had identified a role for the gene in rats and mice. In that work, animals genetically engineered without a working CD36 gene no longer displayed a preference for fatty foods. In addition, animals that cannot produce the CD36 protein have difficulty digesting fat.

The variant in the CD36 gene that is associated with making significantly less

CD36 protein is believed to occur in up to 20% of the population. Which means that about one in five people may be less sensitive to the presence of fat in food.

Abumrad was the first to identify CD36 as the protein that facilitates the uptake of fatty acids. She says better understanding of how the protein works in people could be important in the fight against obesity.

“Diet can affect sensitivity to fat, and in animals, diet also influences the amount of CD36 that’s made,” Pepino says. “If we follow the results in animals, a high-fat diet would lead to less production of CD36, and that, in turn, could make a person less sensitive to fat. From our results in this study, we would hypothesize that people with obesity may make less of the CD36 protein. So it would seem logical that the amounts of the protein we make can be modified, both by a person’s genetics and by the diet they eat.”

The human diet contains fat, mainly in the form of triglycerides (fatty acids linked to glycerol). In the taste test, the researchers presented subjects with two types of fat. Some cups contained a broth of free fatty acids. Others contained triglycerides.

Pepino and Abumrad knew from animal studies that CD36 is activated by fatty acids but not triglycerides. Human subjects, however, were able to taste both. Pepino believes that is probably due to the activity of the lipase enzyme in the saliva that releases fatty acids while the fat is still in the mouth.

“Rats, for example, can produce salivary lipase, and the lipase quickly will begin to digest the triglyceride and convert it into . . . fatty acid[s],” she explains. “In humans, the role of lipase hasn’t been as clear. In our experiments, people could detect fat whether it was a triglyceride or a fatty acid.”

But when the researchers added the diet drug orlistat, subjects could still taste the fatty acids but were less able to detect the triglycerides. Orlistat inhibits lipase in the mouth, stomach, and intestine and is often prescribed to people who are obese to prevent them from absorbing fat in foods.

“Orlistat made it more difficult for people to taste fat,” Pepino says. “The solution had to contain higher amounts of triglyceride before they could detect fat. With free fatty acid[s], however, there was no difference.”

The study appeared in the *Journal of Lipid Research* (doi: 10.1194/jlr.M021873, 2011). ■

Biotechnology News

The advocacy group Food & Water Watch (Washington, DC, USA) announced in January 2012 a campaign to persuade Wal-Mart Stores, Inc., the largest food retailer in the United States, not to sell genetically engineered (GE) sweet corn. Monsanto Co. has announced the seeds of this variety will be available for planting in spring of 2012. According to the group, the retail chains Trader Joe's, Whole Foods, and the food manufacturer, General Mills, have already agreed not to use GE sweet corn in any of their products (tinyurl.com/GE-sweet-corn).



The National Center for Soybean Biotechnology at the University of Missouri (Columbia, USA) selected BGI, a genomics organization with offices in Cambridge, Massachusetts, USA, and Copenhagen, Denmark, to re-sequence 1,008 soybean germplasm lines. The purpose of the re-sequencing project, "Better Soybean, Better Life," is to assist molecular breeding to enhance the productivity, biotic and abiotic stress tolerance, and nutritional quality of US-grown soybeans by identifying genetic markers and understanding genetic variances and their associations with specific phenotypes or traits. Among the key traits of interest to researchers are the content and quality of the oil derived from soybean seed, drought and flood tolerance, and soybean nematode resistance.



India's National Biodiversity Authority alleged in January 2012 that the developers of the country's first genetically modified (GM) food crop—brinjal (eggplant)—used local varieties to develop the transgenic crop without obtaining the appropriate licenses for field trials. Jalna-based Maharashtra Hybrid Seeds Co., together with St. Louis-based Monsanto Co. and several cooperating universities, is being accused of violating farmers' rights to use naturally occurring breeds. The Bangalore-based Environment Support Group says the country's Biological Diversity Act obligates commercial developers of GM crops to negotiate with farmers for the intellectual rights to breeds and traits developed by indigenous farmers and their ancestors. ■



Hybrid silkworms

Even insects are being targeted for genetic manipulation. In January 2012, scientists announced that silkworms genetically engineered to contain spider genes were able to spin super-strong silk.

The work originated with the observation that spider silk is strong and tough, yet elastic enough to stretch several times its original length. In fact, the toughest biological material yet found, according to *National Geographic*, is the silk from Darwin's bark spider (*Caerostris darwini*). It is 10 times tougher than Kevlar (tinyurl.com/NatlGeo-DarwinSpider).

Not only is spider silk strong, scientists have also discovered how to make specific alterations to a spider's genes to produce silks with different properties.

In theory, spider silk could be used in products such as surgical sutures, artificial ligaments, and body armor—if there were enough of it. In the real world, farming spiders is not feasible. They are territorial animals that have a penchant for preying on each other.

Scientists have tried to synthesize spider silk proteins in other organisms such as bacteria, insects, mammals, and plants, but the yield has been disappointing. Furthermore, the silk protein would need to be converted into fibers, a complex process.

Enter the humble silkworm, which has been farmed for centuries. These creatures have large glands that turn silk protein into fiber. Silkworm silk already is used to make sutures, but it lacks some of the desirable properties of spider silk.

Researchers from the University of Wyoming (Laramie, USA), Zhejiang

University (Hangzhou, China), and the University of Notre Dame (Indiana, USA) have now reported the successful genetic engineering of silkworms by insertion of genes from the golden silk orb-weaver spider (*Nephila clavipes*) into the silkworm moth (*Bombyx mori*) to produce a hybrid material that is 96–98% silkworm silk and 2–4% spider silk (*Proceedings of the National Academy of Sciences* 109:923–928, 2012).

Even with this slight incorporation of spider silk, the hybrid silk that the silkworms produced was more than twice as tough as natural silkworm silk—but only about half as strong as spider silk.

Discover magazine quoted Donald Jarvis, one of the co-authors of the study, as saying, "The next step will be to produce silkworms that produce silk fibers consisting entirely of spider silk proteins" (tinyurl.com/Discover-silkworms).

Monsanto shareholders reject request

In August 2011 Harrington Investments, based in Napa, California, USA, submitted a shareholder resolution for Monsanto Co. (St. Louis, Missouri, USA) to study "material financial risks or operational impacts" of the chemicals and genetically modified crops that the company sells. For example, Monsanto markets a number of varieties of seeds—including corn, soybean, and sugar beets—in the United States that are engineered to withstand the weed killer glyphosate. These engineered varieties need application of fewer chemicals and reduce the necessity of tilling fields to kill weeds.

However, there is considerable resistance to export of these food crops in Europe, China, and Japan. According to the Associated Press, John Harrington, chief executive officer of Harrington Investments, said, “The potential legal implications for Monsanto are staggering.”

Unremarkably, the company had recommended shareholders defeat the proposal, saying in a statement, “Farmers should have the freedom to choose which production method is best suited for their needs, whether organic, non-GM conventional, or biotechnology traits.” In the material sent to shareholders before the company’s annual meeting (January 24, 2012), Monsanto recommended the shareholders defeat the proposal, saying that an additional report on that topic would “be redundant and provide no meaningful additional information” because Monsanto has already studied the issue extensively.

About 20.7 million shares were voted in favor of the study, and 341 million shares were voted against it (biz.yahoo.com/e/120124/mon8-k.html).

BASF announces withdrawal from GM crop market in Europe

BASF Plant Science, once located in Limburgerhof, Germany, announced in January 2012 that it was stopping production of genetically modified (GM) seeds solely for growth in Europe. As part of this decision, the company is moving its headquarters to Raleigh, North Carolina, USA. Research and development activities will be concentrated mainly in Raleigh; Ghent, Belgium; and Berlin, Germany. Regulatory approval processes already underway will be continued. About 140 positions in Europe are being eliminated.

Hostility from consumers led to the decision. In a company statement, Stefan Marcinowski, member of the Board of Executive Directors of BASF, responsible for plant biotechnology, said, “We are convinced that plant biotechnology is a key technology for the 21st century. However, there is still a lack of acceptance for this technology in many parts of Europe—from the majority of consumers, farmers, and politicians. Therefore, it does not make business sense to continue investing in products exclusively for cultivation in this market.” He added, “We will therefore concentrate on the attractive markets for plant

biotechnology in North and South America and the growth markets in Asia.”

BASF had been the only company still seeking approval of GM crops in Europe.

BASF Plant Science will halt the development and commercialization of all products designed solely for production in European markets, including GM starch potatoes (Amflora, Amadea, and Modena); the late blight (*Phytophthora infestans*)-resistant Fortuna table potato; a light blight-resistant starch potato; and a wheat variety resistant to fungal disease.

Former *inform* Contributing Editor Denis Murphy, professor of biotechnology at the University of Glamorgan (Pontypridd, Wales), said in a statement sent to reporters and quoted by *Nature* (tinyurl.com/Nature-Murphy), “Europe is now in danger of becoming a scientific backwater and will be unable to assist developing countries address food security.” He added, “There is now a danger that we will lose, not only companies like BASF, but also academic researchers and students—as well as any influence that we have had previously in developing countries where we used to be major providers of assistance and expertise.”

Monsanto withdraws GM in France and in Britain

On January 24, Monsanto announced it would not sell its genetically modified (GM) corn MON810 in France in 2012 or after, even though the country’s highest court overturned a ban in November (*inform* 23:IPR, 2012). In a statement reported by Reuters news agency, the company said, “Monsanto considers that favorable conditions for the sale of the MON810 in France in 2012 and beyond are not in place.” The company also notified French authorities of its intentions.

According to Mark Buckingham, spokesman for Monsanto UK, Monsanto has not sold MON810 seed in France since spring 2007. The last field trials were in 2008 (tinyurl.com/GMcorn-France).

“For 2012 and in the foreseeable future Monsanto has no plans to sell MON810 in France, unless both French farmers and the French government support sales,” Buckingham said. “Monsanto invests to offer GM traits wherever a choice of GM has broad support among farmers and government, leading to a stable business and regulatory environment for innovation.” He commented, “This is not the case in France at this time. Until France has a stable business and regulatory environment

based on sound science, commercializing GM technology is not practical for Monsanto.”

United Press International (UPI) reported in early February that Monsanto is closing its wheat-growing operation, based in Cambridge, and selling off crop-breeding centers in France, Germany and the Czech Republic. According to the UPI, the decision was made shortly before the British government announced that research had found that farming with genetically modified seeds would have long-term negative impacts on the country.

“Nourishing gene” identified in corn

Scientists have discovered a “nourishing gene” that controls the transfer of nutrients from plant to seed—a significant step that could help increase global food production.

The research, led by the University of Warwick (UK) in collaboration with the University of Oxford (UK) and agricultural biotech research company Biogemma (Chappes, France), has identified for the first time a gene, named *Meg1*, that regulates the optimum amount of nutrients flowing from mother to offspring in corn plants. Unlike the majority of genes that are expressed from both maternal and paternal chromosomes, *Meg1* is expressed only from the maternal chromosomes.

This unusual form of uniparental gene expression, called imprinting, is not restricted to plants but also occurs in some human genes that are known to regulate the development of the placenta to control the supply of maternal nutrients during fetal growth.

The findings mean that scientists can now focus on using the gene and understanding the mechanism by which it is expressed to increase seed size and productivity in major crop plants.

Jose Gutierrez-Marcos, corresponding author for the study and associate professor in the University of Warwick’s School of Life Sciences, said, “These findings have significant implications for global agriculture and food security, as scientists now have the molecular know-how to manipulate this gene by traditional plant breeding or through other methods to improve seed traits, such as increased seed biomass yield.”

The report, entitled “Maternal control of nutrient allocation in plant seeds by genomic imprinting,” appeared in *Current Biology* 22:160–165, 2012. ■

Briefs

Will detergent pods (single-dose packs of liquid or powder detergent) save the sagging laundry detergent market in North America? Procter & Gamble (P&G)—as *inform* went to press—was scheduled to introduce its Tide Pods in February 2012 (having delayed the introduction from September 2011). The delay has allowed the competition to catch up; Henkel will introduce Purex UltraPacks, Sun Products is rolling out All Mighty Paks, Church & Dwight is producing Toss 'N Done Power Paks, and Phoenix Brands is developing concentrated detergent packs across three brands—Fab, Ajax, and Dynamo—according to *AdvertisingAge* magazine. Further complicating things for P&G is the fact that the company reportedly had only enough supply for shelf displays and not off-shelf promotions—a mere six weeks before the scheduled February 21, 2012, introduction of Tide Pods. Stay tuned . . .

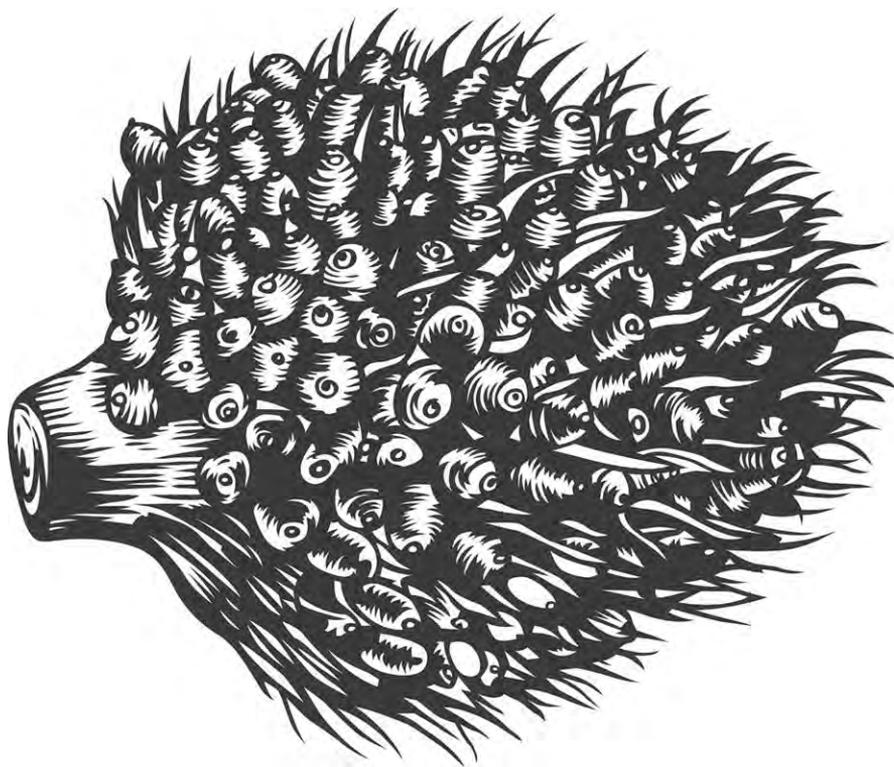


Johnson & Johnson, in collaboration with Brazilian petrochemical company Braskem, has released a new line in its Sundown range of sun care products, packaged in ethanol-based polyethylene packaging. Braskem said in a statement that for each ton of plastic produced, its “green” plastic sequesters 2.5 metric tons of carbon dioxide released during sugarcane cultivation through photosynthesis. A company spokesperson was quoted by *packaging.com* as saying this is “a significant gain compared to traditional plastic, whose production releases 2.1 tons [presumably metric] of CO₂.”



Solazyme, the renewable oil company based in South San Francisco, California, USA, has introduced a line of algae oil-based cosmetics. (The company also has a development deal with consumer products giant Unilever.) The Algenist skin care line is available at more than 600 Sephora cosmetics shops, with prices ranging from \$56–\$94. The products deliver alguronic acid, which marketing materials say helps shield algae from hostile environments. When used on human skin, alguronic acid exhibits anti-aging properties, Solazyme claims. ■

Surfactants, Detergents & Personal Care News



China's need for oleochemicals

Rising demand by Chinese consumers for “green” soaps and detergents is a boon for Malaysian investors in China's oleochemical industry, Malaysian Palm Oil Board (MPOB) Director-General Choo Yuen May told the *Business Times* newspaper in late December 2011. China consumed about 2.5 million metric tons of oleochemicals in 2010, she said, and growth is expected to be about 10–15% annually going forward.

The article (available at tinyurl.com/OleoBT) summarized oleochemical capacity at a number of facilities in China. Included in the summary:

- Emery Oleochemicals and Sime Darby (both of Malaysia) have partnered with Chinese detergent manufacturer Guangzhou Lonkey Industrial Co. Ltd. to form

Guangzhou Keylink Chemical Co. That joint-venture firm is building a 40,000-metric-ton (MT)-per-year facility to manufacture methyl ester sulfonates (MES). Emery's Chief Executive Officer Kongkrapan Intarajang told the newspaper the plant should begin production in the first quarter of 2012.

- KLK Oleochemicals Group is operating a 50,000-MT-per-year MES facility in Malaysia and expects to double production in 2012.

- Singapore's Wilmar International Ltd. is the “biggest player in China's oleochemical industry,” the newspaper article said, “with an estimated annual capacity of 800,000 MT.”

- Kuala Lumpur Kepong Bhd.'s unit KLK-Taiko Palm Oleo Co. Ltd. operates a facility in Zhangjiagang, which is about two hours by car from Shanghai. That plant produces 220,000 MT of fatty acids, soap noodles, and glycerine per year, the BT report noted.

- Malaysia's Teck Guan Perdana Bhd. operates an oleochemical facility at Rugao, which is about a four-hour drive from Shanghai, with an annual capacity of 200,000 MT of fatty acids, soap noodles, and glycerine.
- Dongma (Guangzhou Free Trade Zone) Oleochemicals Co. Ltd., a unit of Malaysia's Kwantas Corp. Bhd., operates two facilities with a combined 200,000-MT-per-year capacity. The plants are in Zhangjiagang near Shanghai and in Guangzhou, the newspaper report said.

Cosmetic chemical hinders brain development in tadpoles

A new study in tadpoles reports that a preservative used in some cosmetics interrupts neurological development even in very low concentrations. The study does not, however, provide any evidence that the preservative is unsafe for humans.

The chemical—methylisothiazolinone, or MIT—is considered safe at concentrations of fewer than 100 parts per million (ppm), according to a statement by the researchers at Brown University in Providence, Rhode Island, USA. Previous studies, however, have found that lower concentrations affected the growth of animal neurons. Picking up from there, the Brown researchers performed a series of experiments to investigate how 10 days of exposure at concentrations as low as 1.5 ppm would affect whole, living tadpoles as they develop. Their results appeared online in *Neuroscience* (doi: 10.1016/j.neuroscience.2011.12.052, 2012).

“The lower concentrations we studied didn't kill the animals or cause any big deformities or affect the behavior you would see just by looking at them,” said Carlos Aizenman, associate professor of neuroscience and the study's senior author.

“But then we decided to do a series of functional tests and we found that exposure to this compound during a period of development that is critical for the fine wiring of the nervous system disrupted this period of fine tuning.”

Aizenman emphasized that there is no evidence in the study that any products with MIT, such as shampoos or cosmetics, are harmful to consumers, a point reiterated by Jay Ansell, vice president of cosmetic programs for the Personal Care Products

Council, a Washington, DC, USA-based trade association.

“As the study's senior author notes, there is no evidence in this study that any products with methylisothiazolinone (MIT) are harmful to consumers,” he said. “While the results of the study are of interest to the scientific community, it must be noted that the safety of MIT to humans has been extensively reviewed worldwide, and expert panels in the United States, European Union, and Canada have concluded that MIT may be safely used as a preservative in personal care products.”

In the laboratory, behavioral effects observed in tadpoles suggested a further search for a “non-obvious but real deficit in neural function.” When Aizenman and lead author Ariana Spawn explored the consequences of exposing tadpoles to two non-lethal concentrations—1.5 ppm and 7.6 ppm—they found some deficits both in behavior and in basic brain development.

In one experiment, they shone moving patterns of light into one side of the tadpole tanks from below. As they expected, the unexposed tadpoles avoided the light patterns, swimming to the other side. Tadpoles that had been exposed to either concentration of MIT, however, were significantly less likely to avoid the light.

In another experiment, Aizenman and Spawn exposed the tadpoles to another chemical known to induce seizures. Tadpoles not exposed to MIT and those exposed to the lower concentration each had the same ability to hold off seizures, but the ones that had been exposed to the 7.6 ppm concentration succumbed to the seizures significantly more readily.

In these experiments, seizure susceptibility had nothing to do with epilepsy, Aizenman said, but was instead a measure of more general neural development.

After observing the two significant behavioral effects in the tadpoles, Aizenman and Spawn then sought the underlying physiological difference between exposed and unexposed tadpoles that might cause them. They performed an electrophysiological analysis of each tadpole's optic tectum, a part of the brain responsible for processing visual information. They found evidence that the chemical seems to have stunted the process by which tadpoles prune and refine neural connections, a key developmental step.

“The neural circuits act like the neural circuits of a much more immature tadpole,”

Aizenman said. “This is consistent with the previous findings in cell cultures.”

One area where further studies may be warranted, according to Aizenman, is in cases of repeated exposure in industrial or occupational settings, but the study's broader message may be that chemical manufacturers and independent labs should test more for neurodevelopmental effects of even low concentrations of products. In the specific case of MIT in tadpoles, he noted, “It's resulting in a non-obvious but real deficit in neural function.”

Moringa oleifera and clean water

A protein obtained from seeds of the *Moringa oleifera* trees could purify and clarify water inexpensively and sustainably in the developing world, where more than 1 billion people lack access to clean drinking water, scientists report.

Stephanie B. Velegol and colleagues at Penn State University (University Park, USA) explain that removing the disease-causing microbes and sediment from drinking water requires technology not always available in rural areas of developing countries. For an alternative approach, Velegol looked to *Moringa oleifera*, also called the “miracle tree,” a plant grown in equatorial regions for food, traditional medicines, and biofuel. Past research showed that a protein in Moringa seeds can clean water, but using the approach was too expensive and complicated. So Velegol's team sought to develop a simpler and less expensive way to utilize the seeds' power.

To do that, they added an extract of the seed containing the positively charged Moringa protein, which binds to sediment and kills microbes, to negatively charged sand. The resulting “functionalized sand,” or “f-sand,” proved effective in killing harmful *E. coli* bacteria and removing sediment from water samples. “The results open the possibility that . . . f-sand can provide a simple, locally sustainable process for producing storable drinking water,” the researchers say.

The authors acknowledge funding from the National Science Foundation, and the US Environmental Protection Agency. The study appeared in *Langmuir* (doi:10.1021/la2038262, 2011). ■

People News/ Inside AOCS

Hill to be recognized

The University of Illinois Urbana-Champaign (USA) has selected AOCS member **Steven Hill** as one of the recipients of the 2012 College of Agricultural, Consumer and Environmental Sciences (ACES) Alumni Association Award of Merit. The ACES Alumni Association Award of Merit is given annually to College graduates who have made significant contributions to their chosen professions, the human sciences, and food and natural resources industries.



Hill

The announcement of the award recognizes Hill's 20-year career at Kraft Foods (Prospect Heights, Illinois, USA). He has developed numerous new technologies and products in the food and health field and holds more than 20 patents. In addition to his professional accomplishments at Kraft Foods, the citation listed his activities as a member and leader of AOCS.

Another person being presented with the College of ACES Alumni Association Award of Merit is **Nancy Moriarity**, who is presently research and development director, nutrition, for PepsiCO in Barrington, Illinois, USA. Both Hill and Moriarity received their advanced degrees under the direction of the late **Edward G. Perkins**, former AOCS president.

The awards will be presented during a luncheon hosted by the ACES Alumni Association on Monday, April 16.

Daun receives life membership

The Canola Council of Canada awarded former AOCS president **James Daun** an honorary life membership to the organization in January. He was recognized for his expertise in the composition and quality issues related

to canola, rapeseed, flaxseed, and other oilseed crops grown in Canada.

In his acceptance of this recognition, Daun said, "Of all the things I accomplished, I am most proud of my work to assist in the definition of canola." He helped create the official definition of canola by establishing specifications for glucosinolates and erucic acid and the method of glucosinolate measurement. Daun also developed methods for determining chlorophyll in canola seed.

Daun joined the Canadian Grain Commission in 1975 and spent 31 years with that organization. In the past five years, he has been an adjunct professor at the University of Manitoba and formed his own company, AgriAnalytical Consulting.



Daun

Changes at ACI

Dennis Griesing retired as vice president of government affairs for the American Cleaning Institute (Washington, DC, USA) in January after 22 years with the organization. He was succeeded by Senior Director of Government Affairs **Douglas Troutman**, effective January 30.

Griesing came to ACI—then The Soap and Detergent Association—with 12 years of professional government relations experience at the federal, state, and local levels. During his tenure at ACI, Griesing advocated on issues such as reform of the Federal Insecticide, Fungicide, and Rodenticide Act, phosphate defense, packaging, advertising issues, eco-labeling, and environmentally preferable procurement.

Troutman has been with ACI since 2007 as director of government affairs. He has experience with government relations also with the National Electrical Manufacturers Association (Arlington, Virginia, USA) and Underwriters Laboratories (Washington, DC).

Artz to retire

After 28 years with the Department of Food Science and Human Nutrition at the University of Illinois at Urbana-Champaign (USA), Associate Professor **William Artz**



Artz

has announced he will retire in May 2012. His future plans are still in flux, but he is considering a variety of possibilities, including consulting, teaching, working outside the United States for a year or two, and assisting a friend with business activities in Brazil. Artz said, "I am not sure which opportunity will pan out. It will probably be a combination of a couple of options." He added, "I will continue with all my current AOCS activities particularly [as book review editor] for *inform* and [as senior associate editor for] *JAOCS*."

Azzarello promoted

As of January 1, 2012, **Steve Azzarello** became vice president of business and corporate development at AMCOL International (Hoffman Estates, Illinois, USA). In this new role, he is responsible for business development on a global scale with focus on AMCOL's Global Minerals and Materials Group. Azzarello



Azzarello

has been with AMCOL for over four years and previously served as commercial director. AMCOL is active in AOCS through its bleaching earth and detergents businesses as well as specialties within each category. Prior to AMCOL, he worked at Novus International, Oil-Dri Corporation, and UOP, a Honeywell company. Azzarello has been active in AOCS since 1987. ■

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IN MEMORIAM

Gerhard Maerker



Maerker

Former AOCS president Gerhard (“Jerry”) Maerker passed away on January 5, 2012, at the age of 88. His wife Roselle survives him, as do his daughters Wendy (David) Harris and Heidi (Mark) Zod, three grandsons, and one granddaughter.

Born in Germany, Maerker came to the United States with his family in 1938 and had a life-long association with the Philadelphia, Pennsylvania (USA) area. After serving in the Army as interpreter during World War II in the United States and Italy, he received his B.Sc. from the Philadelphia College of Pharmacy and Science (now, the University of the Sciences in Philadelphia), in 1951. He then went on to earn his M.S. and Ph.D. degrees from Temple University in Philadelphia in 1952 and 1957, respectively. While he worked on his advanced degrees, he was also employed as a research chemist by the Allied Chemical Corporation.

In 1958 Maerker joined the Animal Fat Laboratory (AFL) of the Eastern Regional Research Center (ERRC), Agricultural Research Service, US Department of Agriculture at Laboratory in Wyndmoor, Pennsylvania, as a chemist, then research leader and ultimately head of the AFL. With the reorganization of the ERRC laboratories in 1980, he assumed a research leader position in the newly formed Food Safety (FS) unit at ERRC, where he remained until his retirement in 1992. Over the course of his career in the AFL, his research covered topics such as fatty acid chemistry, heterocyclic derivatives of fatty acids and esters, lipid analysis, detergents, lubricants, urethane polymers derived from fatty acids, soap-based detergents, and glycidyl ester synthesis, while his research in the FS unit centered on the mechanisms of the oxidation of cholesterol. He had over a dozen patents in both the United States and Canada based on his research, and he authored over 80 papers, which appeared in journals such as *Journal of the American Oil Chemists’ Society*, *Lipids*, *Analytical Chemistry*, *Journal of Food Science*, *Journal of Agricultural and Food Chemists*, *Preparative Biochemistry*, and the *Textile Research Journal*. He lectured in Mexico and in many countries in Europe and Asia.

Maerker joined AOCS in 1960 and became an emeritus member in 1993; he was appointed an AOCS Fellow in 1999. As a long-time member of AOCS, he was involved in many aspects of the life of the organization. He chaired several symposia on the industrial uses for fats and oils at AOCS annual meetings as well as short courses on the industrial uses of fatty acids. He co-chaired the technical programs for the fall 1974 meeting in Philadelphia, and was technical program chair in 1990 in Baltimore, Maryland. Maerker also served as general chairperson of the 1985 Annual Meeting, held in Philadelphia.

In his activities in the governance of AOCS, Maerker served on the governing board in 1984–1985, and again in 1990–1991 when he was vice president, 1991–1992 when he was president, and 1992–1993, when he was immediate past president of the organization. He also served on several committees, such as books and special publications, advertising, and nominations and elections.

Tatu A. Miettinen

(The following is based on the obituary of Dr. Miettinen by Y.A. Kesäniemi and S.M. Grundy, which appeared on December 22, 2011, in the *Journal of Lipid Research*, doi: 10.1194/jlr.E023853).

Tatu Miettinen, a leader in the field of sterols and the developer of Benecol, the first margarine containing sitostanol ester, died on November 30, 2011, at the age of 81 in Phuket, Thailand, as the result of a car accident.

Miettinen was born in Lapinlahti, Finland, and started his medical training as an assistant at the Department of Medical Biochemistry, University of Helsinki in 1956. He received his M.D. in 1958 and his doctor of medical sciences (Ph.D.) in 1961. He started his clinical training in internal medicine, and accepted a research fellowship in 1963 at the Rockefeller University (New York, USA). His research there with E.H. (Pete) Ahrens, Jr. provided a basis for today’s understanding of cholesterol metabolism in humans. Miettinen was appointed professor of medicine and the head of the Second Department of Medicine at the University of Helsinki in 1973.

His contributions to the understanding of cholesterol metabolism were in areas such as the regulation of the synthesis and excretion of cholesterol, the role of cholesterol absorption in the determination of plasma lipid levels, and clearance of low density lipoprotein from plasma. He also carried out studies on cholesterol metabolism in clinical situations.

Benecol margarine, commercialized by Raisio plc, the Finnish functional food ingredient company, was based on Miettinen’s research on the effects of long-term consumption of plant and sterol esters on vascular function. The product was introduced in Finland in 1995 and is now licensed in more than 30 countries. Regarding Benecol products, the European Commission stated, “Plant stanol esters have been shown to lower/reduce blood cholesterol. Blood cholesterol lowering may reduce the risk of coronary heart disease” (tinyurl.com/Benecol-EC).

Miettinen was one of the initiators of the Scandinavian Simvastatin Survival Study (*Lancet* 344:1383–1389, 1994), which showed the beneficial impact of statin therapy in lowering both cardiovascular disease morbidity as well as overall mortality.

He was well known for his talent in training young scientists, his unique ability to work effectively in a variety of settings in the medical community, and his zest for research. He published over 450 scientific articles, and there are others still in preparation.

David R. Nelson

David Nelson, of Bonner Springs, Kansas, USA died at the age of 60 on Monday, November 28, 2011. At the time of his passing, he was associated with Caravan Ingredients Co. in Lenexa, Kansas.

Nelson was born in Wichita, Kansas, and earned a BA in chemistry and biology from Greenville College (Greenville, Illinois). He completed his master’s degree in business administration at the University of Missouri-Kansas City in 1993. Before joining Caravan Ingredients, he had worked at Thompson-Hayward Chemical Co. and the Sunflower Army Ammunition Plant.

He is survived by his wife Marsha; three daughters, Michelle (Jeffrey) Sussenback, Megan (Matthew) McPeak, and Rachel (Joshua) Woods; his mother; two brothers; and 10 grandchildren.

Nelson joined AOCS as part of his attendance at the AOCS Annual Meeting & Expo held in Cincinnati, Ohio, in May 2011. ■

Book Review

Microscopic Analysis of Agricultural Products, 4th Edition

James Makowski, Neil Vary, Marge McCutcheon, and
Pascal Veys (eds.)

AOCS Press, 2011, 204 pages, ISBN 978-189399771-4,
Book alone: \$200 (nonmembers), \$160 (members); Book
plus CD-ROM: \$300 (nonmembers), \$240 (members).

Patricia Ramsey

Microscopic Analysis of Agricultural Products is a spiral-bound manual that functions as a practical reference and study guide and as a complete system for the microscopic analysis of agricultural products (food, feed, and the like). The manual can be used adjacent to the microscope in the laboratory or at one's desk, and it would work well as a teaching tool for the beginning microscopist.

In my opinion, this manual will not go out of date, and any new methods could be published and added as supplemental section(s). The guide correctly covers the full spectrum of the modern approach to agricultural microscopy.

What level of experience is required to use the manual? The manual is readily understandable and so would be a very good teaching tool. Even individuals who have never used a microscope would be able to understand and benefit from the majority of the material. However, the section about detection of Animal Products in Feeds and Feed Ingredients is relatively advanced. A reader would need extensive experience to master the material in this section of this book. With respect to the readability of the manual, it flows well. Most of the manual is written simply and in a straightforward manner.

The picture reproduction is excellent and very helpful. However, the manual needs additional photographs/figures illustrating microchemical spot tests. I recommend a supplement with this material. In my opinion, the illustrations are well drawn and match the actual microscopy photos almost perfectly.

Although I did not receive a CD-ROM, I have spoken with several users who did. The consensus is that the CD can be very handy, if one's computer is next to the microscope. Otherwise, The CD could be used as a study guide at one's desk, while the manual would be close to the microscope for quick reference.

This fourth edition has corrected all of the problems of the first three editions. Plus, there are important new methods and topics included such as fertilizer microscopy and the detection of animal products in feeds in light of concerns over transmissible spongiform encephalopathies. In addition, more feed ingredients are included. I have seen other publications by that are softbound, but they begin to lose pages after a few years, particularly if used regularly.

In summary, the only weak point of this manual is the absence of microchemical test pictures. The ease of use and understandability, as well as the new topics included, make this an excellent edition. This will be a worthwhile addition to any agricultural microscopy reference library, scientific library, or academic library.

Patricia Ramsey is a retired agricultural microscopist who worked for 32 years at the California Department of Food and Agriculture. She can be reached at pramseyatms@aol.com.

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



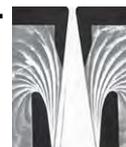
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Extracts & Distillates

Biogenesis and functions of lipid droplets in plants

Chapman, K.D., J.M. Dyer, and R.T. Mullen, *J. Lipid Res.* 53:215–226, 2012.

The compartmentation of neutral lipids in plants is mostly associated with seed tissues, where triacylglycerols (TAG) stored within lipid droplets (LD) serve as an essential physiological energy and carbon reserve during postgerminative growth. However, some non-seed tissues, such as leaves, flowers and fruits, also synthesize and store TAG, yet relatively little is known about the formation or function of LD in these tissues. Characterization of LD-associated proteins, such as oleosins, caleosins, and sterol dehydrogenases (steroleosins), has revealed surprising features of LD function in plants, including stress responses, hormone signaling pathways, and various aspects of plant growth and development. Although oleosin and caleosin proteins are specific to plants, LD-associated sterol dehydrogenases also are present in mammals, and in both plants and mammals these enzymes have been shown to be important in (steroid) hormone metabolism and signaling. In addition, several other proteins known to be important in LD biogenesis in yeasts and mammals are conserved in plants, suggesting that at least some aspects of LD biogenesis and/or function are evolutionarily conserved.

Circulating inflammatory and atherogenic biomarkers are not increased following single meals of dairy foods

Nestel, P.J., *et al.*, *Eur. J. Clin. Nutr.* 66:25–31, 2012.

Inflammation characterizes obesity and is nutritionally modifiable. The hypothesis of this study is that full-fat dairy foods influence circulating inflammatory and atherogenic biomarkers according to fermentation status. Thirteen overweight subjects participated in five test meals. Single breakfasts containing control low-fat milk or 45 g fat from butter, cream, yoghurt, or cheese were tested over 3 weeks. Plasmas obtained 3 and 6 h were later

analyzed for inflammatory markers interleukin (IL)-6, IL-1 β , tumor necrosis factor- α and high-sensitive C-reactive protein, and atherogenesis-related markers monocyte chemoattractant protein-1, macrophage inflammatory protein-1 α , intercellular adhesion molecule-1 and vascular cell adhesion molecule-1. A 4-week study in 12 subjects compared the effects on these biomarkers of diets containing ~50 g dairy fat daily as either butter, cream, and ice cream (non-fermented) or cheese plus yoghurt (fermented) dairy foods. In single-meal study, one outlier subject showed marked increments in biomarkers, hence the following results apply to 12. *Within* group analysis includes significant falls at 3 h in four inflammatory markers after cream, butter, and low fat, and three atherogenesis-related biomarkers after cream. Changes were few after cheese and yoghurt. By 6 h, most values returned to baseline. However, *between* group analysis showed no differences between the five meals. The 4-week study showed no significant differences in fasting biomarker concentrations between non-fermented and fermented dairy diets. Single high-fat meals containing sequentially four different full-fat dairy foods did not increase eight circulating biomarkers related to inflammation or atherogenesis. Among subjects, significant falls occurred at 3 h in inflammatory biomarkers after cream and butter but were not specific for full-fat dairy foods. We could not confirm the reported increments in inflammation after fat meals.

DHA and EPA reverse cystic fibrosis-related FA abnormalities by suppressing FA desaturase expression and activity

Njoroge, S.W., *et al.*, *J. Lipid Res.* 53:257–265, 2012.

Patients and models of cystic fibrosis (CF) exhibit consistent abnormalities of polyunsaturated fatty acid composition, including decreased linoleate (LA) and docosahexaenoate (DHA) and variably increased arachidonate (AA), related in part to increased expression and activity of fatty acid desaturases. These abnormalities and the consequent CF-related pathologic manifestations can be reversed in CF mouse models by dietary supplementation with DHA. However, the mechanism is unknown. This study investigates this mechanism by measuring the effect of exogenous DHA and eicosapentaenoate

(EPA) supplementation on fatty acid composition and metabolism, as well as on metabolic enzyme expression, in a cell culture model of CF. We found that both DHA and EPA suppress the expression and activity of Δ 5- and Δ 6-desaturases, leading to decreased flux through the n-3 and n-6 PUFA metabolic pathways and decreased production of AA. The findings also uncover other metabolic abnormalities, including increased fatty acid uptake and markedly increased retroconversion of DHA to EPA, in CF cells. These results indicate that the fatty acid abnormalities of CF are related to intrinsic alterations of PUFA metabolism and that they may be reversed by supplementation with DHA and EPA.

Antioxidant behavior in bulk oil: limitations of polar paradox theory

Zhong, Y., and F. Shahidi, *J. Agric. Food Chem.* 60:4–6, 2012.

The polar paradox theory that explains the efficacy of antioxidants as affected by their polarity and that of the medium involved was re-evaluated. For the first time, the effect of concentration on validity of the polar paradox theory was investigated using four pairs of polar and nonpolar representative antioxidants in bulk oil. A model on antioxidant behavior in response to their polarity is proposed.

Quality evaluation of olive oil by statistical analysis of multicomponent stable isotope dilution assay data of aroma active compounds

Dierkes, G.A., *et al.*, *J. Agric. Food Chem.* 60:394–401, 2012.

An instrumental method for the evaluation of olive oil quality was developed. Twenty-one relevant aroma active compounds were quantified in 95 olive oil samples of different quality by headspace solid phase microextraction (HS-SPME) and dynamic headspace coupled to gas chromatography-mass spectrometry. On the basis of these stable isotope dilution assay results, statistical evaluation by partial least-squares discriminant analysis (PLS-DA) was performed. Important variables were the odor activity values of ethyl isobutanoate, ethyl 2-methylbutanoate, 3-methylbutanol, butyric acid, *E,E*-2,4-decadienal, hexanoic acid, guaiacol,

CONTINUED ON NEXT PAGE

2-phenylethanol, and the sum of the odor activity values of *Z*-3-hexenal, *E*-2-hexenal, *Z*-3-hexenyl acetate, and *Z*-3-hexenol. Classification performed with these variables predicted 88% of the olive oils' quality correctly. Additionally, the aroma compounds, which are characteristic for some off-flavors, were dissolved in refined plant oil. Sensory evaluation of these models demonstrated that the off-flavors rancid, fusty, and vinegary could be successfully simulated by a limited number of odorants.

Lipid profiling by electrospray ionization tandem mass spectrometry and the identification of lipid phosphorylation by kinases in potato stolons

Cenzano, A.M., *et al.*, *J. Agric. Food Chem* 60:418–426, 2012.

There is limited information about the involvement of lipids and esterified fatty acids in signaling pathways during plant development. The purpose of this study was to evaluate the lipid composition and molecular species of potato (*Solanum tuberosum* L., cv. Spunta) stolons and to identify phosphorylated lipids in the first two developmental stages of tuber formation. Lipid profiling was determined using ESI-MS/MS (electrospray ionization-tandem mass spectroscopy), a useful method for the determination of the biosynthesis and catabolism of lipids based on their fatty acid composition. The most prevalent compound identified in this study was phosphatidic acid (PA); digalactosyldiacylglycerol was the second most abundant compound. A 34:2 species was identified in PA, phosphatidylcholine, phosphatidylinositol, and phosphatidylethanolamine. The identification of lipid phosphorylation by kinases was revealed by the presence of the phosphorylated lipids. PA was metabolized to diacylglycerol pyrophosphate by phosphatidic acid kinase (PAK). This work establishes a correlation between lipid fatty acid composition and lipid metabolism enzymes at the beginning of tuber formation and is the first report of PAK activity in the early events of potato tuber formation.

Electrochemical conversion of fatty acids

Schäfer, H.J., *Eur. J. Lipid Sci. Technol.* 114:2–9, 2012.

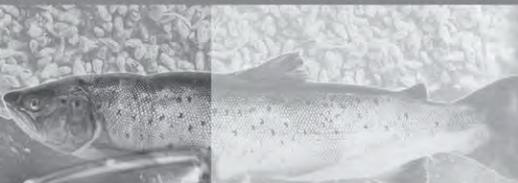
AOCS Journals



Journal of the American Oil Chemists' Society (February)

- Phenolic characterization and geographical classification of commercial extra virgin olive oils produced in Turkey, Alkan, D., F. Tokatli, and B. Ozen
 - Effect of ascorbic acid or acyl ascorbate on the stability of catechin in oil-in-water emulsion, Watanabe, Y., T. Suzuki, H. Nakanishi, A. Sakuragochi, and S. Adachi
 - Antioxidant phenolics of millet control lipid peroxidation in human LDL cholesterol and food systems, Chandrasekara, A. and F. Shahidi
 - Effect of temperature and time on the stability of salmon skin oil during storage, Aryee, A.N.A., B.K. Simpson, L.E. Phillip, and R.I. Cue
 - Physicochemical properties of *Jatropha curcas* seed oil from different origins and candidate plus plants (CPPs), Aminul Islam, A.K.M., Z. Yaakob, N. Anuar, S R.P. Primandari, and M. Osman
 - Physicochemical properties of soy protein adhesives obtained by *in situ* sodium bisulfite modification during acid precipitation, Qi, G., N. Li, D. Wang, and X.S. Sun
 - Lewis acid-catalyzed synthesis of hyperbranched polymers based on glycerol and diacids in toluene, Wyatt, V.T.
 - Cardanol-based bis(azo) dyes as a gasoline 91 colorant, Paebumrung, P., A. Petsom, and P. Thamyongkit
 - Polyunsaturated fatty acid concentrates of carp oil: chemical hydrolysis and urea complexation, Crexi, V.T., M.L. Monte, M.L. Monte, and L.A.A. Pinto
 - Lipid and biomass distribution and recovery from two microalgae by aqueous and alcohol processing, Wang, G., and T. Wang
 - Changes in volatile compounds during processing of Tunisian-style table olives, Dabbou, S., M. Issaoui, F. Brahmi, A. Nakbi, H. Chehab, *et al.*
 - Emulsifying properties of different modified sunflower lecithins, Cabezas, D.M., R. Madoery, B.W.K. Diehl, and M.C. Tomás
-
- ### Lipids (February)
- Applications of stereospecifically-labeled fatty acids in oxigenase and desaturase

Lipids



biochemistry, Brash, A.R., C. Schneider, and M. Hamberg

- Myristic acid increases dihydroceramide $\Delta 4$ -desaturase 1 (DES1) activity in cultured rat hepatocytes, Ezanno, H., J. le Bloc'h, E. Beauchamp, D. Lagadic-Gossmann, P. Legrand, *et al.*
- Tissue distribution of α - and γ -tocotrienol and γ -tocopherol in rats and interference with their accumulation by α -tocopherol, Uchida, T., C. Abe, S. Nomura, T. Ichikawa, and S. Ikeda
- Fish oil normalizes plasma glucose levels and improves liver carbohydrate metabolism in rats fed a sucrose-rich diet, Hein, G.J., A. Chicco, and Y.B. Lombardo
- Daily intake of cod or salmon for 2 weeks decreases the 18:1n-9/18:0 ratio and serum triacylglycerols in healthy subjects, Telle-Hansen, V.H., L.N. Larsen, A.T. Høstmark, M. Molin, L. Dahl, *et al.*
- Stable carbon isotope composition of c9,t11-conjugated linoleic acid in cow's

milk as related to dietary fatty acids, Richter, E.K., J.E. Spangenberg, F. Klev-
ehusen, C.R. Soliva, M. Kreuzer, *et al.*

- Identification of C18 intermediates formed during stearidonic acid biohydrogenation by rumen microorganisms *in vitro*, Alves, S.P., M.R.G. Maia, R.J.B. Bessa, A.J.M. Fonseca, and A.R.J. Cabrita
- Steryl glucoside and acyl steryl glucoside analysis of *Arabidopsis* seeds by electrospray ionization tandem mass spectrometry, Schrick, K., S. Shiva, J.C. Arpin, N. Delimont, G. Isaac, *et al.*
- Suitability of Soxhlet extraction to quantify microalgal fatty acids as determined by comparison with *in situ* transesterification, McNichol, J., K.M. MacDougall, J.E. Melanson, and P.J. McGinn
- Quantitation of multiple sphingolipid classes using normal and reversed-phase LC-ESI-MS/MS: comparative profiling of two cell lines, Masood, M.A., R.P. Rao, J.K. Acharya, J. Blonder, and T.D. Veenstra

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Electrochemical conversions combine an electron transfer with a chemical reaction, which allows conversions that are not available in non-electrochemical reactions. Electrochemical conversions usually need fewer steps, produce less waste, provide a cheaper reagent, require less auxiliaries, and allow often an easier scale-up than non-electrochemical syntheses. In addition, they can be conducted at ambient temperature and pressure. All these qualities agree well with the rules of green chemistry. Electroactive sites for fatty acids are the carboxyl group, the C=C double bond and the activated C-H bond. The deprotonated carboxyl group is anodically decarboxylated to afford an alkyl radical. The radical can couple or add to a C=C double bond. Radical coupling provides diesters, pheromones, or C-glycosides. At the anode the double bond can be substituted in allylic position, add two nucleophiles or can be cleaved. Cathodic reduction of fatty acids with an enone group affords dimer fatty acids in a hydrodimerization. Non-activated C-H bonds in fatty acids can be oxygenated at the anode; the conversion occurs preferentially at the remote C-H bonds.

Does fish oil prevent cardiac arrhythmias?

Stanley, J., *Lipid Technol.* 24:15-16, 2012.

It is widely accepted that the very long chain n-3 polyunsaturated fatty acids (VLC n-3 PUFA) characteristic of marine oils protect against the development of cardiovascular disease (CVD). This idea is supported by a large body of consistent epidemiological studies showing favorable associations between intakes of VLC n-3 PUFA and CVD risk and, more importantly, by several large and lengthy dietary intervention trials showing favorable effects of VLC n-3 PUFA on the development of CVD. The effects of VLC n-3 PUFA on sudden death and on survival from a heart attack demonstrated in these trials could be explained if they have anti-arrhythmic effects. Recent meta-analyses of the available dietary intervention trials suggest that neither ventricular nor atrial arrhythmias are influenced by VLC n-3 PUFA intakes. Hence a convincing mechanism of action of VLC n-3 PUFA on CVD has yet to emerge. ■

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Patents

Published Patents

Natural marine source phospholipids comprising polyunsaturated fatty acids and their applications

Sampalis, F., Neptune Technologies & Bioresources, Inc., US8030348, October 4, 2011

A phospholipid extract from a marine or aquatic biomass possesses therapeutic properties. The phospholipid extract comprises a variety of phospholipids, fatty acid, metals, and a novel flavonoid.

Nitrilases and methods for making and using them

Madden, M., *et al.*, Verenum Corp., US8034595, October 11, 2011

The invention provides nitrilases and methods for making and using them, and in one aspect, provides methods for producing enantiomerically pure α -substituted carboxylic acids, such as α -amino acids and α -hydroxy acids. In one aspect, methods of the invention combine an aldehyde or ketone with a cyanide and ammonia or an ammonium salt or an amine, in the presence of a nitrilase or a polypeptide having nitrilase activity, to stereoselectively hydrolyze the amino nitrile or cyanohydrin intermediate under conditions sufficient to produce the carboxylic acid.

Glyceride oil composition from fish oil and preparation method thereof

Yoon, D.-H., *et al.*, Ilshin Wells Co., Ltd., US8048468, November 1, 2011

A glyceride oil from a fish oil and a preparation method thereof are provided. The composition includes 45 to 95% by weight of docosahexaenoic acid (DHA) plus docosapentaenoic acid (DPA), 0.001 to 13% eicosapentaenoic acid (EPA), and 0.001 to 5% by weight of palmitic and/or stearic acid bonded at the 1- and 3-positions. The DHA/DPA weight ratio is 0.5 to 8 and the DHA/EPA weight ratio is 3.5 to 15. The oil is excellent in digestion and absorption of polyunsaturated fatty acids into a human body by containing a low amount of saturated fatty acids at the 1- and 3-positions and process characteristics such as an oxidation stability and water dispersibility.

Biomass hydrolysate and uses and production thereof

Fichtali, J., *et al.*, Martek Biosciences Corp., US8048652, November 1, 2011

The present invention includes a palatable, stable composition comprising a biomass hydrolysate emulsion for incorporation, into, or used as, nutritional products, cosmetic products, or pharmaceutical products. Preferred sources for biomass are microbial, plant, and animal sources. The present invention also provides methods for making such compositions, specifically, a method for producing product comprising a nutrient, particularly a long-chain polyunsaturated fatty acid,

comprising hydrolyzing a biomass comprising the nutrient and emulsifying the hydrolyzed biomass. Such compositions and methods are useful, for example, for increasing intake of nutrients such as omega-3 long-chain polyunsaturated fatty acids having 18 or more carbons.

Cocoa beans with reduced polyphenol oxidase activity and high polyphenol content

Bradbury, A.G.W., and E.-M. Berndt, Kraft Foods R&D, Inc., US8048469, November 1, 2011

The present invention relates to a process for reducing the polyphenol oxidase activity in cocoa beans comprising the step of steaming non-fermented, non-roasted raw cocoa beans with water vapor.

Microbial oils produced in transformed host cells comprising $\Delta 9$ elongases

Damude, H.G., *et al.*, E.I. Du Pont de Nemours and Co., US8048653, November 1, 2011

The present invention relates to $\Delta 9$ elongases, which have the ability to convert linoleic acid (18:2, LA) to eicosadienoic acid (20:2, EDA). 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.

Method for producing polyunsaturated C_{20} - and C_{22} -fatty acids with at least four double bonds in transgenic plants

Cirpus, P., and J. Bauer, BASF Plant Science GmbH, US8049064, November 1, 2011

The present invention relates to a process for the production of polyunsaturated fatty acids in transgenic plants, by introducing, into the plant, the nucleic acids which code for polypeptides with $\Delta 6$ -desaturase, $\Delta 6$ -elongase, $\Delta 5$ -desaturase, $\Delta 5$ -elongase, $\Delta 4$ -desaturase, $\Delta 12$ -desaturase, and/or ω -3-desaturase activity. These desaturases and elongases are advantageously derived from *Phytophthora sojae*. The invention furthermore relates to the nucleic acid sequence, nucleic acid constructs, vectors and organisms comprising the nucleic acid sequences according to the invention, vectors comprising the nucleic acid sequence and/or the nucleic acid constructs and to transgenic plants comprising the abovementioned nucleic acid sequence, nucleic acid constructs and/or vectors. A further part of the invention relates to fatty acid compositions produced by the process according to the invention and to their use.

Lysosomal phospholipase A2 (LPLA2) activity as a diagnostic and therapeutic target for identifying and treating systemic lupus erythematosus

Shayman, J.A., *et al.*, The Regents of the University of Michigan, US8052970, November 8, 2011

The present invention is directed to methods for diagnosis and treatment of systemic lupus erythematosus and drug-induced systemic

lupus erythematosus using a lysosomal phospholipase A2 in methods for the diagnosis and treatment of autoimmune disorders such as systemic lupus erythematosus and drug-induced systemic lupus erythematosus.

Interactive chocolate board game

Sweeting, J., Madelaine Chocolate Novelties, Inc., US8052149, November 8, 2011

The present invention relates to an interactive board game comprising a playing surface having a series of tabs, wherein each opened tab reveals clues or directions to the next tab to be opened. In one embodiment, the board game comprises individual cells containing a prize, such as a chocolate, located under each tab, which are accessible upon opening the tabs.

Mono- and disaccharide derivatives

Hilgers, L.A.T., and A.G. Blom, Protherics Medicines Development Ltd., US8052981, November 8, 2011

The present invention includes a formulation comprising a physiological salt solution, or an oil-in-water emulsion, or a water-immiscible solid phase, and an adjuvant comprising one or more disaccharide derivatives derived from cellobiose, gentiobiose, lactose, lactulose, maltose, melibiose, sucrose, or turanose, wherein at least four of the free hydroxyl groups of the disaccharide molecule have been modified such that the disaccharide derivative has: (i) at least 3 but not more than $n-1$, fatty acid ester groups, and (ii) at least one, but no more than $n-1$ anionic groups, wherein n is the number of hydroxyl groups of the disaccharide from which the derivative is derived and wherein the combined number of fatty acid esters and anionic groups does not exceed n .

Hard fat

Andou, M., *et al.*, Nisshin OilliO Group, Ltd., US8053015, November 8, 2011

A hard fat which can be a basic ingredient for obtaining a margarine or shortening having favorable meltability in the mouth of a lauric fat, and also having favorable plasticity, as well as a margarine or shortening in which the hard fat is used, and confectioneries and breads using the same are provided. A hard fat containing 25 to 45% by mass of a lauric acid, having an iodine value of 0 to 25, and having the following triglyceride (TG) composition: triglycerides [carbon number (CN) 32 to 54 TG] of 85 to 100% by mass; triglycerides (CN 32 to 38 TG) of 30 to 50% by mass; triglycerides (CN 40 to 46 TG) of 25 to 55% by mass; triglycerides (CN 48 to 54 TG) of 10 to 30% by mass, and further having the following constituent triglyceride ratio: (CN 32 to 38 TG)/(CN 40 to 46 TG) of 0.5 to 1.5; (CN 32 to 38 TG)/(CN 48 to 54 TG) of no less than 1.0; and (CN 40 to 46 TG)/(CN 48 to 54 TG) of no less than 1.0.

Solid oral dosage form containing an enhancer

Ramtoola, Z., and K. Cumming, Merrion Research III Ltd., US8053429, November 8, 2011

The invention relates to a solid oral dosage form comprising a pharmaceutically active ingredient in combination with an enhancer which enhances the bioavailability and/or the absorption of the active ingredient. Accordingly, a solid oral dosage form comprises a drug and

an enhancer wherein the enhancer is a medium-chain fatty acid ester, ether or salt or a derivative of a medium-chain fatty acid, which is, preferably, solid at room temperature and which has a carbon chain length of from 6 to 20 carbon atoms. Preferably, the solid oral dosage form is controlled release dosage form such as a delayed release dosage form.

Glycerophospholipids containing omega-3 and omega-6 fatty acids and their use in the treatment and improvement of cognitive functions

Ben Dror, G., *et al.*, Enzymotec Ltd., US8052992, November 8, 2011

Disclosed herein is a phosphatidylserine moiety and polyunsaturated fatty acid (PUFA) acyl groups (particularly long-chain polyunsaturated fatty acid [PUFA] acyl groups such as omega-3 and/or omega-6 acyl groups) wherein said PUFA is covalently bound to said glycerophospholipid. Said lipid preparations are particularly useful in the treatment of mental and cognitive disorders, e.g., ADHD (attention deficit hyperactivity disorder) and Alzheimer's disease. The disclosed preparations present improved bioactivity and are useful in the treatment of various cognitive and mental conditions and disorders, as well as for maintenance of normal functions of brain-related systems and processes.

Nutrition containing fat blend

Stahl, B., *et al.*, N.V. Nutricia, US8053471, November 8, 2011

The invention relates to the use of long-chain polyunsaturated fatty acids for the manufacture of a nutritional composition for feeding infants of a mother who suffered from a metabolic disorder during pregnancy and to a corresponding composition. Said composition comprises an n-3 polyunsaturated fatty acid fraction containing at least 0.1 wt% docosahexaenoic acid (DHA) based on total weight of the lipid, at least 0.01 wt% n-3 docosapentaenoic acid (DPA-n-3) based on total weight of the lipid, and at least 0.01 wt% eicosapentaenoic acid (EPA) based on total weight of the lipid, wherein the sum of DHA, DPA-n-3, and EPA is below 1 wt% of total lipid.

Catalyst and process for preparing carboxylic acid esters

Liu, K.H., *et al.*, US8053593, November 8, 2011

A catalyst and a process for preparing carboxylic acid esters from an aldehyde and an alcohol in the presence of molecular oxygen are disclosed. The catalyst comprises metals supported on a silica-containing support, wherein the metals consist essentially of palladium, lead, an alkali or alkaline earth metal, and at least one of niobium and zirconium. The process for preparing a carboxylic acid ester comprises reacting an aldehyde with an alcohol in the presence of molecular oxygen and the aforementioned catalyst.

Patent information is compiled by Scott Bloomer, a registered US patent agent with Archer Daniels Midland Co., Decatur, Illinois, USA. Contact him at scott.bloomer@adm.com.



Replacing animal fats with vegetable oils in meat products

Gerard G. Dumancas

Meat consists of muscle tissues that are very high in protein and contain all of the essential amino acids. It is also a source of essential micronutrients such as iron, selenium, and vitamins A, B12, and folic acid, thus meat consumption is important to human health and development.

Both meat and its associated products can be modified by adding ingredients that are considered beneficial to health or by eliminating or reducing components that are considered harmful. Generally, these represent a new category of foods having functional properties such as lowering cholesterol or providing antioxidant, anti-aging, or anti-cancer components.

Along these lines, several studies have investigated improving the fatty acid profiles in processed meat products by replacing the animal fat with vegetable oil. Doing so usually involves mixing the vegetable oil into the meat content in varied formulations.

The most-studied meat products are dry-fermented sausages, cooked meat products, and fresh meat products. During formulation, water, sodium chloride, sodium caseinate, diphosphate, and sodium nitrite are added in small amounts. The resulting processed meat products are then evaluated via sensory characterization for firmness, color, flavor, juiciness, and overall acceptability. Such properties are usually characterized on a numerical scale of 1.0 to 6.0 or 1.0 to 9.0, with 6.0 or 9.0 as the extremely liked or the most favorable. Fat content, protein content, rancidity, and pH, among other properties, are determined by chemical analysis. Common vegetable oils used for replacement are olive, corn, sunflower, and soybean oil.

Studies with olive oil

Olive oil is among the most highly monounsaturated vegetable oils. Its consumption is associated with a decreased risk of heart disease and breast cancer. As such, there is keen interest in developing olive oil as an animal fat replacer in meat products to enhance their nutritional value, oxidative stability, and protective properties against several cancer types [1, 2].

Studies have shown that partially replacing animal fat with olive oil improves processing and quality characteristics of dry-cured sausages [3] and frankfurters [4,5]. In one study, replacing 20% to 60% of the beef fat in Turkish *soudjouk* (sausage) with virgin olive oil led to positive effects on the sensory quality (appearance and texture) of the sausages [6].

In a study involving varied formulations of dry fermented sausages with fat levels of 10% to 30% and two levels (0% and 20%) of pork back fat replaced by olive oil, the appearance of the sausages was affected by substituting olive oil for 20% of pork back fat. Fat-reduced sausages without olive oil and low-fat sausages with olive oil had the highest score for odor and taste. However, the visual appearance of fat-reduced sausages was just acceptable while that of low-fat sausages



was unacceptable because the surface was intensely wrinkled and case hardening had developed [3]. The same authors also found that replacing 20% of the pork back fat with olive oil in high- and reduced-fat Greek sausages significantly decreased the oxidation process.

Extra virgin olive oil has also been used as an ingredient in salami products made from pork back fat. In a study involving varied salami formulations with 15% total fat, substituting 0% to 66.5% of the pork back fat with extra virgin olive oil did not substantially affect the chemical, physical, and sensorial characteristics of the products. It also did not reduce lipid oxidation [7].

In Pamplona-style chorizo, four different sausage formulations were prepared in which 50% of the pork back fat was replaced with olive oil emulsified with alginate and mixed with 0% to 10% inulin. The formulation with 6% inulin not only had 20% less fat than traditional sausage and was richer in monounsaturated fatty acids but also retained sensory notes similar to those of traditional chorizo and achieved a good acceptability rating [8].

Other studies with vegetable oils

Olive, corn, sunflower, and soybean oils have also been used as ingredients in low-fat frankfurters with 10% fat and 12% protein as compared to control franks consisting of 29.1% animal fat and 10.4% protein. Such products presumably would be more healthful since they are higher in protein and lower in total fat, calories, saturated fatty acids (SFA), and cholesterol [9]. Low-fat frankfurters with vegetable oils had a darker external and internal color than conventional frankfurters and were firmer and less juicy. Frankfurters made with olive, corn, and sunflower oil had the same flavor intensity as controls and received higher scores for overall acceptability. Frankfurters with soybean oil had the lowest scores for flavor, overall acceptability, and storage stability.

Rodriguez-Carpena and colleagues incorporated avocado, sunflower, and olive oils into ground pork patties [10]. Replacing 50% of the back fat with each of the vegetable oils (50 g oil per kg of burger patty) enhanced the oxidative stability of the patties when they were cooked with avocado and olive oils and subsequently placed in chilled storage. The study also revealed that the vegetable oils had a positive influence on the nutritional profile and oxidative stability of the patties without causing major color and texture modifications [10].

Chorizo de Pamplona formulated with a partial substitution of 15% to 25% of pork back fat by pre-emulsified soybean oil exhibited no differences in water, protein, and fat content between control and modified sausages. Moreover, the cholesterol content scarcely decreased [11], and no increase in oxidation in the modified sausages was observed. SFA and monounsaturated fatty acids (MUFA) were lower in the modified products. Polyunsaturated fatty acids (PUFA), on the other hand, rose owing to the significant increase in linoleic and α -linolenic acids that occurred when soy oil was added. No significant differences among products were observed in relation to texture profile analysis, hardness, or springiness. The instrumentally measured colors were also comparable with those of commercial products. Sensory evaluation of most of the modified sausages did not show significant differences with regard to the control [11].

In another study, the nutritional quality of the lipid fraction was improved by substituting one-quarter of the amount of pork back fat present in traditional formulations of chorizo de Pamplona with a linseed oil emulsion. The PUFA/MUFA ratio increased and the

n-6/n-3 ratio decreased in sausages with linseed oil as a consequence of α -linolenic acid contribution [12].

Youssef and colleagues determined that substituting beef fat with canola oil or pre-emulsified canola oil (using soy protein isolate, sodium caseinate, or whey protein isolate) improved yield and restored textural parameters in comminuted meat products. It also significantly reduced the redness of the final products. Highest hardness value was obtained using sodium caseinate to pre-emulsify the oil [13].

In general, meat products with some animal fat replaced by vegetable oils are evaluated on several sensory characteristics such as color, texture, taste, juiciness, and overall acceptability. High scale values are obtained by meat products replaced by vegetable oils having bright and characteristic red or pink color, smooth surface with fewer wrinkles, typical flavor, juiciness, and overall acceptable meat-like flavor.

Studies with interesterified vegetable oils

An alternative to using vegetable oils, which have high unsaturated fatty acid contents and are liquid at room temperature, is to use interesterified vegetable oils. Replacing meat fat with interesterified vegetable oils can modify the fatty acid composition of frankfurters and Turkish-type salami without any detrimental changes in sensory characteristics [14]. Vural and colleagues discovered that the oleic and linoleic acid contents and PUFA/SFA ratios significantly increased in frankfurters produced with IVO without any changes in appearance, color, texture,

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flavor, or other sensory characteristics [15]. In another study that used IVO, Fernandez-Lopez and colleagues prepared chemically modified vegetable oils using an interesterification reaction that involved sunflower, soybean, palm, canola, cotton, safflower, olive, and maize oils. Results led to a 10–20% reduction in SFA, a melting point similar to that obtained in the back fat, a PUFA/SFA ratio higher than 0.4, and an n-6/n-3 ratio of less than 4 [16].

Meats as functional foods

In some German products, animal fat is partially or totally replaced by polyunsaturated vegetable oil. In these instances, insoluble fibers may help stabilize the product batter and avoid “fattening out.” Best fat binding is achieved when the fibers are premixed with the oil. An example is a German “healthful” cooked poultry sausage concept developed by the company J. Rettenmaier und Söhne consisting of soluble and insoluble fibers, poultry white meat, carbonate as a cutter process aid, and rapeseed oil [17].

There has been increasing pressure on the food industry to reformulate food products to reduce SFA content. The UK's Food Standards Agency, for example, launched its Saturated Fat and Energy Intake (SFEI) program in February 2008 as part of a bid to tackle cardiovascular disease and obesity. The draft included recommendations for the SFA levels in certain biscuits and cakes to be reduced by 10% levels by 2010 [18].

Until recently, there has been limited research into functional foods in the meat category, while functional foods in the dairy sector have been developed to a high degree. During the 2006 International Congress on Meat Science and Technology in Dublin, Ireland, Keizo Arihara, a professor in the department of animal science at Kitasato University in Japan, observed that meat is less allergenic than many other foods and that much more research into the development and marketing of novel functional meat products is required. Arihara further noted that regulations for functional foods are not yet well established in many countries, which could be a significant barrier to the development of novel functional products.

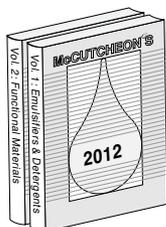
In the United States and European countries, markets for functional foods have been expanding rapidly. However, the meat industry in most countries has been hesitant to adopt the functional trend and to introduce physiologically functional properties into meat products. Arihara concluded that since food safety is another critical aspect of food quality, efforts should also be directed to ensure that new functional meat products are safe. Without proof of product safety, most consumers would hesitate to adopt new foods into their diet [19]. Moreover, food manufacturers face the challenge of providing nutritious food while, at the same time, ensuring that the product has an appealing taste, texture, and appearance.

Further research is needed to completely understand the interactions of vegetable oils and other food components that add functional properties to meat products before their safety can be guaranteed in potential industry applications [20].

Gerard G. Dumanças is a doctoral candidate in analytical chemistry at Oklahoma State University (Stillwater, USA), where he conducts research in chemometrics and fatty acids. He has received several AOCS student awards, including the 2010 AOCS Honored Student Award and the 2010 AOCS Hans Kaunitz Award for outstanding research. He is an editor of the upcoming Nova Science Publishers book Arachidonic Acid: Dietary Sources and General Functions and is an editorial advisory board member for inform. He can be contacted at gerard.dumanças@okstate.edu.

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OMEGA-3 BIOAVAILABILITY (CONTINUED FROM PAGE 144)

blood levels when identical amounts were consumed daily in triglyceride rather than phospholipid form (10). By contrast, Carnielli *et al.* (11) reported that DHA from a phospholipid form in formula was somewhat better absorbed than that from preterm breast milk (mainly in natural triglyceride form) at 88% and 78% efficiency, respectively, while no difference between the breast milk and a triglyceride form of DHA was found with respect to absorption.

Direct comparison of similar intakes of DHA/EPA (as ethyl ester) over three weeks in a capsule or as a specific type of microencapsulated preparation for food applications indicated no significant difference in human volunteers based on blood measures of serum phospholipids of DHA/EPA from our laboratory (12).

Large studies

Two major long-term, well-designed omega-3 bioavailability clinical trials (large numbers of subjects and lengthy durations) have been published.

The study by Dyerberg *et al.* (13) attempted to compare the bioavailability of the different forms of DHA/EPA. A similar dose (3.1 to 3.6 g/daily) of ingested DHA plus EPA across the different preparations was compared—namely, re-esterified triglyceride, ethyl ester, free fatty acid, fish body oil (natural triglyceride form), and cod liver oil (natural triglyceride form). The omega-3 supplements were each given twice daily at mealtimes for two weeks, and the net rise of the

DHA plus EPA, as differences between serum lipid concentrations at the end of the study relative to baseline, was used to compare and assess relative bioavailability.

The bioavailability of DHA/EPA from the re-esterified triglyceride form was found to be significantly better than for the ethyl ester form. By assigning an apparent “bioavailability index” of 100% for the rise in circulating DHA plus EPA found with natural fish oil, the re-esterified triglyceride form was determined to have an index of 124%, as compared to only 73% for the ethyl ester form. An intermediary index of 91% was found for the free fatty acid form.

Interestingly, even though essentially identical intakes of the triglyceride and ethyl ester forms were ingested daily (1.85 and 1.87 g, respectively), the net rise of EPA in the circulating blood serum phospholipid was found to be markedly greater, by 62%, for the re-esterified triglyceride form as compared to the ethyl ester form.

Very recently, Neubronner and colleagues from Germany reported (14) on the largest (150 volunteers) and longest (over a period of six months) study on the comparative bioavailability when supplementing with the triglyceride vs. the ethyl ester forms. (Daily dose of EPA and DHA was 1.00 g and 0.67 g, respectively.) The increased levels of EPA and DHA in the red blood cells in the triglyceride group were significantly greater than for the ethyl ester group (197% vs. 171% at six months). This latter study indicated a moderately better bioavailability (by approximately 15% overall in relative terms) with long-term intakes of EPA and DHA as the triglyceride form.

Conclusions

In general, it would appear advantageous to bioavailability if consumers ingested their DHA/EPA supplements at or around mealtime rather than on an empty stomach. Our studies have indicated little difference in bioavailability if such supplements are consumed at one mealtime or spread out over all meals. Also, there is no convincing data in the evidence-based literature to date to suggest that the gastric acid-resistant coating of omega-3 capsules can enhance DHA/EPA bioavailability.

The triglyceride forms of DHA/EPA can be expected to give similar bioavailability (if taken with meals) to that of fish sources of DHA/EPA, which are mostly in the natural triglyceride form. However, while recent long-term studies indicate a somewhat better bioavailability for DHA/EPA in triglyceride vs. ethyl ester form, the cost of high-omega-3 concentrates is generally much greater for the triglyceride forms vs. equal amounts of omega-3 in the concentrated ethyl ester form. Future trials comparing the bioavailability of DHA/EPA from phospholipid and free fatty acid vs. other forms in humans would be of interest. Also, the various microencapsulated forms of DHA/EPA now available for food/beverage applications should be clinically tested for bioavailability.

This article was originally published on November 11, 2011, by Nutritional Outlook magazine (NutritionalOutlook.com), a leading U.S. dietary supplement and healthy food/beverages magazine based in the United States. Bruce Holub is professor emeritus in the Department of Health and Nutritional Sciences at the University of Guelph in Canada. He is also scientific director of the DHA/EPA Omega-3 Institute and can be reached at bholub@uoguelph.ca. Jennifer Kwok Grebow is editor-in-chief of Nutritional Outlook magazine. She can be reached at jennifer.kwok@cancom.com.





OMeGA-3 In Du St Ry vlew POInt

Jennifer Kwok Grebow

As Dr. Holub's article emphasizes, research is still progressing—and results are still mixed—on which omega-3 forms may be best absorbed or bioavailable. At the recent Supply-Side West trade show, I spoke to several omega-3 industry members about the topic.

While triglyceride-form omega-3 fatty acids may be more expensive (it's costlier to add the extra processing step of taking an ethyl ester product back to its triglyceride state), ingredient suppliers say that some customers have been increasingly asking for the triglyceride form. "We're seeing increased demand for the triglyceride form because it's considered more natural," says Gunilla Trajberg, marketing manager for EPAX Norway AS (Oslo, Norway). "The science is divisive—some claim that the triglyceride form is better absorbed in the body, and some studies show that there is no difference really. We offer both forms, and it's up to our customers to choose which."

"It is more expensive to buy a triglyceride product/concentrate than an ethyl ester, so you want to be able to justify the cost and whether there is an added benefit. But I think it's still up for debate. I don't know if anyone has really conclusive science on that yet," adds Katherine Bond, director of business development for Cyvex Nutrition (Irvine, California, USA), whose parent company is fish oil omega-3 supplier Omega Protein.

"Animal studies have demonstrated a better uptake of EPA and DHA by giving a phospholipid compared to a triglyceride formulation. Increased uptake may translate into higher tissue concentrations of these fatty acids. However, omega-3 supplements are not a pain-killer type of product, which has to help and give an effect as soon as possible. Rather, a food supplement should be taken over months and years, and so a small difference in uptake is not very essential," contends Morten Bryhn, MD, PhD, scientific adviser for EPAX Norway AS.

Eric Anderson, vice president of sales and marketing, Aker BioMarine (Oslo, Norway), supplier of the trademarked Superba krill oil, says that as opposed to the bioavailability of omega-3

sources, it's bioefficiency that matters. "The bioavailability definition is whether they achieve uptake and absorption by the body. The difference is in bioefficiency. How much of the omega-3 fatty acids make it to the cells and tissues?"

According to Anderson, his company has conducted a single-center, open-label, randomized crossover study, with data to be published, showing that the DHA and EPA from phospholipid-bound krill oil is about 60% better compared to triglyceride sources in reaching human tissue. "Whether that's because the body is burning the triglycerides as energy or if there's some other mechanism that's not fully elucidated, we're not perfectly sure," he says. The study looked at equal doses (8 g) of Superba krill oil, Superba krill powder, and fish oil (and interestingly found the krill powder to be even more bioavailable than the krill oil, the company says).

Adam Ismail, executive director of the Global Organization for EPA and DHA Omega-3s (GOED), says that we're still in the early stages in terms of scientific investigation. "Omega-3s aren't really a commodity ingredient yet. They have a tendency to be looked at as a commodity ingredient, but just between the ratios of EPA and DHA alone, we know that the different fatty acids have different functions but we don't fully know what they are yet in every case. And the same applies to their forms. If you look at it in terms of life stages of research, we're still at an early stage just trying to figure out what EPA and DHA do differently, and then from a product-form point of view, we're at an even earlier stage."

Still, he says, expect more research to come. "There's not a ton of research differentiating between these different product forms, but it's coming. People are working on it and trying to answer these questions. I think we're going to know a lot more in the next couple of years. One of the issues is that there needs to be more university-led research in this area. Right now, a lot of the companies are investing in it, and I think universities are starting to get excited enough to look at these areas. If we can get universities to really do independent research in these areas, I think we'll know a lot more."

Jennifer Kwok Grebow is editor-in-chief of Nutritional Outlook magazine. She can be reached at jennifer.kwok@cancom.com.

How AOCS inspired one student toward research and academic excellence

Kathy Heine

When Gerard Dumancas was an undergraduate at the University of the Philippines, he had never even heard of AOCS. Yet, the analytical chemistry student was consistently drawn to fats and oils-related projects.

One project in which he studied *n*-hexane-extractable materials in Iloilo River (Philippines) sediments was particularly engaging.

"I spent countless nights in the laboratory alone doing *n*-hexane extraction of the river sediments, but I didn't even miss going out with my friends, because I had discovered this intense desire to contribute more for the betterment of society," he says. His efforts were a primary step in developing a strategy for identifying all anthropogenic sources of oil and grease and developing measures to reduce oil and grease inputs to river sediments.

In April 2005, when Dumancas graduated *cum laude* with a B.S. in chemistry, he realized that his passion for learning was related to fats and oils chemistry. He needed a new outlet to explore this area of interest, and within a month he had found one.

In May 2005, he was one of 18 Bayer Young Environmental Envoys of the Philippines to attend a five-day residential eco-camp at Lagos del Sol Resort in Cavinti, Laguna, Philippines. These young people were chosen from a nationwide search of applicants based on their academic, research, and sustainable development experience. Not only did Dumancas get to hear speakers from government, academia, industry, media, and civil society talk about their experiences and contributions to environmental preservation, but he was also one of only three finalists from the Philippines chosen to attend the International Eco-minds Youth Forum in Manila.

At this Youth Forum, Dumancas and other young delegates from eight Asia-Pacific countries had a rare opportunity to develop scientific solutions to sustainable development problems under the guidance of international experts such as Roy Jackson (Sir John Monash distinguished professor and founding director of the Centre for Green Chemistry at Monash University in Australia), Michael Schneider from Bayer CropScience in Germany, and Jeffrey Sachs, director of the Center for International Development at Harvard University and the United Nations secretary general advisor on the millennium development goals. Once again, Dumancas' efforts were galvanized by oil chemistry. His workable solution, which involved the use of cottonseed oil wastes as diesel replacement fuel, won first place in the international Eco-Minds competition and earned him his first international award: the 2005 Eco-Minds Pathfinder Award representing eight countries in Asia-Pacific.

Two years later, when Dumancas entered the doctoral program at Oklahoma State University (Stillwater, USA) as an Arts & Science Student Excellence Awardee, he chose to apply chemometrics to polyunsaturated fats. He wanted to expand his network by seeking a group of like-minded professionals who were similarly interested in fats and



oils chemistry, but he had never heard about such a group and had no idea that one even existed. After doing an online search, Dumancas realized that AOCS could possibly be an organization that could advance his career.

Dumancas joined the AOCS Analytical Division in 2007, then won the 2009 AOCS Analytical Division Student Award for Excellence in Analytical Chemistry Research for his project entitled "Direct calibration for the direct determination of lipids." To date, Dumancas has published eight papers in international scientific journals (including *Trends in Analytical Chemistry*), co-authored one book chapter, and made about 20 oral and poster presentations at international and local scientific conferences.

During the 101st AOCS Annual Meeting & Expo in Phoenix, Arizona, USA, in 2010, Dumancas won not only an AOCS Honored Student Award for outstanding research, academics, and leadership involvement but also the AOCS Analytical Division Student Award for Excellence in Analytical Chemistry Research for the second year in a row, as well as the AOCS Hans Kaunitz Award for his research entitled "Chemometric algorithms for the direct determination of lipids."

In the process, he developed a simple, rapid, rugged, and inexpensive colorimetric assay that is specific to the $-\text{CH}=\text{CH}-\text{CH}_2-$ group.

CONTINUED ON PAGE 192

Leadership expert/ best-selling author to deliver Annual Business Meeting keynote address

emily wickstrom

Jackie Freiberg, bestselling author and leadership expert, will deliver the keynote address at the AOCs Annual Business Meeting on Monday, April 30, as part of the 103rd AOCs Annual Meeting & Expo in Long Beach, California, USA.

Freiberg has dedicated her career to helping individuals practice the art of leadership. Her mission is to help leaders create the best work places, where the best people can do their best work to make the world better. "For over 25 years, I've been sharing leadership, culture, and innovation practices with people who want to learn, grow, and borrow from the best," she stated. "My goal is to create a movement of leaders who choose to defy mediocrity, take charge of their success at work, and make a difference in their own little corner of the world."

Freiberg is the co-author of four books with her husband Kevin, including *NUTS! Southwest Airlines' Crazy Recipe for Business and Personal Success*; *GUTS! Companies That Blow the Doors Off Business as Usual*; *BOOM! 7 Choices for Blowing the Doors Off Business-As-Usual*; and their latest title, *NANOVATION: How a Little Car Can Teach the World to Think Big and Act Bold*, highlighting the Tata Motor's Nano as a modern example of innovation and creative business thinking.

Freiberg is one of the most sought-after business speakers in the United States. She is an adjunct professor at the University of San Diego (USD; California, USA), where she teaches master's- and doctoral-level classes in leadership and public speaking. For over 20 years

she taught presentation skills to the United States Marine Corps Recruiter School, training more than 1,500 Marine recruiters per year on the fundamentals of building and delivering winning presentations.

Her articles and interviews have been published in the *Wall Street Journal*, *Business Week*, *Investor's Business Daily*, Dubai's *Capital-ME*, as well as India's *Management Next*, *Business Standard*, *Economic Times*, and *Financial Times*.

Before co-founding Freibergs.com in 1993, Jackie Freiberg was the manager of corporate and professional programs at USD's Executive Conference Center. During her tenure at USD, she co-founded the Family Business Institute, founded the Certificate in International Business Program, and was the director of the Institute for Quality & Productivity.

Freiberg earned a doctorate in leadership from USD, a master's degree in communication from San Diego State University, and a bachelor's degree in communication from the University of New Hampshire. For more information, visit her website at www.freibergs.com.

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



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twitter, not just for kids

You don't have to tweet to benefit from opening a Twitter account. This how-to will get you started in no time at all.

Catherine watkins

Twitter.com describes itself as a “real-time information network that connects you to the latest information about what you find interesting.”

This popular social networking site presents short bursts of 140-character-or-fewer microblog entries known as “tweets.” Don't be fooled by the length; a great deal of detail can be packed into each tweet, including links and embedded media. The brevity is precisely why Twitter is such a useful tool for keeping up with news: It is singularly easy to scan a day's tweets by the companies, publications, and scientists you follow for nuggets of news that are important to you and your work.

For example, the *inform* news staff regularly follow a wide range of accounts, including @JohnNCoupland (recipient of the 2004 AOCs Young Scientist Research Award and a professor at Penn State University); @CandTEditor (news from *Cosmetics & Toiletries* magazine); and @EurekAlertAAAS, the online, global news service operated by AAAS, the science society.

Why use Twitter? In brief, it can save you time. Searching by topic or reading through the real-time stream of tweets posted by the accounts you follow is simple. And it is much faster, in fact, than reading RSS (Really Simple Syndication) feeds. Then again, using Twitter can further your reputation as an expert. Cogent observations on trends or technology, or judicious sharing of interesting material, will build your base of followers. (That is, assuming you decide to tweet yourself and not just use Twitter as a source of news.)

twitter primer

Here's how to get started.

- Sign up at twitter.com.
- Twitter will suggest a username, based on your actual name and email address. You can also use a descriptive handle such as oilchemist or docbiodiesel. Keep it short; JDoe is better than JaneDoe because it uses fewer characters. When/if your followers retweet your musings, the fewer letters used by your handle, the better.
- Write a brief (up to 160 characters) profile, which is what others will see if they want to learn more about you.
- Configure your account under the “settings” tab. Under the “Account” tab, do not put a check in the Protect My Tweets box under Tweet Privacy. If you do, only those who follow you can see your tweets. Under the “Notifications” tab, check all the boxes under “Messages” and “Activity” to receive notifications. You will want to veto any followers that clearly are not connected to your line of business or are questionable and so will want to receive notification of any new followers of your account.

What's up With the @s and #s?

Once you start using Twitter, you will see any number of symbols and abbreviations. (Decode 130 Twitter-related terms and symbols at tinyurl.com/TwitterSlang.) Primary among them are the at symbol (@) and hashtag (#).

Using the @ symbol before a username in your tweets will ensure that that person or entity will be notified about your comment. Which raises another issue. Never forget that Twitter is public; never say anything that you will regret having made public. Read more about using the @ symbol in the Twitter help center (<https://support.twitter.com>).

As for the hashtag (#), it is used to flag keywords or topics. For example, an AOCs news tweet might read “#Olive oil production rises in Spain,” with a link to a news article with more details. Anyone searching on #olive oil will see this tweet and any others with those keywords marked. Users can also click on a hashtagged word in a message to see all other tweets in that category. Again, for more about hashtags, see the Twitter help center.

- Register your cell phone under the “mobile” tab in order to tweet via text message (if you want to do so).
- Connect an avatar, or image, to your account. This will appear with your tweets and with your profile.
- Search for companies, publications, and scientists to follow. Be selective and follow only a few at first until you learn the ropes.
- Learn more about the basics at tinyurl.com/TwBasics.

We don't want to overload you with information; this is more than enough to get started. There are other tools we have not covered, such as lists, that can help you organize the wealth of information that is available. Look into them when you are ready.

And don't forget: AOCs staff can help you enter this brave new world. If you attend the 2012 AOCs Annual Meeting & Expo (AM&E), visit The Lab on the Expo floor. There, AOCs' resident social networking expert, Web Strategy Manager Amy Lopez, will personally answer your questions. If you will not be attending the AM&E or need immediate help, then email or call her at amylo@aocs.org or +1 217-693-4836.

We cannot stress this enough: Using Twitter well and wisely can actually save you time. To repeat ourselves from articles past: Just do it!

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

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"The value of AOCS is a pretty simple equation for me: AOCS has given me an excellent conduit for keeping up with technologies and people throughout my career, and involvement in AOCS committees and activities has allowed me to grow as an individual, and to have a lot of fun in working with a lot of interesting and talented folks."

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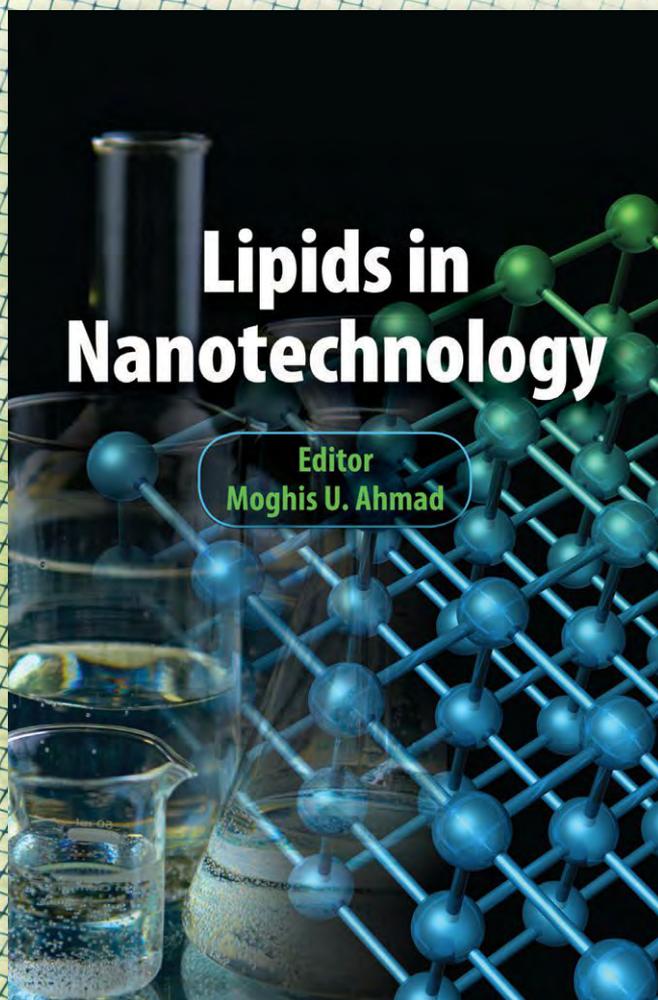
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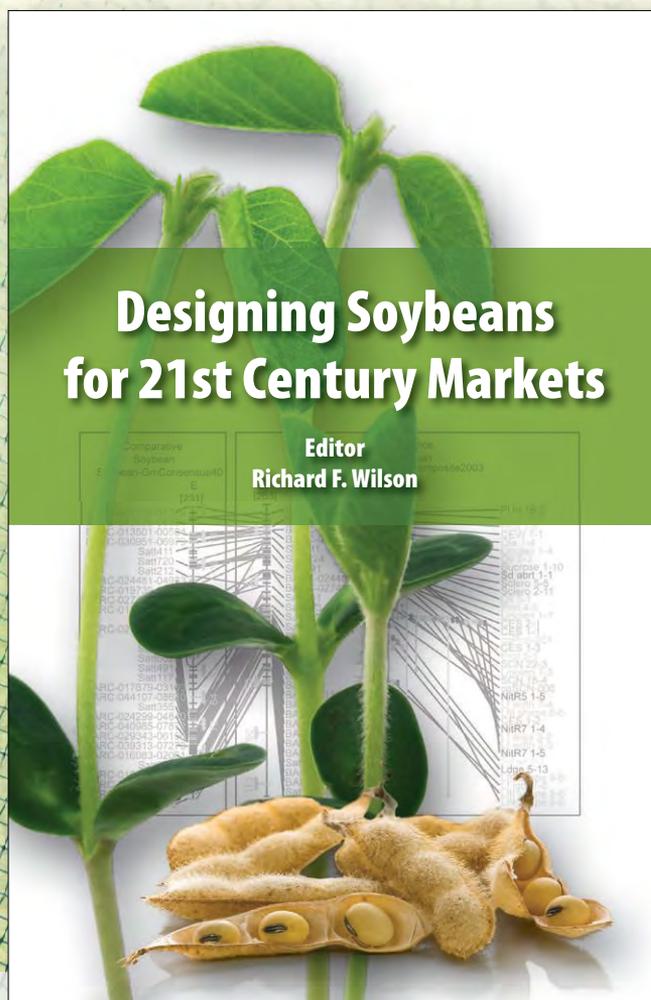
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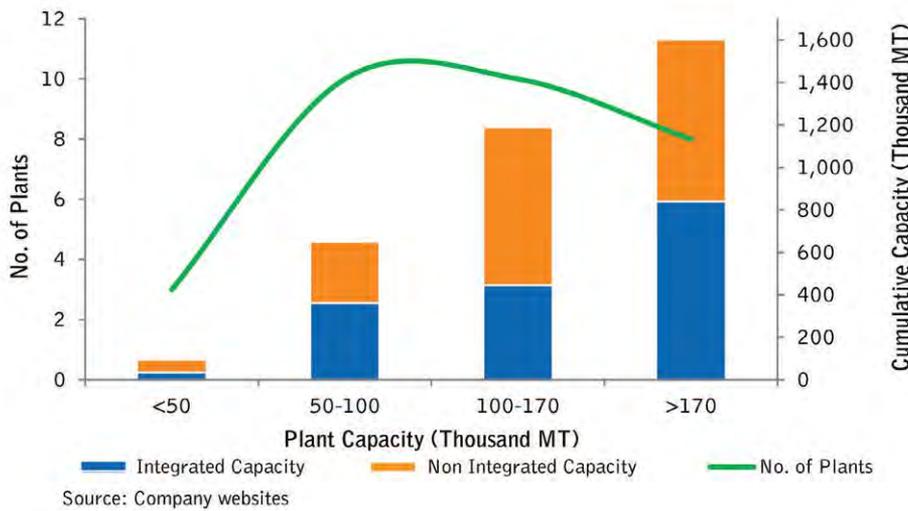


FIG. 2. Global LAB capacity by plant size (2010). For abbreviations see Fig. 1.

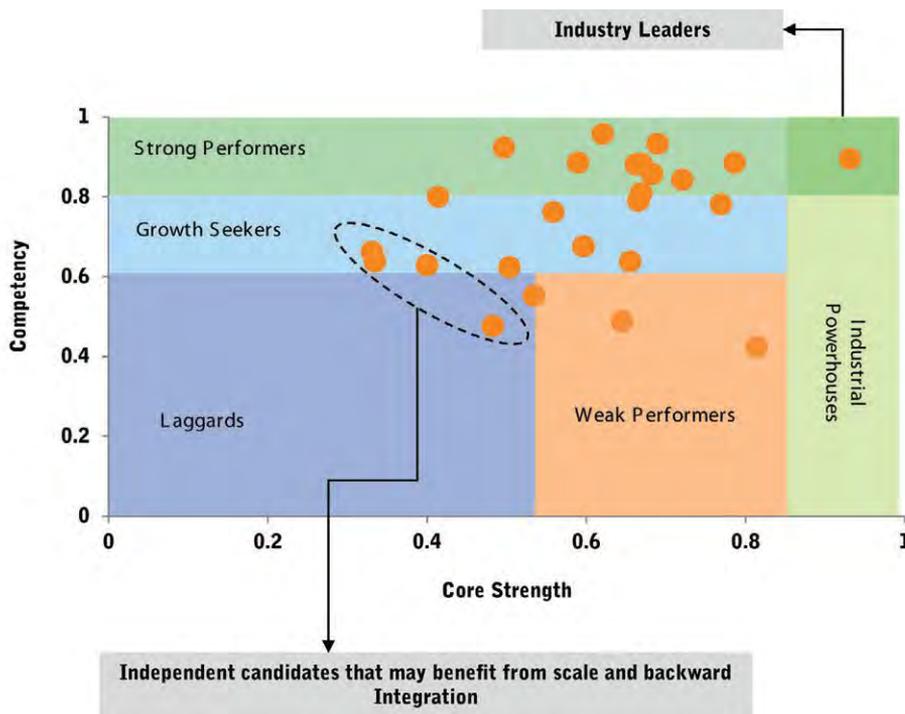


FIG. 3. Possible LAB industry consolidation

already set up with an export-oriented strategy, along with new additions, will cement the Middle East as the major export hub. The Middle East is expected to hold 19% of the global LAB capacity by 2015. Middle East facilities are blessed with cheap feedstock and better supply integration across the chain.

Sustainable competitive advantage of facilities has been mapped based on core strength and competence metrics, to assess the company’s current position. This analysis measures a company’s core strength against its ability to compete effectively. Some of the important factors considered in determining core strength include total capacity, backward integration, capacity expansions, and technological setup. Competency of the company is measured by determining factors such as capacity utilization, feedstock and sales guarantees, and investment in upgrades.

Fragmented industry heading toward a likely consolidation

In a globally fragmented industry, the global LAB trade appears to be rapidly consolidating to players based out of the Middle East and Asia Pacific. The future looks less certain for some middle-bracket players who are nonintegrated in upstream feedstock territory and are currently facing the brunt of price volatility of feedstock economics, leading to underutilization of their current facilities. Erosion of market margins was witnessed globally with weak pricing power affecting all players. This may lead to consolidation via existing players.

Classification of players (see Table 1)

Powerhouses. Large facilities and access to financial resources typically define industry powerhouses. Their core strength is their presence in the entire supply chain with easy access to cheap feedstock. They can easily sail through industry down cycles with little

TABLE 1. Overview of industry

Metric	Strong performers	Growth seekers	Weak performers	Laggards
Total No. of Companies	12	10	2	2
Backwardintegratedcandidates	83.3%	20%	0%	0%
Average capacityutilization (2010E)	98.6%	87.3%	66.8%	58.9%
Average total installed capacity(2010)	112.25 TMT	119.2 TMT	200 TMT	115 TMT
Average degree of backwardintegration	91.6%	35%	50%	50%

Source: Company websites

concern for capacity utilization owing to their efficient management of feedstock input and managing output as per foreseeable LAB demand. Being strong in their core competency—and as part of their expansive strategy—they can acquire mid-bracket players to strengthen their market share and boost their margins and fight any competition arising in strong demand markets.

Strong performers. With 83% of the companies being backward integrated and having high operating rates, strong performers have efficiently handled the industry down cycle. With the common trait being efficient performance and strong competence, strong performers have heavily invested in technology upgrades to keep up with new technological developments to increase their LAB production and quality. Foreseeing considerable demand from developing economies on account of low penetration and low per capita expenditure of surfactants, many strong performers are planning future expansions. They have consistently generated high sales with better returns on account of their core competence in upstream feedstock and technology front. They cater to the global as well as regional markets and account for most of the global trade.

Growth seekers. Companies in this category are trying hard to move in the direction of the “strong performers” category, with a few who trail and are facing the possibility of being engulfed in the “laggards” category.

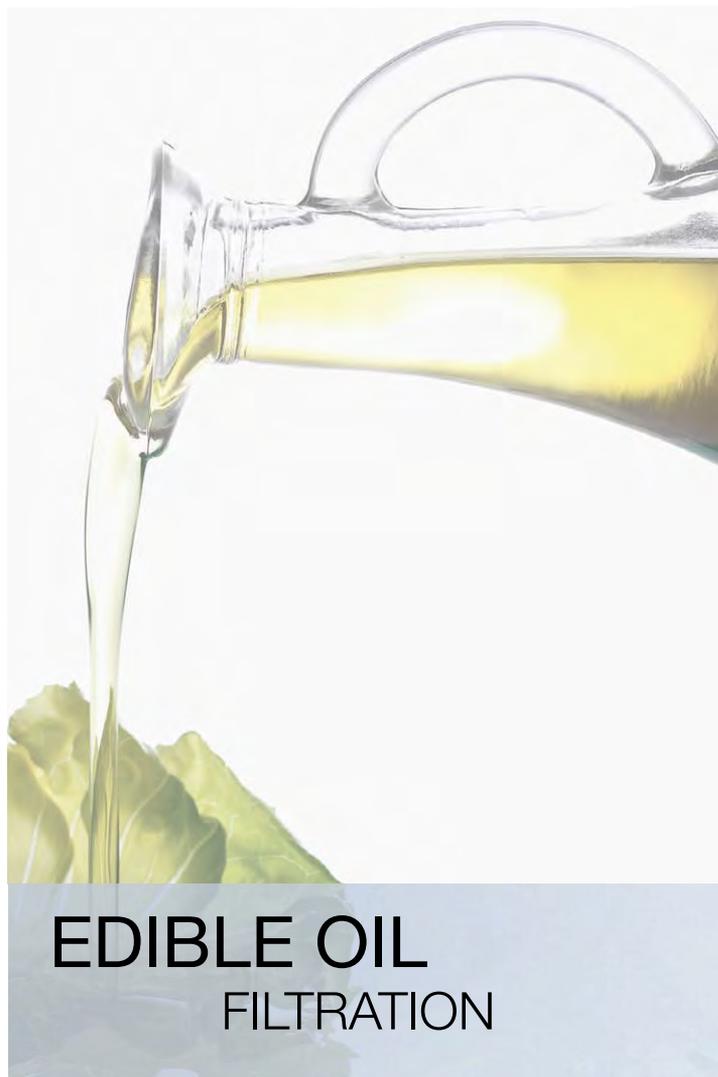
Because only 20% of the candidates are backward integrated till kerosene, the rest of the category such as (growth seekers) will face a constant struggle to arrange their required purchase feedstock volumes. Apart from a few plants, which have captive feedstock requirements to feed their downstream facilities, others have to gamble on their margins to increase sales volume and retain key accounts. Technology employed in this category is at par with industry consensus although some plants use their own alkylation technology. They usually cater to their regional markets.

Weak performers. Despite strong industrial setup, huge scale to leverage, and large capacities, plants in this category face escalating raw material costs, weak pricing power, and falling margins. High feedstock exposure as a result of no backward integration has led to below-average profitability or continual losses in the past. At one time, industry struggled with serious oversupply in LAB and upstream feedstock space, which led to intense rivalry and low margins and a rationalization wave was imminent to keep the industry competitive. These players have to bring in a second rationalization wave to keep up with industry margins and growth.

Laggards. Companies in this category are usually nonintegrated in feedstock territory and face the brunt of feedstock price volatility. They are the victims of the tight merchant feedstock market and are currently pursuing moves for long-term supply assurances. The latter consequences have led to lower operating rates in the past. Their prime market is regional in scope. They are currently facing margin erosion and stagnant sales as a result of their feedstock exposure and low utilization rates. They constantly face the threat of acquisition and, to survive and move to their desired target of “growth seekers,” they must either rationalize their capacity to become competent or look for long-term supply assurances.

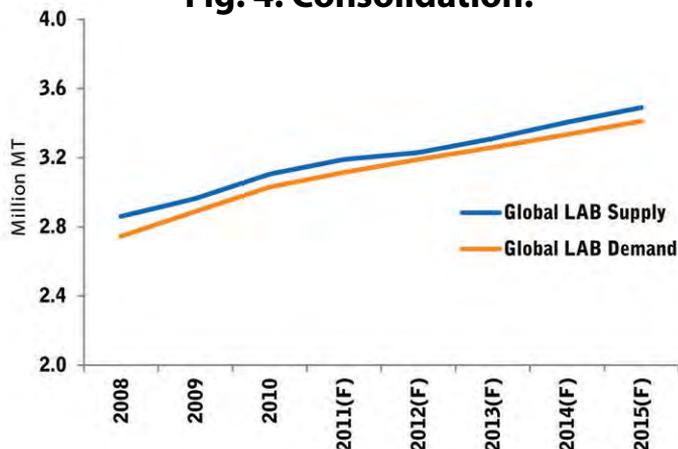
Three possibilities

Scenario 1: Consolidation (Fig. 4, page 184). In this scenario, there could be consolidation by upper-bracket players as part of their expansion strategy to retain their LAB market share and to compete with

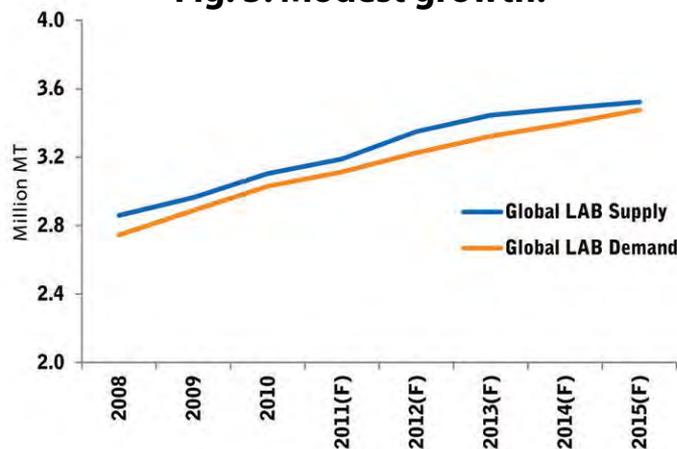


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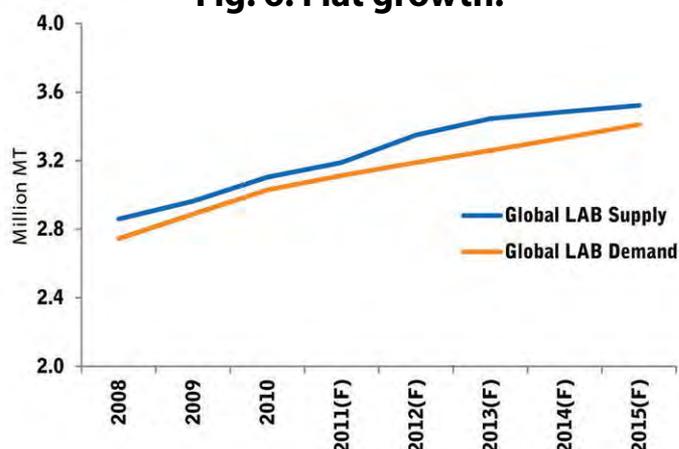
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Fig. 4. Consolidation.

upcoming expansions in Asia and the Pacific (APAC) and the Middle East. The likely consolidation candidates are middle-bracket nonintegrated LAB manufacturers facing poor operating rates and eroding margins. In addition to securing their captive LAB requirement for their downstream applications such as LAS and other surfactants, this move will result in partial capacity rationalization to improve price margins and efficient operation. With supply tightness continuing in the paraffin market that will not ease with the opening of the Qatar Petroleum/Shell Oil Pearl gas-to-liquids (GTL; see tinyurl.com/PearlGTL-Qatar) project in 2012, there will be further rationalization of capacity by some players in APAC. Abbreviation: F, forecast.

Fig. 5. Modest growth.

Scenario 2: Modest growth (Fig. 5). In this scenario, the industry remains fragmented with the same multiplicity of players expected to continue. Supply and demand will grow flat, tracking GDP at best in mature economies of the United States and Western Europe owing to the shift in consumer preference toward liquid detergents, which require less surfactant formulation per wash load. Low per capita expenditure on detergents and low penetration in emerging regions such as India, China, and the Middle East—where per capita consumption is low compared to the Western world—will keep the global demand growth rate at 2.7% till 2015, compensating for flat growth rate in the high-volume and highly penetrated markets of the Western hemisphere. New capacity expansions will be concentrated in the Middle East and China.

Fig. 6. Flat growth.

Scenario 3: Flat growth (Fig. 6). Flat growth involves a stalled growth period because of an industry shift toward oleo-surfactants owing to increasing demand for renewable surfactants. This trend is not situation based compared to last two years where the price of oleo-feedstocks was lower than LAB but is due to the growing interest in greener surfactants even though the prices between the two have narrowed down (i.e., oleo-based surfactants and LAB). Many formulators are now looking toward oleo-based surfactants even though the price spread between the two surfactants has narrowed as the demand for biobased surfactants surges in developed regions. High feedstock exposure and inheritance of upstream price volatility in the current supply crunch places LAB in a weak position compared with competing oleo-based surfactants made from fatty alcohols and methyl ester sulfonate.

Road ahead

A blend of the consolidation and modest growth scenarios (Fig. 7) is the most likely outcome for the global LAB industry. The LAB industry is heading toward further consolidation where the likely consolidation candidates lie in the APAC and Middle East regions, which are high-growth regions and located near cheaper feedstocks.

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Organizations

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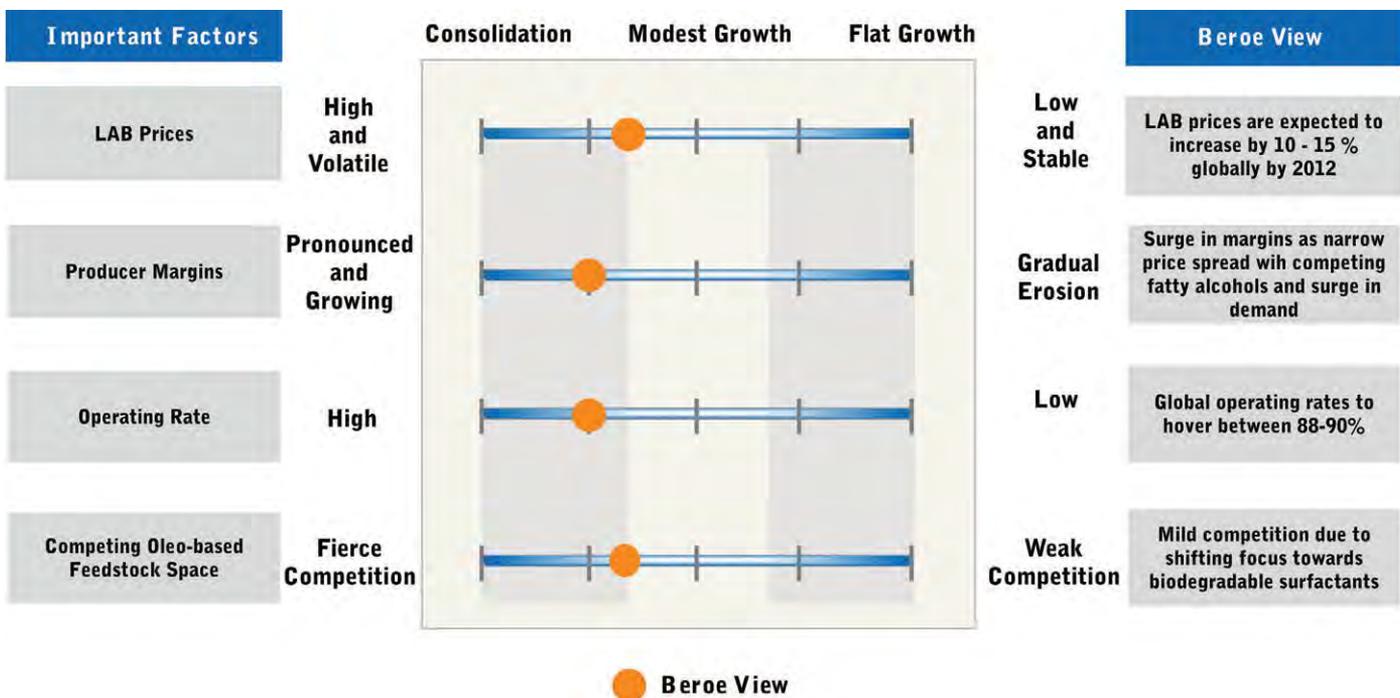


FIG. 7. Beroe's view: a blend of consolidated and modest and flat growth.

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Positive effects of DHA in experimental traumatic brain injury

Traumatic brain injury results in 53,000 deaths in the United States every year (Fig. 1), with nearly twice that number suffering permanent disability, including diminished cognitive ability.

Treatments with long-term benefits are few and of limited effectiveness. Progesterone may have neurological benefits and is in a Phase III clinical trial for patients with moderate-to-severe traumatic brain injury. Attention has also turned to the potential effects of DHA [docosahexaenoic acid] in preventing and ameliorating traumatic brain and spinal cord injury. DHA involvement in neuronal membrane structure and function, learning and memory, as well as neuroplasticity and synapse formation provides a compelling rationale to investigate its potential for mitigating or preventing the damage from these events.

Evidence from animal studies suggests that DHA might be a promising therapeutic approach in neurological injury. Animals fed an omega-3 (n-3) polyunsaturated fatty acids (PUFA)-rich diet prior to mild fluid percussion injury (FPI) were protected against the damaging effects of injury as shown by normalized levels of brain-derived neurotrophic factor (BDNF), synapsin I, and cAMP [cyclic adenosine monophosphate] responsive element-binding protein and learning ability, plus reduced oxidative damage. In a study of hypoxic-ischemic encephalopathy in rats, such as might occur in hypoxia in pregnancy, females fed DHA-enriched diets during pregnancy had fewer apoptotic neuronal cells and lower 8-OHdG [8-hydroxydeoxyguanosine]-immunoreactivity compared with the unenriched control group when exposed to hypoxic brain injury. A study of traumatic brain injury in animals that were subsequently supplemented with fish oil reported a significant reduction in β -amyloid precursor protein-positive axons and caspase-3 expression, both indicators of neuronal damage. Another study of cerebral ischemia/reperfusion injury in animals reported that pretreatment with DHA was accompanied by decreased brain infarction, less blood-brain barrier disruption and edema, and reduced inflammatory cell infiltration and interleukin-6 and caspase-3 activity, all indications of neuroprotection.

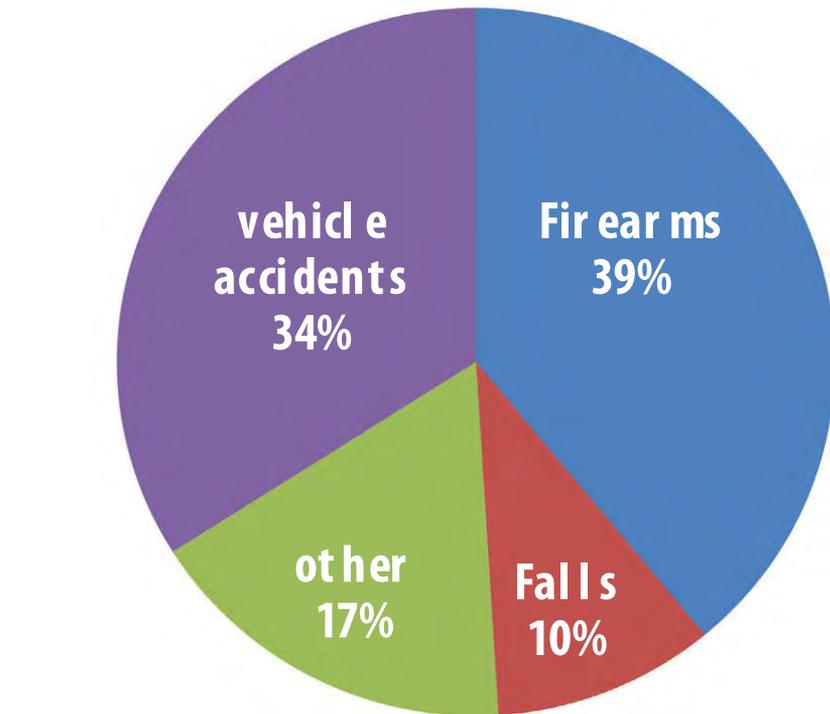


FIG. 1. Leading causes of fatal traumatic brain injury. Sources: Wikipedia and León-Carrión et al., *Pituitary* 8:197–202 (2005).

DHA treatment was also shown to improve histological and behavioral outcomes after spinal cord injury and to prevent white matter damage in such animals.

Sufficient evidence from animal studies exists to make a compelling case for the investigation of DHA in mitigating or preventing the damage from traumatic brain and spinal cord injury. A new report describes the effects of DHA on synaptic plasticity, membrane function, and learning in traumatic brain injury.

In a new report, Aiguo Wu and colleagues at the University of California at Los Angeles (USA) extended their studies with DHA in animals with traumatic brain injury from FPI. They investigated the effect of a DHA-enriched (1.2%) or regular chow diet in FPI or sham-operated rats. The markers studied included brain fatty acids, cognition, BDNF, oxidative stress, and intracellular phospholipase A2 and syntaxin-3 levels. The chosen markers are associated with synaptic plasticity, membrane function, or learning

and memory. In particular, BDNF has been linked to the regulation of synaptic plasticity, which has been described as the cellular correlate of learning and memory. BDNF is also necessary for the survival of striatal neurons, which are involved in learning and memory in the basal ganglia system.

Animals were fed the diets for 12 days immediately after surgery. Learning ability was evaluated by the Morris water maze test carried out one week after surgery, over five days. Animals were sacrificed and tissues analyzed for the markers of interest as described in the original publication.

As expected, the FPI animals fed the DHA-enriched diet accumulated more DHA in brain than either sham-operated or FPI animals fed the regular chow diet. Learning ability was assessed by the escape latency in the Morris water maze. The FPI animals fed DHA took significantly less time on each successive test day to reach the escape platform than the FPI animals on the regular

TABLE 1. Summary of docosahexaenoic acid (DHA) effects on brain neurological indicators in animals with traumatic brain injury fed regular or DHA-enriched diets for 12 days after surgery

Assessment	Sham-operated	Injured-regular diet	Injured + DHA diet
Brain DHA content, wt% total fatty acids	12.9 ± 0.3	12.6 ± 0.7	14.0 ± 0.7 ^{a,b}
Morris water maze, time (sec) to reach platform on day 5 ^c	~23	~30 ^a	~21 ^b
Brain-derived neurotrophic factor, % of sham	100	70 ^a	103 ^b
Calcium/calmodulin-dependent protein kinase II, % of sham	100	76 ^a	98 ^b
Synapsin I, % of sham	100	74 ^a	96 ^b
cAMP responsive element-binding protein, % of sham	100	78 ^a	104 ^b
4-Hydroxynonenal, % of sham	100	133 ^a	85 ^b
Superoxide dismutase, % of sham	100	73 ^a	92 ^b
Sir2, % of sham	100	64 ^a	90 ^b
Phospholipase A2, % of sham	100	65 ^a	104 ^b
Syntaxin 3, % of sham	100	74 ^a	97 ^b

^a*P* < 0.05 vs. sham-operated; ^b*P* < 0.05 vs. injured-regular diet; ^cestimated from chart.

diet or the sham-operated controls. On day 5 the DHA-supplemented FPI animals took approximately 21 seconds to reach the platform, whereas the FPI animals on the regular diet required nearly 30 seconds (*P* < 0.05).

FPI resulted in a 30% decrease in BDNF in the animals fed the chow diet. However, there was no decrease in BDNF in the DHA-fed or sham-operated animals. Similar findings were obtained for the levels of calcium/calmodulin-dependent protein kinase, an enzyme involved in signaling and long-term potentiation, the strengthening of synapses thought to underlie memory.

FPI injury reduced the levels of synapsin I and cAMP-responsive element-binding protein in the hippocampus by 74% and 78%, respectively. Synapsin I is found in the membranes of synaptic vesicles and is involved in synaptogenesis and neurotransmitter release. cAMP-responsive element-binding protein is a nuclear transcription factor involved in

neuronal excitation and the formation of long-term memory. DHA-supplemented FPI animals showed no significant decrease in these markers.

Additional analyses examined the effects of the DHA-enriched diet compared with the chow diet on indicators of oxidative stress in FPI animals. The investigators measured the levels of 4-hydroxynonenal (4-HNE), a peroxidation product of n-6 PUFA, such as arachidonic and linoleic acids, and two substances related to the control or inactivation of oxidation products, superoxide dismutase, which acts as an antioxidant factor, and Sir2, a protein with complex regulatory function in the brain. FPI animals on the regular diet had an approximately 33% higher level of 4-HNE compared with the sham-operated animals, but the DHA-enriched animals had significantly reduced 4-HNE (85% of the sham-operated

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controls). Similarly, injured animals on the regular diet had significantly reduced levels of superoxide dismutase (26% decrease) and Sir2 (36% decrease), but these effects were not observed in the DHA-fed animals. These responses suggested that DHA did not increase oxidative stress and may have protected against it.

For additional evidence of membrane protection, the investigators measured calcium-independent phospholipase A2 and syntaxin-3 levels in the hippocampus. Animals on the regular diet had 65% of the enzyme activity observed in the sham controls, while the DHA-enriched animals had 104% of the activity observed in the controls. Syntaxin-3 levels followed the same pattern, with a 74% reduction in the untreated animals and 97% of the control levels observed in the DHA-fed animals. A summary of these observations is shown in Table 1 (see page 187).

The provision of dietary DHA for 12 days immediately following brain injury in animals counteracted the deleterious effects of the injury on cognitive function, neuronal signaling, membrane integrity, synaptic function, and oxidative stress. In parallel, DHA-treated and injured animals had improved learning and memory.

Taken together, these observations suggest that the provision of dietary DHA immediately after traumatic brain injury from increased fluid pressure counteracted the deleterious effects of the injury on cognitive function, neuronal signaling, membrane integrity, synaptic function, and oxidative stress. The importance of protecting neuronal membrane structure and function may be critical for the preservation of synaptic function and neurotransmission, guarding against lipid peroxidation, maintenance of learning ability and memory, and reduction in the damage associated with traumatic brain injury. The authors especially note the maintenance of BDNF with the DHA-enriched diet. This neurotrophic factor facilitates synaptic transmission, is involved in intracellular signaling, regulates the expression and activation of synapsin I, and affects neurite outgrowth. It also activates the cAMP-response element-binding protein, which is involved in learning and memory. The findings of Wu and colleagues provide additional support to the idea that DHA may be involved in protecting cognitive and neuronal function in traumatic brain injury and support the existing literature in animal research on the protective effects of DHA on neuronal survival and function.

This article originally appeared in PUFA Newsletter [www.fatsoflife.com], December 2011. The original work was done in the laboratory of Adina Michael-Titus. The original citation of the article upon which the article is based is as follows: Wu, A., Z. Ying, and F. Gómez-Pinilla, The salutary effects of DHA dietary supplementation on cognition, neuroplasticity, and membrane homeostasis after brain trauma, J. Neurotrauma 28:2113–2122, 2011.

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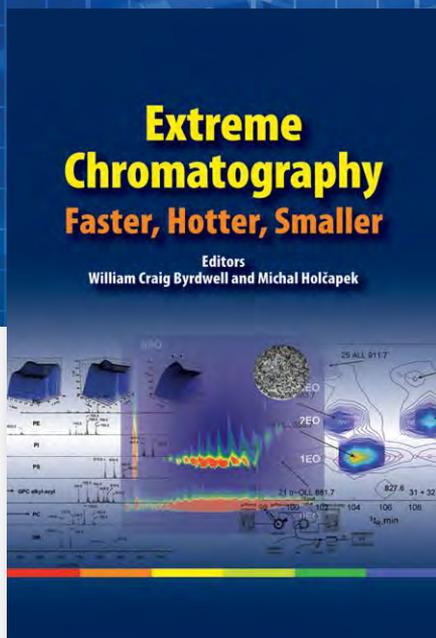
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BIOFUELS NEWS (CONTINUED FROM PAGE 151)

95-million-liters-per-year) biorefinery, to be constructed on an industrial site in Boardman, Oregon, USA, along the Columbia River.

The biorefinery will use high-yield cellulosic fermentation technology to produce advanced biofuels (cellulosic ethanol and other biofuels). An existing 250,000 GPY cellulosic integrated demonstration plant at the site is currently generating operational data that will provide information needed for the commercial-scale project, which will be located on an adjacent site. An estimated 51% or more of the biorefinery's output will be advanced biofuel, and the remainder will be high-value biobased chemicals, such as acetic acid and ethyl acetate.

The feedstock will consist of approximately 30% agricultural residue, such as wheat straw and corn stover, and 70% woody biomass from a local hybrid poplar tree farm. Microbial fermentation will convert cellulosic sugars into ethyl acetate, which can then be hydrogenated into ethanol. Hydrogen for the process can be generated by gasifying the lignin that is separated from the cellulosic biomass, according to the Environmental Protection Agency rule published on January 9, 2012 (tinyurl.com/FedRegister-ZeaChem).

The total project cost for the 25 million GPY biorefinery is estimated to be \$390.5 million. The amount above the USDA commitment will be covered through equity contributions by ZeaChem and its investment group, according to BiofuelsDigest.com (tinyurl.com/BD-ZeaChem-Oregon). Plans are for the plant to be operational by late 2014.

Iowa plant receives \$25 million loan guarantee for converting waste to ethanol. On January

20, 2012, the USDA approved a \$25 million conditional loan commitment to Maryland-based Fiberight LLC and Fiberight Blairstown Operating LLC for their plant in Blairstown, about 43 km from Cedar Rapids, Iowa, USA. The company's plans include converting organic solid waste and industrial pulps into cellulosic ethanol. Seed corn wastes also will serve as feedstock for ethanol production.

A new 55,000-square-foot (5,100-square-meter) plant will be built adjacent to Fiberight's existing facility, which makes ethanol from corn. Plans are being drawn up for the plant to produce 3.5 million gallons (13 million liters) per year.

According to [Business380](http://Business380.com) (tinyurl.com/Bus380-ethanol), Fiberight intends to create a "hub-and-spoke" system in Cedar Rapids and the immediate vicinity to act as collection points for waste. Materials would be pulverized at those sites before going to the Blairstown plant. Other wastes would be separated before shipment to reduce the number of truckloads going to the plant.

Navy transitions to 100% biodiesel

The US Department of the Navy is using five new boats to shuttle visitors to and from the USS Arizona Memorial at Pearl Harbor (Honolulu, Hawaii). These craft are currently operating on 20% biodiesel, but the goal is to make the transition to 100% biodiesel fuel. The fuel is manufactured, mostly from waste cooking oil, by Hawaii-based Pacific Biodiesel Inc. ■

HEALTH & NUTRITION BRIEFS (CONTINUED FROM PAGE 154)

fat diet initiation. Although initially transient, hypothalamic inflammation reappeared with prolonged consumption of a high-fat diet along with other indicators of brain injury such as increased abundance of neuronal stress proteins, increased neuronal autophagy, and ultimately neuronal loss. In a preliminary analysis, the authors saw radiologic evidence of gliosis in the hypothalamus of obese but not lean humans, consistent with the rodent studies. One hypothesis is that the hypothalamic injury caused by a high-fat diet actively contributes to the progression of obesity and its associated metabolic disorders, but this remains to be experimentally established. The work appeared in the

Journal of Clinical Investigation (122:153–162, 2012).

■■■

High plasma levels of 25hydroxyvitamin D, the metabolite used to estimate the amount of bioavailable vitamin D in the body, may lower the risk of colorectal cancer by almost 40%. All but the quintile of subjects with the lowest dietary calcium intake were also associated with a roughly 30% lower risk of the cancer. The research, led by Taiki Yamaji of Japan's Research Center for Cancer Prevention and Screening, appeared in the *American Journal of Epidemiology* (doi:10.1093/aje/kwr295, 2011). ■

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STUDENT PROFILE (CONTINUED FROM PAGE 174)

In a single assay, cholesterol, methyl esters of n-3 fatty acids (i.e., linolenic, eicosapentaenoic, and docosahexaenoic acids), and methyl esters of n-6 fatty acids (i.e., linoleic, conjugated linoleic, and arachidonic acids) are quantified simultaneously. The method, which is based on simultaneous spectrophotometry and chemometrics, could potentially provide a cheaper alternative to separation methods for the direct determination of polyunsaturated fatty acids (PUFA) in addition to cholesterol in human serum and synthetic serum models. Dumancas has since used his patented reagent system to analyze the oleic, linoleic, and linolenic acid content in vegetable oils; to discriminate dyslipidemic disease states in synthetic serum and human serum; to quantify cholesterol and PUFA in food samples; and to determine oleic acid in human serum.

With these credentials, Dumancas has already assumed leadership roles in AOCS. He is currently a Leadership Team Member of the AOCS USA Section, a member of the AOCS Student Leadership Team, and an editorial advisory committee member for *inform*.

In these roles, he communicates regularly with section members, who have provided him with a network of supporters he can go to for advice or letters of recommendations. He was invited to become a scientific reviewer for the *Journal of Laboratory Automation* and also selected as editor-in-chief of the upcoming Nova Science Publishers book, *Arachidonic Acid: Dietary Sources and General Functions*. Moreover, Nova Science invited him to write book chapters regarding polyunsaturated fats for two other books.

"As a whole, AOCS has played an essential role in my career, because there are so many ways you can get involved and connected

with people," he says. "Opportunities for students are more limited in other organizations. Most are really big, so you don't get to know people well. Also, the scope of what's covered during meetings is so broad that you can have a hard time deciding where to go and what to do. AOCS meetings offer just enough choices without overwhelming you."

The motivation, opportunities, and connections Dumancas has made through AOCS have had a snowball effect on his résumé. In 2011, he was recognized as an Outstanding Teaching Assistant Award Finalist by the Graduate and Professional Student Government Association at Oklahoma State University. In February 2012, the Society for Laboratory Automation and Screening named him as one of the world's 39 up-and-coming scientists for the second year in a row via the society's 2012 Tony B. Award, and in March 2012, he will be one of six finalists worldwide for the 2012 American Chemical Society/Agricultural and Food Chemistry Division Withycombe-Charalambous Award.

What does the future hold for this promising fats and oils chemist? One thing Dumancas is sure of is that AOCS will continue to be a part of it.

"AOCS is my second home," he says. "The opportunities and accolades this society has given me have really marked and changed my professional view of working harder to contribute more to the Society's research and leadership."

Kathy Heine is managing editor of inform. She can be contacted at kheine@aoacs.org.

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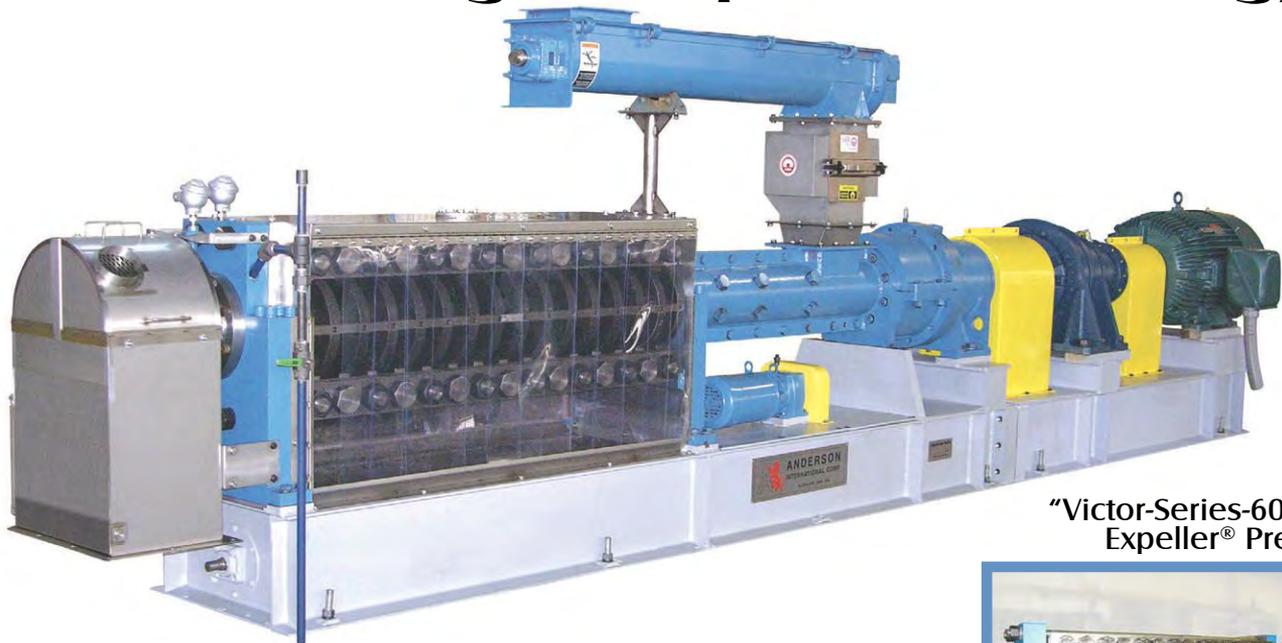
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