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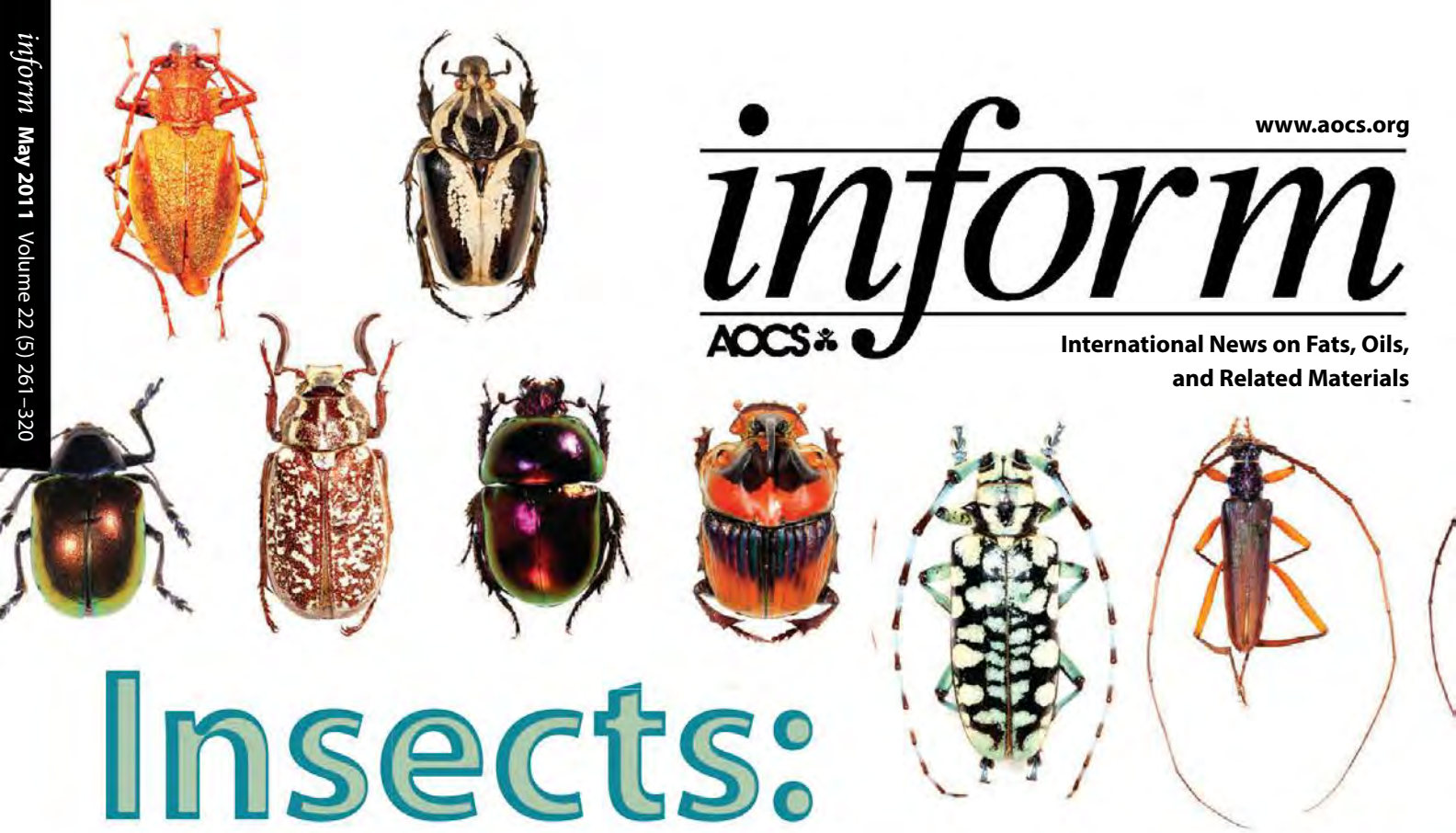

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Calendar

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

June

June 5–9, 2011. 13th International Groupe Consultatif International de Recherche sur le Colza (GCIRC), Prague Congress Centre, Prague, Czech Republic. Information: www.irc2011.org.

June 6–8, 2011. 8th World Surfactant Congress and Business Convention (CESIO 2011), Austria Center Vienna, Austria. Information: www.cesio2011.com.

June 6–10, 2011. 19th European Biomass Conference and Exhibition: From Research to Industry and Markets, International Congress Center (ICC), Berlin, Germany. Information: www.conference-biomass.org.

June 9–10, 2011. Sustainable Fragrances, Crystal Gateway Marriott Hotel, Arlington, Virginia, USA. Information: www.sustainablefragrances.com/home.aspx.

June 11–15, 2011. Institute of Food Technologists' Annual Meeting and Expo, New Orleans, Louisiana, USA. Information: www.am-fe.ift.org/cms/.

June 13–16, 2011. Clean Technology Conference and Expo 2011, Hynes Convention Center, Boston, Massachusetts, USA. Information: www.techconnectworld.com/Cleantech2011/sym/bio_energy.html.

June 13–16, 2011. A Short Course in Agricultural Microscopy, sponsored by AOCS/Great Plains Institute of Food Safety, Northern Crops Institute, Fargo, North Dakota, USA. Information: email: meetings@aocs.org; phone: +1 217-693-4821; fax: +1 217-693-4865; www.northern-crops.com/scourses/scmicroscopy/11microscopysc.html; www.aocs.org/Education/content.cfm?ItemNumber=16751.

June 15–16, 2011. European Biodiesel 2011, Rotterdam, the Netherlands. Information: Marisa Magtultol: tel: +44 (0)20 7981 2503; email: mmagtultol@acieu.net; www.acius.net/aci/conferences/eu-eaf4.asp.

June 18, 2011. Sensory Evaluation of Olive Oil Short Course, Hilton Hotel, İzmir, Turkey. Information: email: meetings@aocs.org; phone: +1 217-693-4821; fax: +1 217-693-4865; www.aocs.org/goto/Turkey2011.

June 18–21, 2011. International Oil Mill Superintendents Association 117th Annual Convention, Nashville Holiday Inn-Downtown, Nashville, Tennessee, USA. Information: www.iomsa.org.

June 18–19, 2011. Basics of Oilseed Processing Short Course, Hilton Hotel, İzmir, Turkey. Information: email: meetings@aocs.org; phone: +1 217-693-4821; fax: +1 217-693-4865; www.aocs.org/goto/Turkey2011.

June 19, 2011. Edible Oil Refinery and Optimization and Maintenance Short Course, Hilton Hotel, İzmir, Turkey. Information: email: meetings@aocs.org; phone: +1 217-693-4821; fax: +1 217-693-4865; www.aocs.org/goto/Turkey2011.

June 19–22, 2011. Nordic Lipid Forum Symposium, Ålesund, Norway. Information: www.lipidforum.info/index.php?p=53-53-53.

June 19–24, 2011. Atherosclerosis: Understanding the Pathophysiology and Identifying New Modes of Prevention, Gordon Research Conference, Salve Regina University, Newport, Rhode Island, USA. Information: www.grc.org/programs.aspx?year=2011&program=athero.

June 20–21, 2011. Oils and Fats World Market Update 2011, İzmir Hilton, İzmir, Turkey. Information: email: meetings@aocs.org; phone: +1 217-693-4821; fax: +1 217-693-4865; www.aocs.org/goto/WorldMarket.

June 21–22, 2011. Enzymatic Processing and Modification, Het Pand, University of

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June 18, 2011. Sensory Evaluation of Olive Oil Short Course, Hilton Hotel, İzmir, Turkey. Information: email: meetings@aocs.org; phone: +1 217-693-4821; fax: +1 217-693-4865; www.aocs.org/goto/Turkey2011.

June 18–19, 2011. Basics of Oilseed Processing Short Course, Hilton Hotel, İzmir, Turkey. Information: email: meetings@aocs.org; phone: +1 217-693-4821; fax: +1 217-693-4821; www.aocs.org/goto/Turkey2011.

June 19, 2011. Edible Oil Refinery and Optimization and Maintenance Short Course, Hilton Hotel, İzmir, Turkey. Information: email: meetings@aocs.org; phone: +1 217-693-4821; fax: +1 217-693-4865; www.aocs.org/goto/Turkey2011.

June 20–21, 2011. Oils and Fats World Market Update 2011, İzmir Hilton, İzmir, Turkey. Information: email: meetings@aocs.org; phone: +1 217-693-4821; fax: +1 217-693-4865; www.aocs.org/goto/WorldMarket.

June 21–23, 2011. World Conference on Oilseed Processing, Fats & Oils Processing, Biofuels & Applications, Izmir Hilton, İzmir, Turkey. Information: email: meetings@aocs.org; phone: +1 217-693-4821; fax: +1 217-693-4865; www.aocs.org/goto/Turkey2011.

September 16–18, 2011. 10th Phospholipid Congress of The International Lecithin and Phospholipid Society (ILPS): Phospholipids—Sources, Processing and Application, Congress Centre "De Doelen," Rotterdam, the Netherlands. Information: e-mail: ilps@lecipro.nl; www.ilps.org/10th%20Congress.htm.

October 10–13, 2011. World Congress on Oleo Science and 29th ISF Congress—JOCS/AOCS/KOCS/ISF/ISBB Joint Meeting, Tower Hall Funabori, Tokyo, Japan. Information: www2.convention.co.jp/wcos2011.

October 17, 2011. Basics of Edible Oil Processing and Refining—AOCS Short Course, Hilton Cartagena, Cartagena, Colombia. Information: email: meetings@aocs.org; phone: +1 217-693-4821; fax: +1 217-693-4865; www.aocs.org/LACongress.

October 17, 2011. Oilseed Processing and Solvent Extraction—AOCS Short Course, Hilton Cartagena, Cartagena, Colombia. Information: email: meetings@aocs.org; phone: +1 217-693-4821; fax: +1 217-693-4865; www.aocs.org/LACongress.

October 18, 2011. Oils and Fats Modification—AOCS Short Course, Hilton Cartagena, Cartagena, Colombia. Information: email: meetings@aocs.org; phone: +1 217-693-4821; fax: +1 217-693-4865; www.aocs.org/LACongress.

October 18, 2011. SODEOPEC: Soaps, Detergents, Oleochemicals, and Personal Care Products—AOCS Short Course, Hilton Cartagena, Cartagena, Colombia. Information: email: meetings@aocs.org; phone: +1 217-693-4821; fax: +1 217-693-4865; www.aocs.org/LACongress.

October 19–21, 2011. 14th Latin American Congress on Fats and Oils, Hotel Cartagena, Cartagena, Colombia. Information: email: meetings@aocs.org; phone: +1 217-693-4821; fax: +1 217-693-4865; www.aocs.org/LACongress.

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Ghent, Belgium. Information: phone: +44 (0)20 7598 1561; www.soci.org/General-Pages/Display-Event?EventCode=OF107.

June 21–23, 2011. World Conference on Oilseed Processing, Fats & Oils Processing, Biofuels & Applications, İzmir Hilton, İzmir, Turkey. Information: email: meetings@aocs.org; phone: +1 217-683-4821; fax: +1 217-693-4865; www.aocs.org/goto/Turkey2011.

June 21–23, 2011. 15th Annual Green Chemistry and Engineering Conference/5th

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International Conference on Green and Sustainable Chemistry, Washington, DC, USA. Information: www.gcande.org.

June 23–24, 2011. Sustainable Foods Summit, Mövenpick Hotel Amsterdam City Center, Amsterdam, the Netherlands. Information: http://www.sustainablefoodssummit.com/index.htm.

June 27–28, 2011. JatrophaWorld Asia 2011, Hainan, China. Information: www.futureenergyevents.com/jatropha/jatrophaworld-asia/.

June 27–30, 2011. BIO [Biotechnology Industry Organization] International Convention, Walter E. Washington Convention Center, Washington, DC, USA. Information: http://convention.bio.org.

June 30–July 1, 2011. European Lab Automation, CCH-Congress Center Hamburg, Germany. Information: www.selectbiosciences.com/conferences/ELA2011.

July

July 10–13, 2011. 5th European Symposium on Plant Lipids, Gdansk, Poland. Information: www.eurofedlipid.org/meetings/gdansk2011.

July 10–15, 2011. Molecular Membrane Biology, Gordon Research Conference, Proctor Academy, Andover, New Hampshire, USA. Information: www.grc.org/programs.aspx?year=2011&program=molecmemb.

July 13–14, 2011. 2nd International Conference on Tocotrienols & Chronic Diseases, Wynn Las Vegas, Nevada, USA. Information: Malaysian Palm Oil Board, Washington, DC, USA: Rosidah Radzian: phone: +1 202 572 9719/9768; fax: +1 202 572 9783.

July 17–20, 2011. 1st International Conference on Algal Biomass, Biofuels and Bioproducts, Westin St. Louis, St. Louis, Illinois, USA. Information: www.algalbbb.com.

July 17–22, 2011. Molecular & Cellular Biology of Lipids, Gordon Research Conference, Waterville Valley Resort, Waterville, New Hampshire, USA. Information: www.grc.org/programs.aspx?year=2011&program=lipids.

July 19–22, 2011 CESSE [Council of Engineering and Scientific Society Executives] 2011 Annual Meeting, Hyatt Regency Vancouver, Vancouver, British Columbia, Canada. Information: http://community.cesse.org/CESSE/CONFERENCE .

July 30–August 5, 2011. 43rd IUPAC World Chemistry Congress, Puerto Rico Convention Center, San Juan, Puerto Rico. Information: www.iupac2011.org.

August

August 14–18, 2011. Practical Short Course, Trends in Margarine and Shortening Manufacture, Non-Trans Products, Food Protein Research & Development Center, Texas A&M University, College Station, Texas. Information: http://foodprotein.tamu.edu/fatsoils/scmargarine.php.

August 21–24, 2011. Delivery of Functionality in Complex Food Systems, Guelph, Ontario, Canada. Information: www.uoguelph.ca/foodscience/content/delivery-functionality-complex-food-systems.

August 28–September 1, 2011. 242nd ACS National Meeting & Exposition, Denver, Colorado, USA. Information: www.acs.org.

August 30–September 3, 2011. 52nd International Conference on the Bioscience of Lipids, Warsaw, Poland. Information: www.icbl.unibe.ch/index.php?id=81.

September

September 14–16, 2011. International Biorefining Conference and Trade Show, Hilton Americas–Houston, Houston, Texas, USA. Information: www.biorefiningconference.com.

September 16–18, 2011. 10th Phospholipid Congress of The International Lecithin and Phospholipid Society (ILPS): Phospholipids—Sources, Processing and Application, Congress Centre "De Doelen," Rotterdam, the Netherlands. Information: e-mail: ilps@lecipro.nl; www.ilps.org/10th%20Congress.htm.

September 18–21, 2011. 9th Euro Fed Lipid Congress, Rotterdam, the Netherlands. Information: email: amoneit@eurofedlipid.org; www.eurofedlipid.org/meetings/rotterdam.

September 18–21, 2011. 12th International Conference on Bioactive Lipids in Cancer, Inflammation and Related Diseases, Westin Hotel, Seattle, Washington, USA. Information: http://bioactivelipidsconf.wayne.edu.

September 20–23, 2011. 7th International Congress of Food Technologists, Biotechnologists, and Nutritionists, Grand Hotel Adriatic, Opatija, Croatia. Information: www.pbncongress2011.hr.

September 21–23, 2011. 7th NIZO Dairy Conference: Flavour and Texture, Innovations in Dairy, Papendal Hotel and Conference Centre, near Arnhem, the Netherlands. Information: www.nizodairyconference.com.

September 22–23, 2011. Biofuels Hall of Fame 2011, Brussels, Belgium. Information: email: dm@greenworldconferences.com; www.greenworldconferences.com.

September 23–25, 2011. Globoil India, Leela Kempinski Mumbai, India. Information: www.globoilindia.com.

September 25–27, 2011. 4th Annual Waste-to-Fuels Conference & Trade Show, Hyatt Regency Mission Bay Spa & Marina, San Diego, California, USA. Information: www.waste-to-fuels.com.

September 28–30, 2011. tcbiomass2011, International Conference on Thermochemical Biomass Conversion Science, Westin Chicago River North, Chicago, Illinois, USA. Information: www.gastechnology.org/tcbiomass2011.

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14th AOCS Latin American Congress and Exhibition on Fats and Oils

The Resource for the Ibero-American Market

October 17–21, 2011 | Hilton Cartagena | Cartagena, Colombia | www.aocs.org/LACongress

International Fats and Oils Congress Comes to Colombia

Spanish or English translations will be available for all oral presentations.

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The Program

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The Exhibition

Held in conjunction with the congress, the exhibition will feature international companies that supply processing equipment, engineering services, reagents, additives and ingredients, laboratory instrumentation, and much more.

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Insect oils:
Nutritional and industrial applications

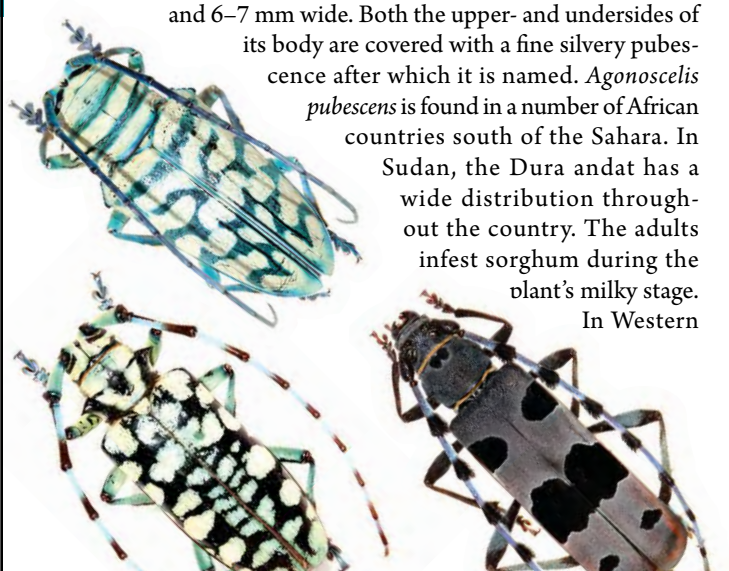
Abdalbasit Adam Mariod

In searching for new sources of oils, many researchers have investigated wild plants, but our research group took a different approach: We looked at insects as an oil source for both nutritional and industrial applications.

According to Sudanese indigenous knowledge, many insects have food and medicinal uses. We targeted two of these insects for our research: *Aspongopus vidiuatus* (melon bug) and *Agonoscelis pubescens* (sorghum bug).

The melon bug (Pentatomidae) is about 20 mm long. It is found in most African countries, where it causes damage to watermelon and other cucurbit shoots. The adult bugs can usually be found by lifting the young melon plants from the ground and inspecting the undersides of the leaves. The nymphs pierce the leaves, stems, and young fruits and suck the sap, resulting in wilting, fruit drop, and the death of the plant. Melon bugs are considered to be edible in Namibia, where the last nymph stage is called "nakapunda." In this soft stage, the bug is cooked and eaten. Melon bugs are widely distributed in Kordofan and Darfor states of Sudan (locally known as Um-buga), where field watermelons are one of the most important crops for the traditional rain-fed agriculture. There, tons of melon bug adults can be collected in infested fields. Elobied Agricultural Research Station (North Kordofan state of Sudan) designed a hand-picking program for melon bug adults in plots of about 5,000 hectares in four different areas of the state, for two seasons. A total of 15 tons of melon bug adults were collected in the first season and 226 tons in the second one (Bashir *et al.*, 2002).

The adult sorghum bug (Pentatomidae), commonly known in Sudan as Dura andat, is shield-shaped, about 11–13 mm long, and 6–7 mm wide. Both the upper- and undersides of its body are covered with a fine silvery pubescence after which it is named. *Agonoscelis pubescens* is found in a number of African countries south of the Sahara. In Sudan, the Dura andat has a wide distribution throughout the country. The adults infest sorghum during the plant's milky stage. In Western Sudan, adult sorghum bugs are collected, fried, and eaten. Additionally, in some areas of Sudan the collected bugs are pressed, and the expressed oil is used for cooking and some medicinal purposes. In the Botana area of central Sudan, nomads use the tar obtained from high-temperature rendering of the bugs to protect their camels against dermatological infections (Mariod *et al.*, 2004).



What is the chemical composition of bug oil?

Oils extracted from these two Sudanese edible insects (Figs. 1,2) have interesting physicochemical properties and fatty acid compositions. For instance the amounts of saturated and unsaturated fatty acids they contain are comparable with those of oils commonly used in Sudan, such as sesame, groundnut, sunflower, and cottonseed (Table 1).

Acting as chain-breaking antioxidants, tocopherols, which are minor components of naturally occurring oils, react with lipid radicals to convert them into more stable products. Tocopherols protect food lipids against autoxidation and thereby increase their storage life and their value as wholesome foods (Kamal-Eldin and Appelqvist, 1996). The oils of melon and sorghum bugs contain only low amounts of tocopherols in comparison to other common Sudanese edible oils (Table 2).

In our experiments the amount of sterols in melon bug oil (MBO) was 17.5 mg/100 g. In sorghum bug oil (SBO), the amount of sterols was 449.9 mg/100 g (Table 3). The main sterol of the two oils is β-sitosterol. In comparison with other oils usually used in human nutrition, SBO had higher amounts of total sterols than either sunflower or groundnut oils.

There is increasing interest in isolating sterols for nutraceutical applications and as ingredients for functional foods (Holser *et al.*, 2004). Sterol fraction analysis can be used to identify a fat or oil, to detect the adulteration of more expensive oils with cheaper oils, and to distinguish between different qualities of the same oil.

Insect oils are highly stable

The oxidative stability of MBO expressed as the induction period determined by the Rancimat method at 120°C is remarkably high (38.0 hr) in comparison to other edible oils. For instance, the oxidative stability of sesame oil is 1.6 hr and for sunflower oil, 5.4 hr. The stability of SBO (5.1 hr) is also in this range. The high oxidative stability of MBO may be due to the low amounts of polyunsaturated fatty acids (PUFA) such as linoleic and linolenic

FIG. 1. *Oil expressed from the melon bug (*Aspongopus viduatus*).*

FIG. 2. *Oil expressed from the sorghum bug (*Agonoscelis pubescens*).*

acid. On the other hand, in spite of the higher content of tocopherols in SBO, the high portion of PUFA in this oil seems to be mainly responsible for its low induction period. Therefore, in this case the fatty acid composition has a much higher influence on the stability of the oil than the antioxidants present in the oil.

Blending sunflower oil with MBO resulted in an increase of oleic and a decrease of linoleic acid and improved the oxidative stability of sunflower oil. This stability increased with an increase of the percentage of MBO in blends (Mariod *et al.*, 2005). When MBO and SBO were stored at 30 ± 2°C in the dark for 24 months, their fatty acid compositions remained almost unaltered. On the other hand, the tocopherols of the two oils gradually decreased. The two oils showed slight changes in their oxidative stability as indicated by the peroxide value (PV), and when this stability was measured by Rancimat method as an induction period, MBO showed a slight decrease with loss of 10% of its induction period during two years of storage (Mariod *et al.*, 2008). SBO showed a gradual increase in the PV and a gradual loss of stability as measured by induction period IP during storage.

In laboratory refining experiments of crude oils, phosphatide, peroxide, tocopherol, and sterol contents as well as oxidative stability fell during processing, while free fatty acids were almost totally removed. The amounts of total volatiles as well as the amounts of hexanal were decreased during the different processing steps. The color decreased throughout the processing steps up to bleaching, then in the deodorization step it darkened sharply in all samples. No change in the fatty acid composition was observed.

Biodiesel from insect oils

MBO and SBO were transesterified using methanol and ethanol in the presence of sulfuric acid. The resultant fatty acid esters were compared with the DIN 51606 specifications for biodiesel. Most of the insect oil biodiesel characteristics met the DIN specifications

TABLE 1. Fatty acid composition (% of total) of melon and sorghum bug oils compared with oils commonly used in Sudan[a]

Oil	12:0	14:0	16:0	16:1	17:0	18:0	18:1Δ9	18:1Δ11	18:2	18:3	20:0	20:1	22:0
MBO	0.02	0.33	30.95	10.7	2.43	3.47	46.63	0.46	3.90	0.09	0.23	0.17	0.00
SBO	0.00	0.21	12.22	1.04	0.14	7.27	40.97	0.73	34.53	1.14	0.77	0.23	0.23
SEO	n.d	0.02	9.76	0.17	0.10	6.17	39.83	0.97	41.43	0.34	0.68	0.17	0.19
GNO	n.d	0.03	10.95	0.10	0.10	3.55	45.83	0.64	29.85	0.10	1.61	1.20	3.43
SFO	n.d	n.d	n.d	15.2	n.d	n.d	33.1	n.d	51.52	n.d	n.d	n.d	n.d
CSO	0.02	0.92	23.63	0.61	0.20	2.61	17.46	0.92	48.82	0.16	0.31	1.34	0.22

[a]Data are means of triplicate results. Abbreviations: n.d, not determined; MBO, melon bug oil; SBO, sorghum bug oil; SEO, sesame oil; GNO, groundnut oil; SFO, sunflower oil; CSO, cottonseed oil. Source: Mariod *et al.* (2009).

TABLE 2. Tocopherol content (mg/100 g) of melon and sorghum bugs oils compared with oils commonly used in Sudan[a]

Oil	α-T	β-T	γ-T	P8	δ-T	Total
SCO	0.36	0.00	13.05	0.00	0.32	13.73
MBO	0.17	0.00	0.13	0.00	0.00	0.30
SBO	0.88	0.00	32.16	0.21	0.78	34.03
SEO	0.60	0.00	63.32	0.23	0.59	64.74
GNO	12.66	0.56	12.99	1.02	0.72	27.96
SFO	91.17	3.02	2.51	0.87	0.00	97.58
CSO	28.62	0.35	45.88	2.61	0.33	77.83

[a]Data are means of triplicate results. Abbreviations: T, tocopherol; P8, plastochromanol; SCO, *Sclerocarya birrea* (Marula tree seed) oil; for other abbreviations see Table 1. Source: Mariod *et al.* (2009).

TABLE 3.
Distribution of sterol contents (mg/100 g oil) of melon and sorghum bug oils compared with oils commonly used in Sudan[a]

Oil	SCO	MBO	SBO	SEO	GNO	SFO	CSO
Cholesterol	1.0	1.4	2.2	0.0	1.6	1.4	3.2
Campesterol	2.1	1.8	11.6	13.0	42.9	39.1	43.9
Stigmasterol	13.4	0.8	25.4	48.1	24.3	29.7	5.3
β-Sitosterol	180.1	10.6	268.8	467.7	183.9	252.3	403.3
Δ5-Avenasterol	47.6	0.5	16.3	70.6	28.7	10.6	15.5
Δ7-Avenasterol	4.8	0.0	1.6	8.4	2.9	12.7	2.1
Δ7-Stigmasterol	4.8	0.9	2.8	6.4	0.7	46.9	3.4
Others[b]	32.8	1.5	121.2	170.7	9.0	24.7	15.7
Total	286.6	17.5	449.9	774.9	294.0	417.4	492.4

[a]Data are means of triplicate results.
[b]Others include 24-methylcholesterol, campestanol, chlerosterol, sitostanol, 5,24-stigmastadienol. For abbreviations see Tables 1 and 2. Source: Mariod *et al.* (2009).

(water content, iodine number, phosphorus). However, the kinematic viscosity values of all samples were much higher than those for biodiesel standards. These can be reduced by blending with other low-viscosity biodiesels.

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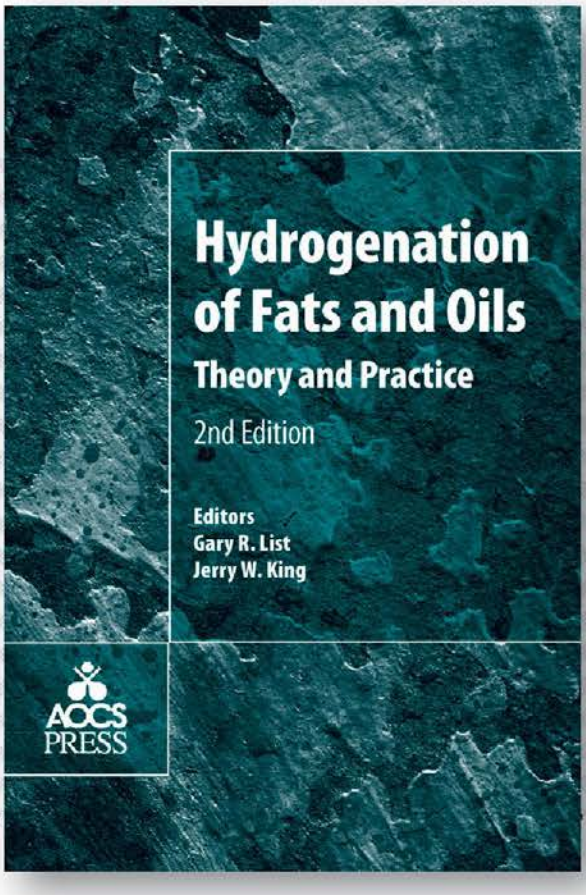

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The olive: a natural supplier of active ingredients for skin lightening and age spot reduction

Editor's note: The following article was reprinted from the March 2011 issue of SOFW Journal 137:*36–46.*

Maria Lüder

Plant extracts became an important element as agents for skin lightening, since substances like hydroquinone, arbuti, and kojic acid that were used for a long time came into negative discussions about their skin toxicology and compatibility. The used plants extracts are, for example, polyphenol-rich licorice extract or corresponding extract combinations like: mallow (*Malva sylvestris*), peppermint (*Mentha piperita*), primrose (*Primula veris*), lady's mantle (*Alchemilla vulgaris*), veronica (*Veronica officinalis*), lemon balm (*Melissa officinalis*), and common yarrow (*Achillea millefolium*). Most extracts are tyrosinase inhibiting [1]. A further plant with skin-lightening properties is the well-known and much-valued olive.

The olive tree, *Olea europaea*, is native to the Mediterranean basin and parts of Asia Minor. Native olive oil has often been used in cosmetic formulations, but other interesting ingredients from the fruit and the leaves were for a long time not investigated for the use in cosmetic products. The fruit and the leaves contain high amounts of polyphenols. The major polyphenol is oleuropein. With increasing maturity of the olive, hydroxytyrosol will be released, which is even stronger in anti-oxidative power than the oleuropein.

The used olive active ingredient, containing higher amounts of polyphenols and hydroxytyrosol, could be expected to provide skin-whitening and age spot-reduction effects. A direct measurement, melanin reduction, and an indirect measurement, glutathione (GSH) increase, were conducted *in vitro* on primary human melanocytes. A high GSH level in melanocytes directs the production of melanin into soluble and lighter brown pheomelanin instead of dark and insoluble eumelanin. An *in vivo* test was designed as a double blind, placebo-controlled study on the hands of 12 Caucasian female volunteers, aged between 46 and 72. The study duration was three months, with readings before the first application, after four, eight, and twelve weeks.

A significant melanin reduction of up to 50% and a significant increase of the GSH level up to 55% could be measured *in vitro*. The confirmation *in vivo* showed not only a significant reduction of age spot color but also a color reduction of the whole skin area on the hands.

Introduction

Skin-lightening ingredients can become active at different stages of melanin production in skin. Many active ingredients act as inhibitors

of tyrosinase, the key enzyme of the melanogenesis. Others prevent the formation of the enzyme or the transport of the pigment to the keratinocytes.

Melanocytes are located in the basal layer (dermal epidermal junction), the separating layer between epidermis and dermis. A melanocyte is surrounded by approximately 36 keratinocytes. Together they form a so-called melanin-unit. The produced melanin is stored in melanosomes, small cell vesicles filled with melanin inside the melanocytes. Via dendrites of the melanocytes, they are transported to the surrounding keratinocytes.

The active ingredients found in the olive can influence melanogenesis in two ways. They act as a tyrosinase inhibitor and at the same time they direct melanin production toward the light and soluble pheomelanin.

Hippocrates used olive leaves for wound healing, and Dioskurides applied them in fomentations against skin inflammation, abscess, thrush, and slowly healing wounds. Today it is known that the high polyphenol content with the powerful anti-oxidative properties is responsible for these effects.

Depending on the olives' degree of ripeness, these secondary plant components [2] are found in the cold pressed oil (approximately 0.1%) and develop effects similar to omega-3 fatty acids, especially

oleuropein. With increasing maturity of the olive, hydroxytyrosol will be released, which is even stronger in anti-oxidative power. Like resveratrol, the amphiphilic hydroxytyrosol is a very strong antioxidant. As hydroxytyrosol is soluble in fat as well as in water, it can develop its effect as powerful radical scavenger in cell membranes as well as in cell plasma.

Publications show that hydroxytyrosol protects human melanocytes *in vitro* from protein damage induced by long-wave ultraviolet (UV) light and reduces the release of inflammation mediators like COX-2 in macrophages [3,4].

GSH is a peptide, consisting of three amino acids: glutamic acid, cysteine, and glycine. It is present in almost all cells in higher concentrations and belongs to the most important natural antioxidants of the body. At the same time it is a reservoir for cysteine. GSH protects cellular macromolecules like proteins and membrane lipids against free radicals (reactive oxygen species). An increased level of GSH stimulates the formation of the lighter and soluble pheomelanin instead of the darker, insoluble eumelanin [5]. Tyrosinase, the rate-limiting enzyme of melanogenesis, catalyzes the hydroxylation of L-tyrosine to Dopa (dihydroxyphenylalanine) and the oxidation of Dopa to Dopa-quinone. If cysteine or GSH is present, it reacts with Dopa-quinone to produce cysteinyl-Dopa and the benzothiazine derivatives of pheomelanin [6].

The olive active ingredient has been developed with a high content of active ingredients and was tested against age spots and for skin-lightening properties *in vitro* and *in vivo*.

The *in vitro* effect of the olive active ingredient was tested in two ways. Melanin reduction and GSH increase as result of a treatment with the active ingredient were measured on primary human melanocytes. The increase of GSH was measured to prove the formation toward the lighter and more soluble pheomelanin.

Materials and methods

As active ingredient, an olive extract with 8% hydroxytyrosol and 12% olive polyphenols (Cayoma® Olive) was used for the *in vitro* studies. All tests were run at independent test institutes. The *in vitro* tests were conducted by CELLnTEC Advanced Cell Systems (Bern, Switzerland), the *in vivo* test was conducted by Skin Test Institute (Neuchâtel, Switzerland). For the *in vivo* study a hand cream formulation with 0.2% of the olive extract as the only active ingredient had been prepared.

Melanin reduction. Primary human melanocytes (Lifeline Technologies, Chesterfield, Missouri, USA) were exposed to the olive active ingredient concentration in the range of 0–0.0078% for a period of 48 hours.

Cells were incubated with 0.1% L-Dopa-containing medium to induce melanogenesis. OD (optical density) measurements were then taken at 405 nm after 0 min and 140 min.

Melanin content was then calculated. Results are presented as a percentage of the negative control (untreated cells). Cytotoxicity tests with the chosen extract concentrations prior to the study did not show any adverse effects.

GSH increase. The assay is based on the conversion of a luciferin derivative into luciferin in the presence of GSH, catalyzed by glutathione S-transferase. The signal generated in a coupled reaction with firefly luciferase is proportional to the amount of GSH present in the sample [7].

Primary human melanocytes were stimulated with the olive active ingredient for 48

hours, then analyzed for GSH concentration. Cytotoxcity tests with the chosen extract concentrations prior to the study did not show any adverse effects.

In vivo *test of age spot reduction on human volunteers*. The aim was to demonstrate the effect of the olive active ingredient on the reduction of age spots and skin-lightening properties in a double-blind, placebo-controlled study. Study duration was 3 months with measurements before the study and after 4, 8, and 12 weeks. Among the 12 volunteers, aged between 46 and 72, 4 had normal skin (33%), 3 had dry skin (25%) and 5 had very dry skin (42%). The volunteers had to apply a hand cream with 0.2% of the olive active ingredient 3 times daily using 0.5 gram of the cream per application. One hand was treated with the test cream; the other was treated with a placebo cream. During the study the volunteers were asked to avoid direct UV irradiation.

The measurements were taken with the Skin Pigmentation Analyzer SPA 99 from Courage + Khazaka GmbH (Cologne, Germany). The measuring head has a diameter of 2 mm, and spot sizes above 3 mm are therefore considered sufficient to avoid false positive results. In the SPA 99, the probe head emits three specific light wavelengths to the skin surface in a controlled environment. A receiver module measures the light reflected by the skin, and the microprocessor within the device calculates the quantity of light absorbed. The result is displayed on a digital readout as a 0–99 index.

Four defined spots were chosen and measured at every defined date. The area free of spots was taken to measure the overall effect of the cream in direct comparison to the spot area. Additionally, photographs were taken of the hands of the volunteers prior to the start and at every measurement date of the study. The melanin index of the chosen skin areas was measured. Measurements were performed under controlled environmental conditions (temperature 22.5 ± 1.5°C; relative humidity 50 ± 10%). The Melanin Index is derived from the reflectance spectrum and can be used as the primary measure of skin color [8,9]. The Melanin Index is a unit-less, continuous variable objectively quantifying skin color [10].

Results

Melanin reduction. At a seeding density of 10,000 cells per well, the largest reduction in melanin content was observed in the highest extract concentration (0.0078%), with values across the various time points dropping to 50–65% of control.

A similar pattern was observed when seeding 5,000 cells per well. Again the highest concentration induced the largest average reduction in melanin content, with values falling to the range of 55–70% of control.

The analyses conducted show that the olive active ingredient is able to significantly decrease melanin content in primary human melanocytes following a 48-hour treatment in the range of 0.002–0.008%.

GSH increase. GSH content significantly increased in cells treated with the olive active ingredient. The effect was dose dependent, with the highest extract concentration (0.0078%) inducing the largest increase in GSH (+55%).

The analyses conducted show that the olive active ingredient is able to significantly increase GSH content in primary human melanocytes following a 48-hour treatment in the range of 0.002–0.008%.

In vivo *test of age spot reduction on human volunteers*. The verum (hand cream with 0.2% olive active ingredient) was significantly efficient at 8 and 12 weeks in depigmenting age spots compared with the placebo.

The verum was also efficient in depigmenting adjacent spot-free zones (unspotted skin) significantly at 8 weeks and extremely significantly at 12 weeks, vs. the placebo.

The depigmenting efficacy of the verum was stronger on the adjacent zones than on the age spots; the statistically significant performance was found to be approximately 10% stronger on the adjacent zones, after 12 weeks of treatment.

The photos at D0 show irregular pigmented skin on the backs of the hands. The study started at a time (autumn) where a seasonal effect results in less sun exposure which explains the difference between D0 and D84 of the placebo-treated hand.

On the treated hand a dark area at D0 (red circle) became significantly lighter at D84. The overall skin color became much more even and significantly lighter during the treatment with the olive extract.

Conclusion

Skin whitening in Asian countries is an important task of the cosmetic industry. Natural beauty is linked to a pale skin complexion. Skin-lightening and age spot reduction in Europe and North America have become a more and more important subject due to the

demographic development of the population. People are becoming older but don't feel old because of an active life, even at a higher age. To look younger requires not only less wrinkles but also an even skin tone. Cosmetic products with active ingredients to fight these signs of aging are very popular.

In the past active ingredients like hydroquinone, arbutin, and kojic acid dominated the whitening agents market. Hydroquinone and products containing hydroquinone are still used in cosmetics in certain parts of the world. Current European legislation prohibits their use in cosmetics completely. In the United States hydroquinone is classified as a drug by the Food and Drug Administration. It is no longer approved for use in cosmetics.

The inherent toxicity of hydroquinone has let cosmetic researchers focus on safer natural or nature-identical isolates with similar function, but without the strong side effects. Hydroquinone is known for serious side effects when used over a long period of time [11].

Hydroquinone occurs in a variety of forms as a natural product from plants and other natural sources. It has been found in non-volatile extracts of coffee beans and as arbutin (a glycoside of hydroquinone) in the leaves of blueberry, cranberry or cowberry and bearberry plants [11]. The use of kojic acid and arbutin is still widespread, because these active ingredients repeatedly have demonstrated a good efficacy as skin lightener. Besides the natural extracts, mulberry and licorice were added as standard components in skin-lightening formulations. Even lemon extract is used in formulations as potential skin lightener. However, it can only be used in low concentrations since it may easily lead to skin irritations. Different active ingredients were isolated from *Sophora* species (pagoda tree species) that act as potential tyrosinase and pigment inhibitors. Niacinamide is, besides tyrosinase inhibition, involved in the melanosome transport to the keratinocytes [12].

Thus, developments in the area of natural and nature-identical active ingredients for skin lightening strongly expanded during the last years. The use of single substances for tyrosinase inhibition was in many cases expanded to complex mixtures, aiming to reach different mechanisms like tyrosinase inhibition, transport to the keratinocytes, antioxidation, and anti-irritation [12].

From the context, it becomes obvious that most skin lighteners currently in use are of botanical or natural origin. Plants with a long history of use are well known to consumers and provide a certain feel of comfort. Olives and olive oil are known for centuries. Their strong antioxidants in the fruits and the leaves have shown interesting anti-aging effects in skin [3,13]. Hydroxytyrosol as one of the prominent anti-oxidants in olives works in different ways. On the one hand, it increases the body's own anti-oxidant power by increasing the amount of GSH in the cells. On the other hand, increased amounts of GSH additionally direct the production of melanin toward the more soluble and lighter pheomelanin and lightens skin color significantly by reducing the overall melanin production [14].

The number of developments has shown that today skin-lightening formulations can be created without skin damages, produced with natural ingredients. At the same time these natural ingredients can protect the skin by additional activation of the body's own defense mechanisms.

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News & Noteworthy

Briefs

A new database designed to protect the US food supply went live on March 23, 2011. The Food Defense Mitigation Strategies Database (MSD) is one of several tools developed for the food industry by the US Food and Drug Administration to help thwart deliberate acts of contamination or tampering. The resource is designed for companies that produce, process, store, package, distribute, and/or transport food or food ingredients. The MSD provides a range of preventive measures that companies may choose to increase the security of their facilities, personnel, products, and operations. More information can be found at www.fda.gov/Food/FoodDefense/ucm245544.htm.

■■■

Emery Oleochemicals Group (Shah Alam, Selangor, Malaysia) and ERCA Group (Grassobbio, Italy) have signed a joint venture to increase the presence of both companies in the global home and personal wellness markets across Europe, Latin America, and Asia. A gradually recovering market and an uptick in global demand make the home and personal wellness segment a significant growth area for both companies. As one of the world's largest oleochemicals producers, Emery Oleochemicals has an extensive network of strategic distribution partners from around the world. ERCA Group has production sites in Europe, Asia, and South America.

■■■

Fortune magazine ranked Archer Daniels Midland Co. (Decatur, Illinois, USA) as the world's most admired company in the food production industry for the third consecutive year. *Fortune* ranked ADM at the top spot in the food production industry in six of the nine categories by which companies were evaluated: people management, social responsibility, quality of management, financial soundness, quality of products, and global competitiveness. A total of 673 companies from 32 countries were evaluated by more than 4,100 executives, directors, and security analysts.

■■■

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Forget peak oil, what about peak phosphorus?

Global production of phosphorus fertilizer could peak and decline later this century, causing shortages and price spikes that jeopardize world food production, according to a sustainability report issued on March 22, 2011, by five major scientific societies.

Along with nitrogen and potassium, phosphorus is one of the three key fertilizer substances that sustain the world's food supply, including staples such as rice, corn, and wheat. Projections indicate that world population will rise from 6.8 billion today to 8.9 billion in 2050. The Chemistry for a Sustainable Global Society report, which arose from a four-day summit sponsored by the Chinese Chemical Society, the German Chemical Society, the Chemical Society of Japan, the Royal Society of Chemistry, and the American Chemical Society, warned not only about "peak phosphorus"—an echo of the more familiar concerns about "peak oil"—but also raised red flags about the supply of other natural resources where monopolies or political instability could cut off supplies or inflate prices.

Thirty international experts on materials science participated in the event, which is part of an ongoing series of summits.

In the report's forward, Ryoji Noyori, who shared the 2001 Nobel Prize in Chemistry, said, "The chemist has a mandate to counsel society on the possible solutions that can be achieved through chemistry." Noyori is president of RIKEN, a non-profit research institute supported by the Japanese government, and a professor at Nagoya University.

Shortages of phosphorus in the soil are especially acute in Australia, the world's seventh-largest wheat producer, and in sub-Sahara Africa, where phosphorus content in the soil limits crop growth and millions of people already face malnutrition and periodic famine. The report cites the likelihood that resources of phosphate rock, mined to produce fertilizer, will be depleted within the next 30–100 years. At present, no substitute exists for that natural source of phosphorus fertilizer. Two thirds of the world's phosphorus resources are in China, Morocco, and the Western Sahara. Demand for phosphorus is already soaring, with the price of diammonium phosphate fertilizer doubling in recent years.

The report also pointed out that shortages of other elements essential for modern

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Solae (St. Louis, Missouri, USA), a world leader in soy ingredients, announced it would raise prices by an average of 6–10% across the globe, effective April 1, 2011, or as contracts allowed. Similar to other food and ingredient companies, Solae continues to be affected by recent surges in world food prices. According to the Food and Agriculture Organization (FAO) Food Price Index, food prices grew by 5.6% for the first two months of 2011 alone. The rise followed increases through the fourth quarter of 2010, bringing food prices to their highest level since 1990.

■■■

Solazyme (South San Francisco, California, USA), the leading industrial biotechnology company producing renewable oil and bioproducts from microalgae, has signed agreements with leading beauty retailer Sephora (Paris, France) and global multimedia retailer QVC (Wilmington, Delaware, USA) to launch Algenist™, Solazyme's microalgae-based prestige anti-aging skincare line, in the United States and internationally. The product will be available through QVC in the United States and in more than 800 Sephora stores in seven countries throughout Europe and the United States before expanding to Asia and the Middle East. ■

technology, from computers to hybrid cars, will occur unless similar efforts are made to find replacements or improve the efficiency of extracting and using existing materials. These materials include lithium, a component of batteries and an ingredient in some pharmaceuticals, as well as platinum, used in fuel cells and as catalysts. Other elements in short supply include rare earth elements, which are essential for the production of computers, hybrid-electric cars, military weapons, and other high-tech products.

"Little public awareness exists about the uncertain supplies of these key materials that we face today and the potential future shortages," said Nancy B. Jackson, president of the American Chemical Society, the world's largest scientific society. Jackson is with the Sandia National Laboratories in Albuquerque, New Mexico, USA. "Secure, adequate supplies of these materials are essential for production of food, medicines, computers, and hundreds of other products. Coming as it does during the International Year of Chemistry, the report demonstrates how the world's major scientific societies can collaborate in addressing great global challenges."

Want to reduce trans-fats with oils? Add hydrocolloids

Researchers from the Central Food Technological Research Institute (CFTRI) in New Delhi, India, demonstrated that it is possible to replace hydrogenated fat in bakery goods with sunflower or coconut oils without sacrificing the characteristics that are typically imparted by shortening.

In the April 2011 issue of the *Journal of Texture Studies*, Kumari and coworkers described how they mimicked the effects of shortening in pound cake by adding emulsifiers and hydrocolloids to the mix.

Unlike shortening, which is a semisolid, vegetable oils do not trap air when they are creamed with sugar. The result is a cake with less volume and a harsher crumb.

The new study looked at the effects of sunflower oil and coconut oil individually and in combination with emulsifiers (sodium stearoyl-2-lactylate and polysorbate-60) and hydrocolloids (guar gum and carboxymethylcellulose) on the rheological properties, fatty acid profile, and quality characteristics of pound cake.

While the oils made the batter runnier, increased its specific gravity, and decreased the overall quality score of the cakes, emulsifier and hydrocolloid additives imparted quality characteristics that were similar to the control cake made with shortening.

Best of all, replacing shortening with the oils increased the polyunsaturated fat content of the cakes by more than 40%. A fatty acid profile comparison showed that the control cake had 51.3% saturated fatty acids and only 6.5% polyunsaturated fatty acids (PUFA). On the other hand, the cake made with sunflower oil was rich in polyunsaturated fatty acids—mainly linoleic acid (44.6%)—and

Sustainability watch

Archer Daniels Midland Co. (ADM; Decatur, Illinois, USA) announced plans to invest in sustainable palm oil production in Brazil. The five-year investment will encompass approximately 12,000 hectares of palm production in the state of Pará and include the construction of a palm processing plant. ADM's sustainable palm and biodiesel production will be part of Brazil's Social Fuel Stamp program that provides incentives for biodiesel producers to purchase feedstock from small family farms. As part of this program, ADM will contract with approximately 600 family farms for 6,000 hectares of palm production and provide them with technical assistance focused on sustainable agricultural practices.

■■■

Beginning in March 2011, the fats and oils supplier AAK UK (Hull, UK) began making all of its bakery fats and many other standard product lines with RSPO-certified sustainable palm oil. AAK, which has been approved by the RSPO (Roundtable on Sustainable Palm Oil) as a supplier of certified sustainable palm oil, has also committed to supplying sustainable stearin within its bakery blends starting in 2012. This is the latest sustainability milestone for AAK, which in 2003 co-founded the RSPO and in 2008 imported Europe's first shipment of certified sustainable palm oil into its refinery in Hull, UK. In April 2010, AAK US was

the cake made with coconut oil was rich in medium-chain fatty acids—mainly lauric acid (48.9%).

Closer look at cell membrane shows cholesterol keeping order

Cell membranes form the "skin" of almost every cell in the human body, but there are not many experimental techniques that allow them to be viewed up close and in motion. A team of scientists working at the US National Institute of Standards and Technology (NIST) and the University of California, Irvine (USA) recently developed a new way to magnify cell membranes. Their work has helped illuminate the important role of cholesterol within this boundary between the cell and the outside world.

The multi-institutional team used tools at the NIST Center for Neutron Research (NCNR) in Gaithersburg, Maryland, to examine the membrane at more than 1,000 times the resolution offered by an optical microscope—the equivalent of magnifying the point of a needle to the size of a large building. This enabled an unprecedented look at the membrane, which—because it controls access to our cells—is a major target for many drugs.

"Drugs that affect pain sensation, heart rhythm, mood, appetite, and memory all target proteins lodged in the cell membrane that function like little gates," said Mihaela Mihailescu of the Institute for Bioscience and Biotechnology Research, a joint institute of NIST and the University of Maryland. "Because membranes and their proteins are important to medicine, we would like a better picture of how the membrane functions—and not just a better snapshot. We want to see it move, as it does constantly in real life."

Optical microscopes offer limited resolution, whereas the more powerful electron microscopes require freezing samples before they can be magnified. But by using neutron diffraction, which does not require frozen subjects, the team not only observed the membrane more closely and in motion but also gained insight into the long-known phenomenon of the membrane growing thicker and stiffer in the presence of cholesterol.

These lipid chains form a two-layer skin with the "heads" of the lipids facing outward toward the cell's exterior and "tails" intermingling on the inside of the cellular membrane. Cholesterol is known to be important for managing disorder in membranes. The team saw for the first time that when cholesterol is present, these tails line up in a tight formation, looking like a narrow stripe from which the lipid chains stretch outward—and producing the order that had been previously anticipated, but never shown directly. But without cholesterol, the tails go a bit wild, flapping around energetically and in some cases even pushing up toward their chains' heads.

Mihailescu says the findings hint that cholesterol may have profound consequences for the membrane's gatekeeper proteins, which are very sensitive to their environment. "The membrane and its proteins interact constantly, so we're curious to learn more," she says. "With this unique magnification technique, we can explore the cell membrane more effectively than ever possible, and we are now establishing a research program with the University of Maryland to do so in greater detail." View image at http://www.nist.gov/ncnr/cell-033011.cfm.

Jaypee executive discusses plans to venture into edible oils

In an interview with *The Economic Times* that appeared online on March 31, 2011, Manoj

Gaur, executive chairman of the large conglomerate Jaypee Group (Uttar Pradesh, India), discussed the company's plans to construct a soya and mustard processing plant at Rewa, Madhya Pradesh, that will process 1 lakh tonne (100,000 metric tons) each of soya and mustard each year.

Gaur explained that the company is entering the edible oils business so that farmers in the region who would otherwise have to travel long distances in search of a better price for their produce "will have a willing buyer at their doorsteps."

A separate company, Jaiprakash Agri Initiatives Company, has been floated to manage the business, which will initially procure oilseeds from villages located within a radius of 100 kilometers of Jaypee Nagar in Rewa.

Gaur expressed confidence in India's ability to accommodate another player in the edible oils market, pointing out that India is currently importing almost 50% of its total consumption of edible oils.

When asked to predict the future of the edible oils business in five years in an era when consumers are becoming health conscious, Gaur noted that according to government estimates, India is facing a serious deficit in edible oil production. "With both population and income levels of consumers on the rise, the edible oil sector has a very bright future," he was quoted as saying. "Nutritionists too feel that edible oils are essential for good health. Consumers need to be educated about how to choose a good edible oil. According to nutrition science, domestically produced oils like mustard, soybean, and sunflower are nutritionally better than imported palm oil."

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the first company in the United States to import RSPO-certified sustainable palm oil.

■■■

McDonald's Corporation has announced its Sustainable Land Management Commitment (SLMC), part of the company's effort to ensure that the food and packaging used in its restaurants around the world are sourced from certified sustainable sources. McDonald's actions will initially be focused on five materials (beef, poultry, coffee, palm oil, and packaging) that were identified via a collaborative analysis with the World Wildlife Fund (WWF) as potentially having the most sustainability impacts. The new SLMC requires that, over time, its suppliers will only use agricultural raw materials for the company's food and packaging that originate from sustainably managed land. ■

Starch-controlling gene increases protein in soybean plants

A newly discovered gene introduced into soybean plants increased the amount of protein in the plant's seeds by 30 to 60%.

The gene, found only in *Arabidopsis* plants, was placed into the soybean plants by Eve Wurtele, professor of genetics, development and cell biology at Iowa State University (Ames, USA) and Ling Li, an adjunct assistant professor and an associate scientist working in her laboratory. The results were a pleasant surprise as the function of the gene, known as QQS, was previously unclear because its sequence is very dissimilar from all other plant genes.

"Most genes contain clues in their DNA sequence as to their biological function," said Wurtele. "But this one has no sequence features that gave us any hint of what it's doing."

Arabidopsis is a small, flowering plant in the mustard family that is often used in scientific research. When the researchers neutralized the gene in the plant, they discovered the gene was involved in regulating starch accumulation, called deposition.

"Based on the changes in activities of other genes that occurred when we altered QQS, we conjectured that it wasn't directly involved in starch synthesis, but rather it may be involved in altering [the plant's] composition in general," Wurtele explained. "We decided to test this concept by transferring the gene to an agronomically important plant species, soybean, which has a seed and is important as a source of vegetable protein and oil."

In addition to having a DNA sequence that is not similar to any other gene in that or any other plant, the gene is also unusual because it has only 59 amino acids. The median size of a gene in *Arabidopsis* plants is 346 amino acids. Wurtele hopes that the discovery may lead to a greater understanding of other genes that don't have recognizable functionalities based on their sequences.

Woody oilseeds seen as solution to China's growing demand for edible oils

The Xinhua Economic News Service in Beijing reported on March 11 that China's Ministry of Finance will make more capital available for the development of woody oilseed-bearing trees such as tea-tree, camellia, walnut, and olive.

One deputy to the National People's Congress, the country's top legislature, was quoted in the report as saying that developing the woody oilseeds industry "was of great significance to relieve pressure on domestic supply against a backdrop of rising prices on the international grain and oils markets."

More than half of the growing demand for soybeans and vegetable oil in China is supplied through imports, making the domestic edible oil market vulnerable to global price fluctuations. Meanwhile, more than 90% of the edible oils produced domestically comes from herbal oilseeds such as rapeseed, peanuts, and soybeans. Expanding the production of such herbal oilseeds could affect grain security by limiting arable land resources.

Making full use of nonfarming land to strengthen the production of woody oilseeds is seen as a better solution. Nearly 53.33 million hectares of barren mountainous areas in China are fit for planting woody oilseed-bearing plants. Production bases for woody oilseed-bearing plants have already been built in mountainous areas throughout the country in response to the increasing demand for edible oils. The majority of the 5.47 million hectares currently under cultivation are located in six provinces (Yunnan, Hunan, Gansu, Hubei, Jiangxi, and Henan).

Bayer opens seed research lab in Singapore

Bayer CropScience (Leverkusen, Germany) has opened an expanded seed research laboratory in Singapore dedicated to support the development of new high-yielding and high-quality seed varieties and hybrids. The original rice seed analytics lab has been relocated and expanded to support a broader range of seed breeding and development activities across Asia/Pacific. Representing an investment of around €20 million over the next five years, the new research unit will work with cutting-edge technologies such as DNA marker analysis and molecular-assisted breeding.

The scientists at the new facility will work to screen and integrate innovative agronomic and quality traits in canola, corn, cotton, wheat, soybean, and rice. Work will also focus on plant pathology for better control of diseases. Agronomic traits of interest include novel modes of or enhanced resistance to diseases, pests, and environmental stress. Quality traits of interest include better storability, easier processing, improved grain quality and nutritional profile, better cooking features, and enhanced fiber quality in the case of cotton.

Molecular-assisted breeding will allow Bayer to deliver high-value, competitive germplasm to the market more quickly. The expanded lab facility will also enable the identification, validation, and deployment of new high-throughput and cost-effective molecular markers and marker detection systems to support the company's elite breeding programs. Currently, 15 scientists and technicians are employed at the new seed analytics laboratory, which has a capacity of more than 30 scientists and technicians. ■

Briefs

The Advertising Standards Authority (ASA) of the United Kingdom banned an ExxonMobil television advertisement because, it said, the company's claims relating to environmental benefits of using algae to form biofuels were misleading. In the ad, a person identified as a scientist said, "[Algae] absorb CO_2, so they help solve the greenhouse gas problem." ExxonMobil acknowledged that the study cited in the ad did not specifically analyze algae. The ASA concluded the ad overstated the technology's total environmental impact and was therefore misleading.

■■■

Cardiles Oil Company, headquartered in Madrid, Spain, is building a plant in Cañetes de las Torres, Córdoba, Spain, that will use olive cake (orujillo) to make biofuel. The company is using a Japanese process, the Kurata system, to break down compounds containing carbon, hydrogen, and oxygen by fast pyrolysis to form second-generation biofuels. The facility is expected to produce 12 million liters of biofuel annually from 40,000 metric tons (MT) per year of olive waste. Based on the outcome of this project, Cardiles plans to construct another facility in Almeria once the Cañetes de las Torres plant is commissioned. The Almeria facility is being designed to process around 200,000 MT per year of vegetable waste from greenhouses to produce 30,000 MT of biofuels.

■■■

According to Biodiesel Magazine (http://tinyurl.com/German-biodiesel), approximately 2.6 million metric tons (MMT) of biodiesel was sold into the German fuel market in 2010. Of that, about 2.3 MMT was sold for blending into the 32.1 MMT German diesel fuel market, or slightly more than 7%. For comparison, the United States in 2010 produced 1.0 MMT.

■■■

The US Air Force successfully flew an F-22 Raptor fueled by a 50:50 blend of petroleum-based JP-8 and hydroprocessed synthetic fuel derived from camelina oil on March 18. Testing took place at Edwards Air Force Base (Cali-

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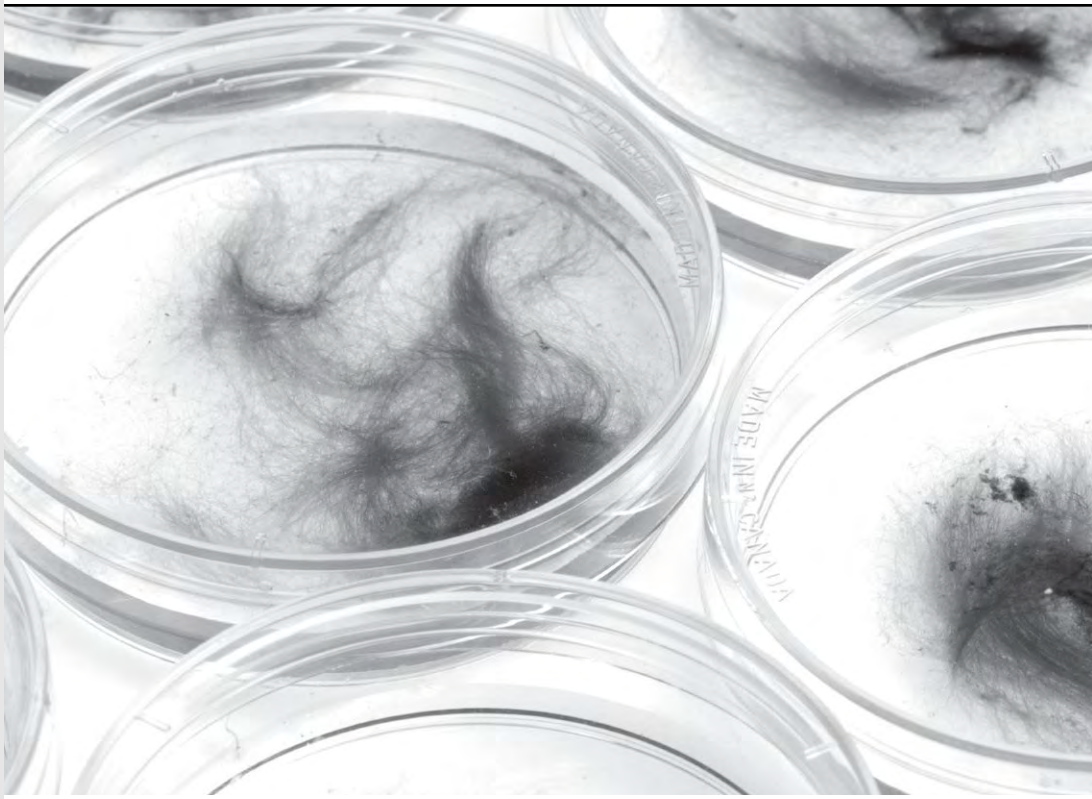
Biofuels News



ALGAE

Solazyme files for IPO

The much-anticipated announcement came on March 11 that algae company Solazyme had filed for a $100 million initial public offering (IPO). The South San Francisco (California, USA)-based company is seeking to raise funds for research and development activities and to accelerate its business, as well as to fund working capital and for general corporate purposes.

Solazyme is not the first US biofuel company to announce an IPO—Gevo and Amyris preceded Solazyme—but it is one of the first companies using algae to list on a major stock exchange. The company said it would like to list the stock on the NASDAQ Global Market under the symbol SZM.

The company grows algae through a fermentation process, not photosynthesis. Genetically modified strains that feed on sugar are used to produce oils and biomaterials that can be optimized for biofuels, as replacements for fossil petroleum, and as ingredients for cosmetics and foods.

Earlier in March, Solazyme announced a joint development agreement with The Dow Chemical Company (Midland, Michigan, USA) to speed up the development of Solazyme's oils for use in next-generation dielectric insulating fluids used in transformers and other electrical applications.

As reported by Sustainable Business.com (March 14, 2011), Solazyme is at present losing money. But the same was true when Gevo made its IPO in February 2011, and when Amyris did the same in September 2010.

RENEWABLE DIESEL

Syntroleum reports $9.5 million loss

Syntroleum Corp. (Tulsa, Oklahoma, USA) is in a 50:50 joint venture with Tyson Foods (Springdale, Arkansas, USA) to process waste animal fats and greases into renewable diesel and specialty distillate products at their Dynamic Fuels LLC facility (Geismar, Louisiana, USA). (See *inform* 21:559, 2010;

fornia) and consisted of air starts, operability, and performance at different speeds and altitude throughout the flight envelope. The plane carried out a supercruise at 40,000 feet (12,000 meters), reaching speeds of 1.5 Mach. Supercruise is supersonic flight without using the engine's afterburner.

The camelina oil was supplied by Sustainable Oils (Bozeman, Montana). According to a statement by the company (http://tinyurl.com/camelina-fuel), it has contracted for more than 500,000 gallons (2.2 million liters) of camelina-based biofuel with the US Air Force, Navy, and Army.

■■■

On March 21 *The New York Times* reported on efforts by US Marines stationed in Afghanistan to develop locally produced energy crops. Sgt. Brian Nelson, a chemical engineer from Falmouth, Massachusetts, successfully demonstrated that excess cottonseed oil produced by a cotton gin in Helmand province could be mixed with JP-8, the military's universal fuel, in a generator. The mixture burned a bit slower than straight JP-8, and the generators required a bit more maintenance, but filters were easily cleaned and emissions were also cleaner. For cold conditions, Nelson used heat from the generator to warm the oil, or else kept the oil inside until it was ready to be used. The hope is that local farmers will realize the potential for profit that such oil could provide.

■■■

A patent application was recently filed by OriginOil (Los Angeles, California, USA) for a technology to keep algae healthy and productive by eliminating microscopic predators without using chemicals. Invaders such as rotifers, bacteria, and ciliates are attracted especially to oil-rich algae. The technology targets invaders with calibrated pulses of low-power electromagnetic energy while not damaging the algae. The pulsing and power levels are adjustable for different algal types and environmental conditions, such as water hardness, and salinity. ■

22:22, 2011.) Dynamic Fuels entered start-up mode in November 2010, and in the interval has produced and sold 3.8 million gallons (14 million liters) of renewable product and 40,000 gallons (150,000 liters) of jet fuel that is being tested by the US military, as reported by the newspaper *Tulsa World* (March 16, 2011). However, Syntroleum's overall revenues totaled only $8.4 million in 2010, compared with $27.4 million in 2009.

In an investor conference call presenting the company's fourth quarter earnings, Jeff Bigger, senior vice president for business development of Syntroleum, said, "The Geismar plant has processed a wide range of feedstocks that have been delivered by more than 20 different suppliers. The feeds processed to-date include beef tallow, choice white grease from pigs, poultry fat, and a wide range of yellow greases, which typically are vegetable oils that have been used in restaurant frying operations. The plant chemistry has worked very well, converting the fats, oils, and greases into diesel, naphtha, and LPG [liquefied petroleum gas]."

Problems with pump seals and with valves in a hydrogen compressor have delayed Dynamic Fuels' efforts to reach full production according to the *Arkansas Democrat-Gazette* newspaper (Little Rock, USA). Once Dynamic Fuels achieves full commercial operation, Syntroleum and Tyson expect increased revenues.

Camelina project initiated in Europe

French plane manufacturer Airbus and TAROM Romanian Air Transport (Otopeni, Romania), in conjunction with a consortium of stakeholders, have initiated a project to make sustainable bio-kerosene. The proposed feedstock for the fuel is camelina oil. It was selected for its energy potential, its rotational crop qualities, its potential for reducing greenhouse gas emissions, and its low water needs.

Camelina is indigenous to Romania, and can readily be grown by smallholders. The residual meal after oil expression from camelina seeds is a high-quality animal feed by-product.

Once feasibility studies on agricultural, technological, and aeronautical development and sustainability assessment are complete, the project will also assess the existing refining facilities in order to identify the Romanian production capability.

Airbus will support the fuel approval processes, and lead in assessing the effect on the aircraft systems and engines. The consortium will work together with the Bucharest University of Agronomical Sciences and Veterinary Medicine's Centre of Biotechnology on the sustainable agricultural phase of the project regarding the camelina plantations, harvesting, and oil production.

TAROM is leading the consortium, which includes Honeywell's UOP, CCE (Camelina Company España, Madrid), and Airbus. Honeywell's UOP is applying its aviation bio-fuel refining technology; and CCE is contributing its knowledge on camelina agronomy, including technologies for camelina growth, agricultural monitoring networks, and plant science. Airbus is providing technical and project management expertise and is sponsoring the sustainability assessment and life cycle analysis.

JATROPHA

Environmental groups protest against jatropha in Africa

ActionAide, an international agency working to end poverty and injustice for poor and disadvantaged people in 40 countries, released information in March from a study carried out by the North Energy Associates consultancy (Stocksfield, Northumberland, UK) indicating that biofuels made from jatropha could lead to the release of 2.5–6 times more greenhouse gases during the production and consumption of jatropha oil than the emissions associated with production and burning of fossil fuels. The study, which centers on a proposed plantation in the Dakatcha Woodlands in Kenya, was also funded by the Royal Society for the Protection of Birds (RSPB) as well as NatureKenya.

The Dakatcha area is one of the last tracts of coastal forest remaining in Kenya. The forest will have to be cleared to make way for the plantation, and over 20,000 people, members of the indigenous minority Watha and Giriama tribes, will be evicted, destroying their livelihoods and sacred burial sites. The Dakatcha Woodlands is also an Important Bird Area, according to international wildlife organizations (e.g., NatureKenya, RSPB,

Audubon Society), and is home to a number of globally threatened bird species, particularly Clarke's weaver bird.

In 2009, Kenya Jatropha Energy Ltd., owned by Italian company Nuove Iniziative Industriali Srl, proposed clearing 50,000 hectares in the Dakatcha area to develop the plantation. Protests from the local population forced the Kenyan government to put the project on hold, but Nuove Iniziative Industriali has come back with a proposed pilot project of up to 10,000 hectares.

Much of the fuel that could be produced in the Dakatcha area would be slated to go to Europe, because of the European Union target requiring that 10% of transport fuels be renewable by 2020, rather than to Kenya.

Planning affects jatropha success in Africa

In Zambia, 8,000 farmers in the North Western Province who are participating in their first season of a three-year trial of jatropha are expected to harvest more than 100 metric tons of seeds. North Western BioPower, which is managing the project, plans to install an expeller machine for processing the crop.

Allan Mbale, manager for North Western BioPower, told the *Post Zambia* (www.postzambia.com/post-read_article.php?articleId=19368) that the company will have no capacity to sustain the activities of the farmers if the European Union-funded project is not renewed.

A biodiesel plant in Zimbabwe is also struggling to continue. The plant, located about 15 km northwest of the capital of Harare, was the product of joint efforts between the Reserve Bank of Zimbabwe and Korean investors. It has been designed to process oils from feedstocks such as sunflower seeds, jatropha seeds, cotton seeds, and soybeans. At full capacity it should be able to produce 100 million liters annually.

However, the plant has never operated on a commercial basis, according to *The Herald*, a newspaper published by the government of Zimbabwe. Several issues were overlooked in the planning of the facility. One was the ability of local farmers to grow and supply enough oil seeds. A second was insufficient training for these farmers in growing these crops. A third was the absence of crushing plants in the area to extract oil for processing into fuel.

The Herald quoted Munyaradzi Kereke, advisor to the governor of the Reserve Bank of Zimbabwe, as saying, "It's very sad that such a noble innovation has been allowed to be seriously underutilized for what reason the authorities do have." He added, "The biodiesel project is as relevant today as it was when it was officially launched [three years ago] by . . . President Mugabe."

SG Biofuels expands to India, Brazil

SG Biofuels, headquartered in San Diego, California, USA, announced its expansion into India in early March. The company has been accumulating a library of DNA and genome information about jatropha, in collaboration with Life Technologies Corp. (Carlsbad, California), in its efforts to design hybrid seeds adapted to particular soils, light patterns, and growth conditions.

Subhas Pattnaik has been named director of operations for the Indian office of SG Biofuels. Pattnaik formerly led operations for Mission NewEnergy Ltd. in India, where he managed the establishment of a jatropha plantation of 200,000 acres (81,000 hectares), 124,000 farmers, and five provinces.

In a company statement, Pattnaik said, "While Jatropha holds tremendous promise as the primary feedstock for biofuels in India, its success is dependent upon the development of improved planting material with higher, more consistent yields than what is being realized today." He added, "With its extensive and diverse library of genetic material, applied plant genetics, and crop improvement platform, SG Biofuels has the right approach to realize the crop's potential in India."

In January 2011, SG Biofuels announced initiation of business operations in Brazil, with Brazilian entrepreneur and genomics innovator Fernando Reinach as senior advisor for its subsidiary, SG Biofuels Brasil, Ltd., based in São Paulo.

BIODIESEL

Europe extends biodiesel import duties

According to Reuters news agency (March 31), European Union (EU) governments approved on March 31 the extension of import duties, originally imposed July 12, 2009 (*inform 20*:420, 511, 2009), on US-made biodiesel in response to evidence that US exporters were evading EU tariffs by shipping via Canada. The duties are worth up to about €400 per metric ton (MT) on biodiesel arriving from Canada.

Earlier, Reuters reported that US exports of biodiesel blends to the EU were 1.5 million MT in 2008, but less than 400,000 MT in 2009, whereas Canadian sales to the EU moved from 1,700 MT in 2008 to more than 140,000 MT in 2009. Canadian exporters attributed this change to growing EU demand and the supply gap left by the United States.

The duties are slated to stay in place until 2014 and are intended to counteract what the EU claims are illegal US subsidies for biodiesel blends.

Sustainability certification to Mission NewEnergy

In a company statement, Mission NewEnergy Ltd., headquartered in Perth, Australia, announced in March that it had entered a long-term supply agreement with Felda Global Group (Kuala Lumpur, Malaysia) that establishes Asia's first fully integrated and certified palm biodiesel supply and production chain.

Felda, one of the world's largest palm oil producers, in collaboration with Mission, recently completed ISCC (International Sustainability & Carbon Certification System) certification of two of its mills and eight plantations in Peninsular Malaysia. Mission's 100,000 metric tons per annum plant in Kuantan was the first biodiesel facility outside Europe to gain full ISCC certification.

Under the arrangement, Mission and Felda Global Group will work together to extend the certification program to additional Felda mills and plantations, further expanding the available supply of ISCC-certified biodiesel through Mission's refineries.

"Mission and Felda's certification constitute full supply chain carbon emissions reporting to demonstrate compliance with German and European GHG [greenhouse gases] savings targets," said Nathan Mahalingam, chief executive officer of Mission.

Currently, ISCC is required for companies wanting to supply biofuel or bioliquid

in Germany, which provides subsidies, tax exemptions, and other privileges to biofuel users. It was written into law in Germany in November 2010.

ETHANOL

US small-engine manufacturers plead for E10

Small-engine manufacturers in the United States continue to seek reassurance that current grades of gasoline will be available once E15 (85% gasoline + 15% ethanol) is introduced (see *inform* 22:118, 141, 2011), perhaps later in 2011.

The US Environmental Protection Agency (EPA) has approved E15 for use in cars and light trucks made in 2001 or later. The Outdoor Power Equipment Institute and 11 other trade groups have petitioned the EPA to require the continued availability of fuel containing 10% ethanol or less once E15 becomes available.

The engine manufacturers claim that boats, lawn mowers, and other outdoor power products designed to use E10 may overheat and perform poorly if they are fueled with E15. Kris Kiser, executive vice president of the Outdoor Power Equipment Institute, told the *Milwaukee Journal-Sentinel* (March 28), "Misfueling is our primary concern. People mostly buy gasoline based on price. If they can get E15 cheaper, that's what they're going to buy."

In the 1970s, when the United States made the transition from leaded to unleaded gasoline, the misfueling rate was 15%, according to the engine manufacturers. As of March 28, the EPA has set no date for a ruling on the engine manufacturers' petition.

GENERAL

Global clean energy investment still growing

Global clean energy finance and investment grew in 2010 to $243 billion, a 30% increase from 2009. China, Germany, Italy, and India were among the nations that most successfully attracted private investments, according to research released on March 29 by The Pew Charitable Trusts (Washington, DC, USA).

China continued to lead the world in clean energy expenditures. Its $54.4 billion in investments in 2010 represents a 39% increase from 2009. Germany was second in the G-20 nations, up from third in 2009, after experiencing a 100% increase in investment to $41.2 billion.

"The clean energy sector is emerging as one of the most dynamic and competitive in the world, witnessing 630% growth in finance and investments since 2004," said Phyllis Cuttino, director of Pew's Clean Energy Program. "Countries like China, Germany, and India were attractive to financers because they have national policies that support renewable energy standards, carbon reduction targets, and/or incentives for investment and production and that create long-term certainty for investors."

The United States, which had maintained the top spot until 2008, fell another rung in 2010 to third with $34 billion. The United Kingdom experienced the largest decline among the G-20, falling from fifth to 13th. The report suggests that uncertainty surrounding clean energy policies in these countries is causing investors to look elsewhere for opportunities.

The complete report, including country profiles, interactive graphics, and video, is available at www.PewEnvironment.org/CleanEnergy. ■

Health & Nutrition News

Briefs

Micronutrient-enriched rapeseed oils could prevent cognitive impairment by reducing oxidative stress in the brain, according to research conducted at the Istituto Superiore di Sanità in Rome, Italy. Results, which appeared in the *Journal of Agricultural and Food Chemistry*, showed that feeding rats a diet of optimized rapeseed oils decreased lipid peroxidation and increased the endogenous antioxidant status of the rats' brains in parallel with increasing levels of micronutrient enhancement. Oxidative stress is particularly harmful to the human brain and can lead to neuronal death and neurodegenerative disorders such as dementia.

■■■

In March, the Codex Committee on Methods of Analysis and Sampling (CCMAS) endorsed guidelines for milk, milk products, and infant formula that will allow authorities to check the level of melamine in powdered infant formula against the recently adopted Codex maximum level of 1 milligram melamine per kilogram of product. The guidelines for the quantitative determination of melamine and cyanuric acid were developed jointly by the International Dairy Federation and the International Organization for Standardization in response to incidents of milk adulteration with melamine that occurred in 2008. They await final adoption by the Codex Alimentarius Commission in July 2011.

■■■

An independent panel of recognized experts has determined Aker BioMarine Antarctic's Superba™ krill oil to be safe for use as an ingredient in human food. The high-phospholipid krill ingredient is intended for use as a source of omega-3 fatty acids in a number of food categories, including beverages, cereals, cheese, dairy products, and other nutritional foods. The company, headquartered in Oslo, Norway, is exploring functional food applications in the United States and in Europe, where Superba krill oil is recognized as safe under the Novel Foods regulation.

■■■

Acrylamide has been added to the list of chemicals that the US state of California recognizes as causing reproduc-

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Omega-3 fatty acids may reduce risk of AMD vision loss

Regular consumption of fish and omega-3 fatty acids found in fish is associated with a significantly reduced risk of developing age-related macular degeneration (AMD) in women, according a study published online on March 14 in the *Archives of Ophthalmology*.

AMD is a chronic and progressive eye disease that attacks the area of the eye responsible for central vision. It is the most common cause of age-related vision loss, affecting an estimated 9 million US adults aged 40 years and older. An additional 7.3 million persons have early AMD, which is usually associated with moderate or no vision loss but does increase the risk of progression to advanced AMD.

For this study, researchers at Brigham and Women's Hospital and Harvard Medical School (Boston, Massachusetts) collected data on 38,022 women who had not been diagnosed with AMD. Information on their eating habits was obtained at the beginning of the study and included information on their intake of docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) [omega-3 fatty acids found in fish], and arachidonic acid and linoleic acid (omega-6 fatty acids). During 10 years of follow-up, additional questionnaires tracked the women's eye health, with specific focus on diagnosis of AMD.

Over the course of follow-up, 235 cases of AMD were reported. In analyses that adjusted for age and treatment assignment, women who consumed the most DHA had a 38% lower risk of developing AMD than women who consumed the lowest amount. Similar results were observed for higher intake of EPA and for higher consumption of both types of acid together.

Results for fish intake showed that consumption of one or more servings of fish per week, when compared to less than one per month, was associated with a 42% lower risk of AMD. This lower risk appeared to be due primarily to consumption of canned tuna fish and dark-meat fish.

You are what your mother ate

Poor diet during pregnancy increases an offspring's vulnerability to the effects of aging, according to research by scientists at the

tive toxicity for the purposes of the Safe Drinking Water and Toxic Enforcement Act of 1986. The listing by the California Environmental Protection Agency's Office of Environmental Health Hazard Assessment was based on formal identification by two agencies (the National Institute for Occupational Safety and Health and the National Toxicology Program's Center for Evaluation of Risks to Human Reproduction) that the chemical causes developmental and male reproductive toxicity.

■■■

On March 27, scientists at the 241st National Meeting & Exposition of the American Chemical Society presented an analysis of nine different kinds of nuts showing that a handful of walnuts contained twice as many antioxidants as a handful of any other commonly eaten nut. The antioxidants were also higher in quality and potency than those in any other nut—two to 15 times as powerful as vitamin E, according to Joe Vinson, a professor of chemistry at the University of Scranton in Scranton, Pennsylvania who conducted the analysis. "Walnuts rank above peanuts, almonds, pecans, pistachios, and other nuts," he said.

■■■

The US Food and Drug Administration issued a No Objection Letter to Cargill Inc. (Minneapolis, Minnesota) on February 16, 2011, in response to the determination that Cargill's arachidonic acid-rich oil (ARA), a nutritional infant formula ingredient, is Generally Recognized as Safe (GRAS) under the agency's guidelines. The determination, coupled with the opening of the global ARA-related patent landscape and additional regulatory approvals, will allow Cargill to service the global infant formula industry with ARA.

■■■

Patients with a recent onset of Parkinson's disease have a high prevalence of vitamin D insufficiency, but vitamin D concentrations do not appear to decline during the progression of the disease, according to a report by M.L. Evatt and coworkers in the March issue of *Archives of Neurology*. Vitamin D insufficiency has been associated with a variety of clinical disorders and chronic diseases, including impaired balance, decreased muscle strength, mood and cognitive dysfunction, autoimmune disorders such as multiple sclerosis and diabetes (types 1 and 2), and certain forms of cancer. ■

University of Cambridge (Cambridge, UK). Their findings, published online on March 8 in the *Proceedings of the National Academy of Sciences*, provide insight into why children born to mothers who consumed an unhealthful diet during pregnancy have an increased risk of type 2 diabetes (a significant contributing factor to heart disease and cancer) later in life.

"What is most exciting about these findings is that we are now starting to really understand how nutrition during the first nine months of life spent in the womb shapes our long-term health by influencing how the cells in our body age," said Susan Ozanne, the senior author on the paper.

It is well established that environmental factors interact with genes throughout life, affecting the expression of those genes and, consequently, tissue function and disease risk. Diet during critical periods of development, such as during the nine months in the womb, has been cited as one such environmental factor. Epigenetics, which refers to modifications to DNA that regulate how much of a gene is produced, has been suggested to underlie these effects.

However, until now, very little was understood about the underlying mechanisms that control the interaction between diet during gestation and gene expression in offspring throughout their adult life. Research, funded by the Biotechnology and Biological Sciences Research Council and the British Heart Foundation, has now shown that the gene *Hnf4a*, which has been linked to type 2 diabetes, is regulated by maternal diet through epigenetic modifications to our DNA. Additionally, they found that poor diet exacerbates the rate at which these key epigenetic modifications accumulate during the aging process.

Previous research has shown that the gene *Hnf4a* plays an important role both during development of the pancreas and later in the production of insulin. The researchers hypothesized that diet during pregnancy influences the expression of this gene later in life, thereby influencing the risk of diabetes.

To test their theory, the researchers used a well-established rat model where, by altering the protein content of the mother's diet during pregnancy, the offspring develop type 2 diabetes in old age.

First, they studied the RNA from insulin-secreting cells in the pancreas from offspring of normally fed as well as malnourished mothers in young adult life and in old age. When they compared the two, they found that there was a significant decrease in the expression of the *Hnf4a* gene in the offspring prone to type 2 diabetes. The expression of *Hnf4a* also decreased with age in both groups.

Second, they studied the DNA and found that the decrease of *Hnf4a* was caused by epigenetic changes. The age-associated epigenetic silencing was more pronounced in rats exposed to poor maternal diet. They concluded that the epigenetic changes resulting from maternal diet and aging lead to the reduced expression of the *Hnf4a* gene, decreasing the function of the pancreas and therefore its ability to make insulin (and thereby increasing the risk of diabetes).

The scientists then studied the DNA from insulin-secreting cells from human pancreases to show that expression of this important gene was controlled in the same way in humans.

A new explanation for chocolate's heart-healthy benefits

Studies have shown that cocoa, the main ingredient in chocolate, appears to reduce the risk of heart disease by boosting levels of high density lipoprotein (HDL), or "good," cholesterol and decreasing levels of low density lipoprotein (LDL), or "bad," cholesterol. Credit for those heart-healthy effects goes to antioxidant polyphenols, which are particularly abundant in dark chocolate. Until recently, however, nobody knew exactly how the polyphenols in cocoa orchestrated those beneficial effects.

A study published in the February 23 issue of the *Journal of Agricultural and Food Chemistry* suggests that the polyphenols in chocolate enhance the activity of certain proteins, including proteins that attach to DNA in ways that boost HDL levels.

The scientists analyzed the effects of cacao polyphenols on cholesterol using cultures of human hepatoma and intestinal cells. They focused on the production of apolipoprotein A1 (ApoA1), a protein that is the major component of HDL cholesterol, and apolipoprotein B (ApoB), the main component of LDL cholesterol. Cacao polyphenols increased ApoA1 levels and decreased ApoB levels in both the hepatoma and intestinal cells. Further, the scientists discovered that the polyphenols seem to work by enhancing the activity of sterol regulatory element binding proteins (SREBP). SREBP attach to

DNA and activate genes that boost ApoA1 levels, increasing HDL cholesterol. The scientists also found that polyphenols appear to increase the activity of LDL receptors, proteins that help lower LDL cholesterol levels.

Low vitamin D linked to allergies in children

A study of more than 3,000 children shows that low vitamin D levels are associated with increased likelihood that children will develop allergies, according to a paper published in the February 17, 2011, online edition of the *Journal of Allergy and Clinical Immunology*. Researchers from Albert Einstein College of Medicine of Yeshiva University (New York City, USA) headed the study.

Researchers looked at the serum vitamin D levels in blood collected in 2005–2006 from a nationally representative sample of more than 3,100 children and adolescents and 3,400 adults. The samples were derived from the National Health and Nutrition Examination Survey (NHANES), a program of studies designed to assess the health and nutritional status of adults and children in the United States. The survey is unique in that it combines interviews, physical examinations, and laboratory studies. One of the blood tests assessed sensitivity to 17 different allergens by measuring levels of immunoglobulin E, a protein made when the immune system responds to allergens.

When the Einstein researchers analyzed the resulting data, they found no association in adults between vitamin D levels and allergies. But for children and adolescents, low vitamin D levels correlated with sensitivity to 11 of the 17 allergens tested, including both environmental allergens (e.g., ragweed, oak, dog, cockroach) and food allergens (e.g., peanuts). For example, children who had vitamin D deficiency (defined as less than 15 nanograms of vitamin D per milliliter of blood), were 2.4 times as likely to have a peanut allergy than were children with sufficient levels of vitamin D (more than 30 nanograms of vitamin D per milliliter of blood).

The research shows only an association and does not prove that vitamin D deficiency causes allergies in children, cautioned Michal Melamed, assistant professor of medicine and of epidemiology & population health at Einstein and senior author of the study. Nevertheless, she said, children should certainly consume adequate amounts of the vitamin. "The latest dietary recommendations calling for children to take in 600 IU of vitamin D daily should keep them from becoming vitamin-D deficient," she said.

A dose of safflower oil each day might keep heart disease at bay

A daily dose of safflower oil, a common cooking oil, for 16 weeks can improve such health measures as good cholesterol, blood sugar, insulin sensitivity, and inflammation in obese postmenopausal women who have type 2 diabetes, according to new research published online in the journal *Clinical Nutrition* (doi: 10:1016/j.clnu.2011.01.001).

The finding came about 18 months after the same researchers discovered that safflower oil reduced abdominal fat and increased muscle tissue in this group of women after 16 weeks of daily supplementation.

"The women in the study didn't replace what was in their diet with safflower oil. They added it to what they were already doing. And that says to me that certain people need a little more of this type of good fat—particularly when they're obese women who already have diabetes," said Martha Belury, professor of human nutrition at Ohio State University (Columbus, USA) and lead author of the study.

Safflower oil contains linoleic acid, a polyunsaturated fatty acid (PUFA). Research dating back to the 1960s has suggested that these dietary oils from plant sources can help prevent heart disease, but attention to these fats has declined as omega-3 fish oils have gained popularity among consumers.

"The health benefits of omega-3 PUFAs seem convincing, but I think there's also a place for omega-6 PUFAs. We've known for a long time that polyunsaturated oils are very beneficial for cardiovascular disease prevention, and these data we are adding now show that these oils can also help with other aspects of metabolic syndrome, including even glycemic control," Belury said. "We suspect it could be through a mechanism that is not yet identified."

At the start of the study, the women were obese and had Type 2 diabetes, low HDL cholesterol, and high levels of C-reactive protein and the HbA1c protein. Within 12 weeks, the safflower oil led to a 14% increase in HDL, or "good," cholesterol, as well as an increase in adiponectin, a hormone that regulates levels of blood sugar and fats and influences insulin levels. After 16 weeks, the women experienced on average an increase in insulin sensitivity of about 2.7% (lowered insulin sensitivity is the hallmark of type 2 diabetes), a small but significant decrease in the blood protein HbA1C (a marker of long-term presence of excess glucose in the blood), and a roughly 17.5% decrease in C-reactive protein (a protein in the blood that rises in the presence of inflammation).

"Good cholesterol" structure identified, could help explain protective effects

Researchers at the University of Cincinnati (Ohio, USA) have determined the structure of human high density lipoprotein (HDL) cholesterol and say the finding could help explain how this "fat packet" protects against cardiovascular diseases, including heart attack and stroke.

The study, led by W. Sean Davidson, a professor in the university's Pathobiology and Molecular Medicine Graduate Program, appeared online on March 13, 2011, in the journal *Nature Structural & Molecular Biology*.

HDL, also known as "good cholesterol," is composed of packets of protein and fat, which deliver fat to specific locations within the body.

Studies of synthetically derived HDL have shown that apolipoprotein A-I (ApoA-I), an abundant protein in HDL, plays a key role in HDL's cardioprotective, anti-inflammatory, and anti-oxidative properties.

"Unfortunately, we've known very little about the molecular details that explain HDL's protective effects," said Davidson. "A major reason for this is an almost complete lack of understanding of HDL's structure and how it interacts with other important plasma factors."

Rong Huang, a post-doctoral fellow in Davidson's laboratory, has isolated human HDL and analyzed its three-dimensional structure as it circulates in human plasma.

"Previous studies have only focused on synthetic HDL made in the test tube," Davidson said. "By isolating human HDL, we were able to focus on the broad range of HDL particles actually circulating in humans."

Team members used spectroscopic and mass spectrometric techniques to find that proteins of HDL form a cage-like structure that encapsulates its fatty cargo. They

determined that most of the HDL particles circulating in human plasma are remarkably similar in structure; however, they found evidence that the particles have a twisting or shock absorber-like motion that allows them to adapt to changes in particle fat content.

By determining the structure of HDL, Davidson and his team were able to conclude that the majority of physiological interactions occurring with HDL—including its twisting movements—occur at the particle surface, which is dominated by the cardioprotective protein ApoA-I.

This monopolization of the particle surface, Davidson said, suggests that other proteins have very little room to bind to HDL and probably have to interact with the protein itself, which could explain how ApoA-I plays such a dominant role in HDL function and its protective effects.

Omega-3 fatty acids therapy for atrial fibrillation: Is the case closed?

Atrial fibrillation (AF) is a common arrhythmia that can cause stroke and heart failure, but for which there is no uniformly effective treatment. Risk of AF increases with age. Basic science studies have shown that omega-3 fatty acids (such as those in fish oil) have anti-inflammatory, antioxidant, and membrane-stabilizing properties. As oxidant stress and inflammation have been suggested to promote AF, these studies raised interest in the possibility that oral omega-3 fatty acid supplements might be useful in treating or preventing AF. A small, non-randomized study reported that dietary omega-3 polyunsaturated fatty acids (PUFAs) were useful for the prevention of AF following cardiac surgery, and anecdotal reports have suggested a benefit of the supplements in treating patients with non-surgical AF.

An article published December 1, 2010, in the *Journal of the American Medical Association* (*JAMA 304*:2363–2372) reported the results of a rigorous randomized double-blind, placebo-controlled, multicenter trial that evaluated the impact of omega-3 fatty acid treatment on recurrence of AF. In that study, 663 patients with AF but without evident structural heart disease were randomized to receive either high daily doses of prescription omega-3 fatty acid esters or a matched placebo control. After 24 weeks of treatment, the researchers had gathered unambiguous clinical evidence that prescription omega-3 fatty acid treatment was no more effective than the placebo treatment in preventing the recurrence of paroxysmal AF.

Two heart researchers published an editorial on this *JAMA* study in the March 2, 2011, issue of *Nature Reviews Cardiology* (*8*:126–128). The authors noted the impressive statistical power of the published study with respect to documenting the lack of efficacy of omega-3 supplements for treating AF in patients without evidence of structural heart disease. At the same time, the editorial cautioned physicians not to jump to conclusions about the effectiveness of omega-3 in older patients with structural heart disease (coronary artery disease, valvular heart disease, heart failure)

Because the group enrolled in the clinical trial did not have structural heart damage, the measure used for testing treatment effectiveness was the time to the first recurrence of an arrhythmic event. Interestingly, most of the AF recurrences occurred within the first two weeks of the study—before measurable changes in the patients' lipid profiles had been observed. "Dietary treatments tend to work by changing the body's composition, and that takes time," said David Van Wagoner, an associate professor in the Department of Molecular Cardiology at Cleveland Clinic and Case Western Reserve's Lerner College of Medicine, who coauthored the editorial.

Van Wagoner pointed out that several preclinical studies suggest that omega-3 fatty acids and other "upstream" drugs may have the greatest therapeutic impact on inflammation and structural heart disease. In these studies, omega-3 fatty acids were effective in preventing the development of fibrosis that increases the duration of AF episodes. "For patients with heart failure or structural heart disease, it is possible that dietary interventions (including eating less red meat, more fish, and more omega-3-rich plants) will help to decrease the relative abundance of omega-6 fatty acids, and may reduce the development of atrial fibrosis and contribute to the prevention of AF," he said.

Van Wagoner also suggested that in future clinical studies seeking to evaluate the impact of omega-3 treatments on patients with structural heart disease, it would be helpful and logical to focus on the end point of arrhythmia burden (the amount of time in which the atria are fibrillating), rather than just the time to first recurrence. "Risk of stroke, heart failure, and death is likely more related to how frequently and how long the atria are fibrillating, than to when a transient episode of AF begins."

Soy isoflavones not a risk factor for breast cancer survivors

Soy food consumption did not increase the risk of cancer recurrence or death among survivors of breast cancer, according to the results of a study presented at the annual meeting of the American Association for Cancer Research (AACR), held April 2–6, 2011.

The study investigated the association between soy food intake and breast cancer outcomes among survivors, using data from a multi-institution collaborative study, the After Breast Cancer Pooling Project. That study included 18,312 women between the ages of 20 and 83 years who had invasive primary breast cancer.

"There has been widespread concern about the safety of soy food for women with breast cancer," said lead researcher Xiao Ou Shu, professor of medicine at Vanderbilt Epidemiology Center, Vanderbilt University Medical Center (Nashville, Tennessee, USA). "Soy foods contain large amounts of isoflavones that are known to bind to estrogen receptors and have both estrogen-like and anti-estrogenic effects. There are concerns that isoflavones may increase the risk of cancer recurrence among breast cancer patients because they have low estrogen levels due to cancer treatment. We're particularly concerned that isoflavones may compromise the effect of tamoxifen on breast cancer treatment because both tamoxifen and isoflavones bind to estrogen receptors."

In the study presented at the AACR meeting, soy isoflavone intake was assessed for 16,048 women on average of 13 months after breast cancer diagnosis using food frequency questionnaires for a group of soy isoflavones in three cohorts and on tofu and soy milk consumption in one cohort. Breast cancer outcomes were assessed, on average, nine years after cancer diagnosis.

Women in the highest intake category of more than 23 mg per day had a 9% reduced risk of mortality and a 15% reduced risk for recurrence, compared to those who had the lowest intake level. However, these results did not reach statistical significance

"Our results indicate it may be beneficial for women to include soy food as part of a healthy diet, even if they have had breast cancer," said Shu. "This can't be directly generalized to soy supplements, however, as supplements may differ from soy foods in both the type and amount of isoflavones." ■

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Briefs

The first pilot project to grow genetically modified maize (corn) in Mexico was approved on March 9, 2011. The project will evaluate the costs and benefits of yellow corn developed by Monsanto Company (St. Louis, Missouri, USA) on one hectare of land in the northern Tamaulipas state. Although Mexico is the number one producer of white maize, it imports yellow corn from the United States for cattle feed. The tests are part of efforts to keep food prices down by boosting domestic production of yellow maize.

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In March, BASF and Monsanto Company announced an agreement to collaborate on the advancement of dicamba-tolerant cropping systems. The agreement will facilitate further development and subsequent commercialization of a dicamba-tolerant trait for soybeans, which is proprietary to Monsanto. The system is expected to be introduced in the United States and Canada in the middle of the decade, pending regulatory approvals.

■■■

An Arkansas (USA) court has ordered a unit of Bayer AG to pay Riceland Foods (Stuttgart, Arkansas) $136.8 million over damages to US rice exports that occurred more than four years ago when a genetically modified long-grain rice from the German agricultural biotech company contaminated US supplies. According to a report by Reuters news agency on March 21, 2011, Bayer has repeatedly been found negligent for allowing a strain of genetically modified long-grain rice to contaminate US supplies, which caused the European Union and other leading importers to cancel purchases.

■■■

Genecor International plans to invest $30 million to expand its enzyme manufacturing facility in Beloit, Wisconsin, USA. The expansion, scheduled for completion in 2012, will increase the company's industrial enzyme manufacturing capabilities by adding technology-intensive applications, equipment, and processes.

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Biotechnology News

Kentucky researchers find a key to plant disease resistance

Plant pathologists at the University of Kentucky have discovered a metabolite that plays a critical role early on in the ability of plants, animals, humans, and one-celled microorganisms to fend off a wide range of pathogens at the cellular level. Such systemic immunity has been recognized for more than 100 years, but the key events that stimulate that form of resistance have remained a mystery.

Those events were described for the first time in an article published online in *Nature Genetics* on March 27, 2011.

Using soybeans and *Arabidopsis*, a model laboratory plant, the scientists were able to identify the metabolite glycerol-3-phosphate as a key mobile regulator of systemic immunity. The glycerol-3-phosphate transforms into an unknown compound and uses a protein, called DIR1 to signal systemic immunity. Scientists already identified the protein as a necessary component to trigger systemic immunity.

"The metabolite and protein are dependent on each other to transport immunity from one location in the plant tissue to the other," said Pradeep Kachroo, an assistant professor and one of the leading authors.

"Metabolite levels increase in plant tissues after the plant has been inoculated by a pathogen."

While the research was conducted on plants, all organisms have a similar process of triggering systemic immunity.

"The metabolite is a highly conserved compound in all species across the board," Kachroo said.

An added benefit is that increased levels of the metabolite do not affect plant productivity, unlike other known inducers of systemic immunity. Consequently, the metabolite could be an effective tool to control plant diseases and enhance pathogen tolerance in plants.

In 2008, Kachroo and his colleagues discovered that the same metabolite was a key component in organisms' basal resistance, which allows organisms to have strong immune systems.

Bacteria convert cellulose to butanol, potential green fuel

Using consolidated bioprocessing, a team led by James Liao, a biomolecular engineer at the University of California, Los Angeles (UCLA; USA), for the first time produced isobutanol directly from cellulose. Such direct conversion of cellulose to butanol could bring down the prohibitively high cost of cellulosic biofuels and allow butanol to be made from non-food sources.

Compared to ethanol, higher alcohols such as isobutanol are better candidates for gasoline replacement because their energy

ACGT Sdn. Bhd., a subsidiary of Genting Plantations Bhd., a plantation company headquartered in Kuala Lumpur, Malaysia, announced in March that it is developing a genomics-based marker-assisted selection technology aimed at potentially reducing the long oil-palm breeding cycle by 50% to six years from 12 years. The breakthrough will accelerate the development and commercial release of seeds without any genetic modifications. "With arable land getting scarce, the palm oil sector cannot rely solely on acreage expansion to boost production," Genting's Chairman and Chief Executive Officer, Tan Sri Lim Kok Thay, said.

■■■

The US Department of Agriculture announced that it will partially deregulate sugar beets that have been genetically engineered to be resistant to Monsanto's Roundup Ready herbicide. The beet's seed will be regulated by a strict permitting process, and the crop's growth will be subject to legal compliance agreements that will limit the beets' movement and release and prohibit cultivation in California and parts of Washington State.

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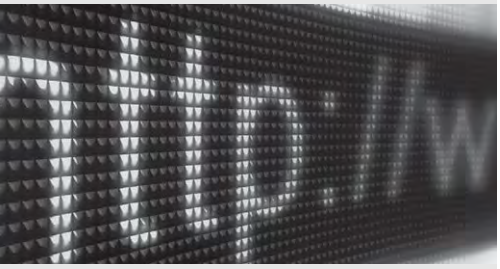


CropLife International has launched a new online Detection Methods Database available at www.detection-methods.com to serve as a global resource for testing information for commercialized biotechnology-derived plant products. The website makes reliable, up-to-date testing methods developed by the same technology companies that deliver biotechnology traits to the market. The database, which is searchable by crop, developer, product, event, and protein, provides detection methods and related materials information, creates an efficient process for testing services to license the detection methods directly from the technology providers for their proprietary technologies, and grants complimentary access to the detection methods for regulatory agencies and seed companies worldwide. ■

Graduate student Brooks Bond-Watts and postdoctoral fellow Jeff Hanson examine cultured Escherichia coli *used to produce* n*-butanol. (Photo by Michael Barnes)]*

density, octane value, and Reid vapor pressure (a measurement of volatility) that are much closer to those of gasoline.

While cellulosic biomass such as corn stover and switchgrass is abundant and cheap, it is much more difficult to use than corn and sugar cane. This is due in large part to recalcitrance, or a plant's natural defenses to being chemically dismantled.

Adding to the complexity is the fact biofuel production that involves several steps (pretreatment, enzyme treatment, and fermentation) is more costly than a method that combines biomass utilization and the fermentation of sugars to biofuel into a single process.

To make the conversion possible, Liao, UCLA postdoctoral researcher Wendy Higashide, and Yongchao Li and Yunfeng Yang of Oak Ridge National Laboratory (Oak Ridge, Tennessee, USA) developed a strain of *Clostridium cellulolyticum*, a native cellulose-degrading microbe originally isolated from decayed grass, that could synthesize isobutanol directly from cellulose. In another effort to enhance the production of butanol, chemists at the University of California, Berkeley (USA) genetically engineered *E. coli* to churn out the gasoline-like biofuel at about 10 times the rate of competing microbes.

Michelle C.Y. Chang, assistant professor of chemistry at UC Berkeley, graduate student Brooks B. Bond-Watts, and recent UC Berkeley graduate Robert J. Bellerose reported the advance in the March 2011 issue of the journal *Nature Chemical Biology*.

The new genetically altered *Escherichia coli* produced nearly five grams of *n*-butanol per liter, which is made at a lower level but at similar efficiency to the best genetically altered *Clostridium* and about 10 times better than current industrial microbial systems such as yeast and *E. coli*.

"We are in a host that is easier to work with, and we have a chance to make it even better," Chang said. "We are reaching yields where, if we could make two to three times more, we could probably start to think about designing an industrial process around it."

Developing nations drive biotech growth to 1 billion hectares

Cumulative biotech crops exceeded 1 billion hectares in 2010, according to the International Service for the Acquisition of Agri-biotech Applications (ISAAA), which issued its 2010 annual report on February 22, 2011. For comparison, 1 billion hectares is roughly equivalent to the land area of China.

With an 87-fold increase between 1996 and 2010, biotech crops are the fastest-adopted crop technology in the history of modern agriculture,

The area planted to biotech crops increased by 14 million hectares—or 10%—between 2009 and 2010, according to the report's author, Clive James, chairperson and founder of ISAAA.

"That's the second highest annual hectare growth ever—bringing 2010 global plantings to 148 million hectares," he said.

For the first time, in 2010, the 10 largest biotech crop-growing countries all had more than 1 million hectares in production, providing a broad and stable base for future growth. In hectarage rank order, they include: USA (66.8 million), Brazil (25.4 million), Argentina (22.9 million), India (9.4 million), Canada (8.8 million), China (3.5 million), Paraguay (2.6 million), Pakistan (2.4 million), South Africa (2.2 million), and Uruguay (1.1 million).

For the second consecutive year, Brazil had the world's largest year-over-year increase in absolute biotech crop plantings, adding 4 million hectares in 2010—a 19% increase—to grow a total of 25.4 million hectares. Only the United States exceeds Brazil in total cropland devoted to biotech crops. Australia, which recovered from a multi year drought, saw the largest proportional year-on-year increase in biotech crop plantings at 184%. Burkina Faso followed at 126% growth with 80,000 farmers planting 260,000 hectares, a 65% adoption rate.

Brazil, after expediting approvals of biotech crops (a total of 27, and 8 in 2010 alone) and securing export trade agreements, now plants 17% of the world's biotech crops, according to Anderson Galvao Gomes, director of Brazilian-based Celeres and contributor to the ISAAA report. Productivity increases attributed to biotech crops helped fuel Brazil's ability to double its annual grain production since 1990 while increasing cropland by only 27%.

The benefits from biotech crops are spurring strong political will and substantial new research and development investments in biotech crops, with speed and effectiveness increasing access to technology, Gomes noted. With an ability to bring up to 100 million more hectares of cropland, with water, into production, Brazil will continue to be a driving force in the global adoption of biotech crops and is investing in infrastructure to support that growth.

"Developing countries grew 48% of global biotech crops in 2010 and will exceed industrialized nations in their plantings of biotech crops by 2015," said James. "Clearly, the countries of Latin America and Asia will drive the most dramatic increases in global hectares planted to biotech crops during the remainder of the technology's second decade of commercialization."

For more information or the executive summary of this report, visit www.isaaa.org.

Alfalfa triggers clash between commercial and organic agriculture

On January 27, 2011, the Animal and Plant Health Inspection Service (APHIS) of the US Department of Agriculture (USDA) announced its decision to grant nonregulated status for alfalfa that has been genetically engineered to resist the herbicide Roundup.

"After conducting a thorough and transparent examination of alfalfa through a multi-alternative environmental impact statement (EIS) and several public comment opportunities, APHIS has determined that Roundup Ready alfalfa is as safe as traditionally bred alfalfa," US Secretary of Agriculture Tom Vilsack said in the immediate wake of the decision. "All of the alfalfa production stakeholders involved in this issue have stressed their willingness to work together to find solutions. We greatly appreciate and value the work they've done so far and will continue to provide support to the wide variety of sectors that make American agriculture successful."

However, the *St. Louis Post-Dispatch* reported on March 18, 2011, that the Center for Food Safety, a group that is critical of genetically modified crops, had sued federal regulators. According to the newspaper, the group alleged that the USDA's approval of genetically modified alfalfa is illegal, that it is based on faulty information, and that genetically modified alfalfa will damage the organic industry by contaminating conventional or organic alfalfa.

The plaintiffs, whose suit was filed in federal court in San Francisco, include dairy farmers who are concerned that they may lose the primary forage for their dairy cows if the organic alfalfa is contaminated by genetically engineered alfalfa. Contaminated alfalfa could make it difficult for such farmers to meet organic standards, which specify that dairy cows must be fed organically grown hay.

The lawsuit is the latest in a string of suits that have been launched against the USDA by the opponents of genetically modified crops. On March 2, 2011, an article in the *Voice of America News* posed the question: Can genetically modified and organic crops coexist? The article pointed out that opposition to genetically modified organisms (GMOs) is one of the factors that have made organic products a $25-billion-a-year market in the United States. The article stated that the major challenge in American agriculture is: "How can these two profitable but mutually exclusive types of agriculture co-exist, when there are so many ways contamination can happen? Pollen can travel from a GMO field and contaminate a non-GMO crop. Grains can mix in storage, shipping, or processing."

After acknowledging that the system is not perfect and that some contamination still happens, Lynn Clarkson, president of Clarkson Grain and Clarkson Soy Products (Cerro Gordo, Illinois, USA), two companies that specialize in supplying organic and non-GMO grains for animal feed, was quoted as saying: "If you deal with the tolerance standards out there today, zero is simply not an option."

Did policies and regulations promote world food crisis?

An article appearing in the *Guardian Web* on March 21, 2011, considered the possibility that (i) arbitrary and unscientific national and international regulatory barriers against new varieties of plants produced with modern genetic engineering and (ii) government policies that divert increasing amounts of land and agricultural production into making biofuels might be partly to blame for current worldwide food shortages, price increases, and food riots.

The article asserted that while farmers in more than two dozen countries are using genetically engineered crop varieties to produce higher yields with lower inputs and reduced impact on the environment, regulation "commonly discriminates specifically against the use of the newest, most precise genetic engineering techniques, subjecting field trials to redundant case by case reviews and markedly inflating R&D costs."

The *Guardian Web* claimed that "a veritable alphabet soup of United Nations' agencies and programmes are prime offenders," and that "these public policy failures, in turn, inhibit the adoption and diffusion of new plants that boast a broad spectrum of new high value-added input and output traits."

The article pointed out that the United States is approaching the diversion of 40% of the corn harvest for fuel and that the EU has a goal of 10% biofuel use by 2020, and called the implications "worrisome."

According to Juergen Voegele, director for agriculture and rural development at the World Bank, who was quoted in the article, feeding 9 billion people in 2050 "will require very significant investments in agriculture R&D and in overall productivity increases."

Major soybean processing complex increases yields via enzymatic degumming

Verenium Corporation, a pioneer in the development of high-performance specialty enzymes, announced on February 28, 2011, that Terminal 6, a major producer of soybean meal, oil, and biodiesel, successfully began using Verenium Corporation's Purifine© enzymatic degumming process at its Puerto General San Martin facility in Argentina. Purifine enzymatic degumming is a novel process that significantly increases yields in edible oil production and can have additional benefits in refining the Purifine-degummed oil.

Implementation of the enzymatic degumming process at the Puerto General San Martin facility, a joint venture between Bunge Argentina and Aceitera General Deheza, has "resulted in a significant increase in oil yields and processing margins, enabling our facility to more fully reach its potential," said Enrique Humanes, chief executive officer of Bunge Argentina.

The Terminal 6 industrial facility has been built to take advantage of large-scale process efficiencies that enable maximum yields of oil and meal from soybeans at low cost. Integration of Verenium's enzyme further improves the plant's performance, because the oil loss in the enzyme-based process is lower than in nonenzymatic processes.

Corn seed tailored for ethanol production gets green light from USDA

(Article by Holly Jessen; originally published online in Ethanol Producer Magazine*, March 10, 2011)*

It's something the ethanol industry has been asking about for awhile now—corn that's genetically modified to produce more ethanol without the use of enzymes. In February, Syngenta Seeds Inc. (Minnetonka, Minnesota, USA) came through with corn amylase Event 3272, which will be sold under the Enogen seed brand.

Production tests of Syngenta Seeds Inc.'s new amylase corn at Western Plains Energy LLC showed an 8% increase in ethanol production and an 8% decrease in natural gas use. It's enough to make Steve McNinch, general manager and chief executive officerof the Oakley, Kansas (USA) plant, never want to go back to a liquid amylase enzyme ever again. "What that means for us is more profits, with less expense," he says. "And there are no 'gotchas' for the plant either."

Syngenta announced February 11 that it had received full deregulation for the amylase corn product. The corn variety—which has been a decade or so in the making—has an α-amylase enzyme engineered right into it, says Jack Bernens, head of technology acceptance for Syngenta Seeds. It's the first genetically modified corn seed tailor-made for the ethanol industry.

"Enogen corn is a breakthrough product that provides ethanol producers a proven means to create more value per gallon while offering targeted corn growers an opportunity to cultivate a premium specialty crop in a contracted, closed production system," says David Morgan, president of Syngenta Seeds. "Also, Enogen corn can substantially reduce the energy and water consumed and the carbon emissions associated with ethanol production."

A 100 million gallons per year (380 million liters) ethanol plant using Enogen corn can save 450,000 gallons (1.7 million liters) of water, 1.3 million kilowatt hours of electricity, and 244 billion Btu of natural gas annually, according to a 2008 study by John Urbanchuk, technical director for Cardno ENTRIX (Houston, Texas, USA). That amount of power is enough to heat several thousand homes while simultaneously reducing CO_2 emissions by 102 million pounds (46,000 metric tons).

Full deregulation basically means the company has the US Department of Agriculture's approval to sell the corn with no conditions, Bernens says. In addition, the variety has had US Food and Drug Administration approval since 2007. "It is perfectly as safe for food and feed as conventional corn," he tells EPM. The only areas for which the amylase corn could cause a functionality concern are in some industrial and food processes. Still, Syngenta plans to only allow contracted corn growers with an ethanol plant in their area to plant Enogen seed corn. The company will use a tightly managed track-and-trace system, grower training, and auditing to ensure that the corn will be used in the industry for which it will provide the most benefit. "It's a high-value crop and it only has additional value if it goes into the dry grind ethanol industry," he says. "It can be fed to cattle, it could be used for other purposes, but it doesn't really add value there."

The company is also working to establish an advisory council, which will be made up of stakeholders including corn growers, food processors, and the USDA. The objective, Bernens says, is to get input from those along the value chain while providing assurance that the product will work as promised. The company also plans to work with ethanol plants to test the grain at additional facilities, giving those plants a chance to see the potential benefits of amylase-engineered corn.

Because it's already relatively late in the year, few acres of the amylase corn will likely be planted in the 2011 season, Bernens says. It's likely to ramp up in 2012, but not as quickly as other corn traits are typically accepted. "It's a much slower gear up from a commercial perspective."

Holly Jessen is an associate editor with Ethanol Producer Magazine.

People News/ Inside AOCS

List to receive honorary doctorate

List

Gary R. List, who is currently working as a consultant after retiring from the US Department of Agriculture, Agricultural Research Service, National Center for Agricultural Utilization Research (Peoria, Illinois), will receive an honorary doctor of science degree on May 15 from the University of Illinois, Urbana-Champaign (UIUC). He is being recognized for his contributions in the field of edible oils, including the preparation of margarine and shortening, the detection of trans fatty acids, and development of alternative methods to produce fats and oils with desirable properties but lacking trans fatty acids.

List earned an associate degree in applied science at Illinois Central College, East Peoria, Illinois, and is a graduate of the US Army Chemical Corps School.

The Chicago section of the Institute of Food Technologists (IFT), headquartered in Chicago, Illinois, has selected List to be the 49th Tanner Lecture honoree. On May 9 he will receive an honorarium and a plaque at the meeting of the Chicago IFT and deliver a lecture on his work. The award is named for Fred W. Tanner, a founder of the Institute of Food Technologists and a long-time faculty member at UIUC who specialized in food safety issues, specifically pasteurization and meat curing.

Procter & Gamble announces personnel changes

Consumer products producer Procter & Gamble Co. (Cincinnati, Ohio, USA) announced several organizational changes in mid-March. **R. Keith Harrison**, global product supply officer, will retire effective September 1, 2011, after more than 41 years with the company. He will serve as officer on special assignment until his retirement date, reporting to **Bob McDonald**, president and chief executive officer.

Harrison

Yannis Skoufalos will succeed Harrison effective July 1, 2011. He is currently vice president of product supply, global operations. (Photos courtesy The Procter & Gamble Company.)

Skoufalos

USB honors two

The United Soybean Board (USB) and soybean checkoff presented its Outstanding Achievement Award in March to **Mark Messina**, executive director of the Soy Nutrition Institute. The USB Excellence in International Marketing Award went to **Phil Laney**, retired US Soybean Export Council country director for China.

Messina

Since 1994, Messina, with support from the soybean checkoff, has organized international meetings to stimulate research on the health properties of soybeans. He also chairs the editorial advisory board for The Soy Connection, a quarterly newsletter delivered to health professionals on the benefits of soy foods.

Laney has seen imports of US soybeans to China rise from about 2.4 million bushels (65 million metric tons, MMT) in 1995 to 825 million bushels (22,500 MMT) in 2010, or about one out of every four rows of soybeans grown in the United States.

CCC has new chair and executive committee

The Canola Council of Canada (CCC) elected **Pat Van Osch**, of Richardson Oilseeds (Winnipeg, Manitoba), to a two-year term as chair of the organization at the CCC's annual general meeting, held in Scottsdale, Arizona (USA) in conjunction with the annual meeting of the National Institute of Oilseed Products (March 13–15, 2011). Van Osch succeeds **Richard Wansbutter** of Viterra (Calgary, Alberta) who stepped down following a two-year term.

The other members of the CCC board of directors executive committee include Vice Chair **Brian Conn** of LDM Foods (Yorkton, Saskatchewan); Second Vice Chair **Terry Youzwa** of SaskCanola (Saskatoon, Saskatchewan); Chair of Finance, **Woody Galloway** of Bunge (Oakville, Ontario); and Director at Large **Shaun Wildman** of Viterra.

ADM names new EVP/COO

On March 21 Archer Daniels Midland Co. (Decatur, Illinois, USA) announced the appointment of Dow Chemical executive **Juan Luciano** as its new executive vice president (EVP) and chief operating officer (COO). The position is a newly created role. Luciano became responsible for ADM's global operations and commercial activities as of April 12. Luciano had been an executive vice president of Dow Chemical Co. and president of its performance division.

Larsen heads sales and marketing for Alfa Laval

Mark Larsen has been appointed senior vice president of Alfa Laval Inc.'s Hygienic Division. In this role, Larsen will be responsible for implementing sales and marketing strategies for the company's Life Science, Sanitary, Food, and Vegetable Oil Segments.

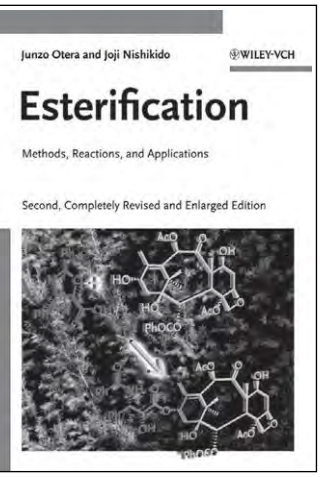
Larsen joined Alfa Laval in 2002 as vice president of Alfa Laval USA's Sanitary Segment. This part of the company's business grew under his direction. Prior to joining Alfa Laval, Larsen was with Wilden Pump and Engineering and Eastman Kodak. ■

Book Review

Esterification: Methods, Reaction, and Application, Second Edition
Junzo Otera and Joji Nishikido (eds.)
Wiley-VCH, 2010, 386 pages
ISBN 978-3-527-32289-3, $200

Jerry W. King

This offering from Wiley-VCH is the second edition of this title—but revised and enlarged with respect to content. It is part of an organic synthesis series and contains eight chapters, primarily aimed at organic synthetic chemists. It is divided into two parts—Methodology and Synthetic Applications. Part 1 focuses on the reaction of alcohols with carboxylic acids and acid derivatives, the use of tin and other metallic alkoxides as catalysts, conversion of carboxylic acids into esters *sans* the use of alcohols, as well as ester interchange reactions. Part 2 is devoted to the topics of kinetic resolution of chiral esters and the like, asymmetric desymmetrization, miscellaneous topics, and industrial uses of esterification.



This second edition, which comes five years after the first, is based on a search resulting in 5,300 SciFinder references, of which approximately 500 have been integrated into the second edition. The importance of "green synthesis and production" is cited in over 250 of the references covering such topics as enzyme and solid acid catalysts, the replacement of organic media with ionic liquids, water, and the use of fluorous solvents and supercritical fluids. New processes focused on scale-up for engineering appear in Section 7.4 as "New Technologies." Highlights in Chapter 8 on the "Industrial Uses" include an updated ethyl acetate and acrylic ester synthesis; Section 8.5 is devoted to "biodiesel." Chapters 5–6 have a heavy focus on chiral synthesis while Chapter 7 is partially concerned with natural product synthesis. A CD-ROM database was supposed to accompany the book, but it was not provided to this reviewer.

Most of the chapters start rather abruptly without much in the way of introductory material. Typical reactions are tabulated along with relevant experimental protocols required to carry them out, although the necessary protocols are quite general descriptions. In Section 1.1, "Reactions with Carboxylic Acids," there is a good discussion focused on the various catalyst options available to the synthetic chemist. The discussions of R groups that appear in the cited examples are not necessarily focused on long-chain lipid moieties that would be of interest to readers of *inform*. Section 1.2 has an extensive discussion of esterification using supported enzymatic catalysis synthesis. Many of the "Experimental Procedures" also have brief information on post-reaction purification schemes, such as chromatography-based purification. Similarly, the preparation of supported enzyme catalysts is also mentioned.

Chapter 2 emphasizes synthesis using tin-based and metallic alkoxide catalysts although little preliminary rationalization for their use is noted. As noted above, Part 2 of the book has a detailed discussion of kinetic resolution, that is, the selective synthesis of chiral compounds based on enantioselectivity. An excellent comprehensive table on acylation reactions catalyzed by lipases appears in this section. Non-enzyme-based resolutions are also tabulated with a thorough listing of possible acylating agents, catalysts, alcohols used, and so on.

Chapter 7, covering miscellaneous topics, contains among other subjects esterifications that are conducted with the use of fluorous acids and ionic liquids. Biphasic systems, consisting of ionic liquids coupled with supercritical carbon dioxide (SC-CO_2) as well as enzymatic reactions conducted with and in the presence of SC-CO_2, are presented on page 259, including the esterification of lipid moieties (p. 260). The section on new technologies is largely concerned with microwave-based esterifications and the coupling of reactions with separation processes. Section 7.5 (pp. 265–292) deals extensively with applications to natural product synthesis.

Chapter 8, on industrial uses, has only very small sections devoted to the synthesis of ethyl acetate, acrylic esters, polyesters, and finally oils-fats on p. 301. The section on oils-fats is contained in only one-half of one page (p. 301), followed by food emulsifier synthesis, a short description of biodiesel synthesis, and amino acid esters production. Section 8.3, concerning flavoring agents, focuses on details that are required to synthesize a particular compound(s) associated with specific flavor note profiles.

All of the references from all of the chapters are in numerical order and are included at the back of the book, which is somewhat inconvenient in terms of using the book. I was disappointed not to see some special mention made of the use of the cited methods and approaches that would be applicable to derivatizations of use in analytical chemistry. In short, I do not feel that this book has much to offer the applied lipid technologist, but it will prove valuable to the synthetic organic chemist who may be involved in the synthesis of lipids.

Jerry W. King holds the Ansel and Virginia Condray Endowed Professorship at the University of Arkansas Department of Chemical Engineering in Fayetteville, Arkansas, USA. He has more than 20 years of research experience in food oil chemistry, processing, and analysis. He can be reached at jwking1@uark.edu.

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Patents

Published Patents

Process to produce an enriched composition

Parker, K.R., *et al.*, Eastman Chemical Co., US7855305, December 21, 2010

A process is provided for producing enriched carboxylic acid compositions, produced by contacting composition comprising a carboxylic acid with an enrichment feed in an enrichment zone to form an enriched carboxylic acid composition. This invention also relates to a process and the resulting compositions for removing catalyst from a carboxylic acid composition to produce a post catalyst removal composition.

Process for producing diesel fuel oil from fat

Tsuto, K., and T. Koshikawa, REVO International Inc., US7857869, December 28, 2010

A process for producing diesel fuel oil from fat and oil comprises producing fatty acid methyl ester for diesel fuel in accordance with transesterification of the fat and oil with methanol, wherein the process further comprises a step of converting glycerol formed as a by-product into methanol, and the obtained methanol is used as a material for the transesterification. In the step of converting glycerol formed as a by-product into methanol, water in an equimolar amount or more to the amount of glycerol is added to glycerol, the obtained mixture is gasified under a pressure of 2 MPa or greater at a temperature of 700°C or higher to convert the mixture into a gas comprising carbon monoxide and hydrogen, and carbon monoxide and hydrogen are then converted into methanol in accordance with a methanol synthesis process.

Co-production of biodiesel and an enriched food product from distillers grains

Krasutsky, P.A., and A.B. Khotkevych, Regents of the University of Minnesota, US7857872, December 28, 2010

Embodiments of the present invention relate to a method for the production of biodiesel and co-production of an enriched food product. The method comprises the steps of extracting with solvent from distillers grains sufficient to produce an extract and an enriched food product, separating the oil from the extract, reacting the oil sufficient to produce biodiesel, and refining the biodiesel.

Pharmaceutical formulation comprising a water-insoluble active agent

Vehring, R., *et al.*, Novartis Pharma AG, US7862834, January 4, 2011

A method of preparing a pharmaceutical formulation comprises providing a solution comprising a first solvent, a second solvent, an active agent, and an excipient. The second solvent is less polar than the first solvent, and the excipient is more soluble in water than the active agent. The first and second solvents are removed from the solution to produce particles comprising the active agent and the excipient. In one version, the excipient comprises an amino acid and/or a phospholipid. A pharmaceutical formulation made by a version of the invention comprises particles comprising an active agent and an excipient which at least partially encapsulates the active agent, wherein the excipient is more soluble in water than the active agent.

Chemical markers

Banavali, R.M., and R.W. Stephens, Rohm and Haas Co., US7858373, December 28, 2010

A method for marking a petroleum hydrocarbon, a biodiesel fuel or an ethanol fuel, by adding an organic marker compound.

Process for producing highly unsaturated fatty acid-containing lipid

Ono, K., *et al.*, Suntory Holdings Ltd., US7863024, January 4, 2011

The present invention provides a process for producing a highly unsaturated fatty acid-containing lipid which is less expensive than existing ones, which comprises culturing a microorganism belonging to the genus *Mortierella* with the use of, as a medium carbon source, a saccharified starch, which is less expensive than glucose, does not contribute to an increase in osmotic pressure of the culture medium, and can be utilized by the *Mortierella* microorganism, and collecting a highly unsaturated fatty acid-containing lipid from the culture.

Process for the transesterification of esters

Krause, E., and V. Rohm, Krause-Rohm-Systeme AG, US7863471, January 4, 2011

The invention relates to a method for transesterification of at least one component comprising at least one ester group with at least one component comprising at least one hydroxyl group, wherein the red mud produced in the Bayer process used for producing aluminum is added to the method as a reaction-promoting component. The invention also relates to the use of carboxylic acid salts produced during the transesterification method as plant-treating agents and as detergents in cleaning and washing agents. The invention also relates to the use of dealkalized red mud obtained by means of the method according to the invention as the iron-contributing component of an iron fertilizer which can be used in particular in agriculture and to which limestone can also be added.

Biological lubricant composition and method of applying lubricant composition

Burdick, J.-A.M., *et al.*, Clemson University Research Foundation, US 7867985, January 11, 2011

Fluid compositions and methods for lubrication of mammalian joints are disclosed, including both natural and artificial fluids. Synovial fluid acts to lubricate the bearing surfaces of bones and bone-like structures which are held in frictional contact within biological joints. Such fluids may be used to treat arthritic, injured, and diseased joints. Synovial fluid containing a dextran-based hydrogel with lipids provides enhanced rheological and tribological properties of such a fluid. Phospholipids are particularly useful in dextran-based compositions

for synovial fluid. One phospholipid that can be used advantageously in synovial fluid is dipalmitoyl phosphatidylcholine (DPPC).

Preparation of glycerol derivatives and intermediates therefor

Lee, T.-S., *et al.*, Enzychem Co. Ltd., US7868196, January 11, 2011

Disclosed is a process for the regioselective preparation of glycerol derivative in a high efficiency and yield. The process for the regioselective preparation of 1-R_1-2-R_2-3-acetyl-glycerol derivative comprises the steps of: obtaining 1-R_1-3-protecting group-glycerol by introducing a protecting group to 3-position of 1-R_1-glycerol; obtaining 1-R_1-2-R_2-3-protecting group-glycerol by introducing R_2 group into 2-position of 1-R_1-3-protecting group-glycerol; and carrying out the deprotection reaction and the acetylation reaction of 1-R_1-2-R_2-3-protecting group-glycerol at the same time. Wherein, R_1 and R_2 are fatty acid groups having 16 to 22 carbon atoms, and are different from each other; and the protecting group is trityl group or trialkylsilyl group.

Low and no trans fat confections

De Muijnck, L., Archer Daniels Midland Co., US7871656, January 18, 2011

A fat composition for use in food products is provided, which contains low levels of trans fats, and includes a non-hydrogenated fractionated palm kernel oil and a non-hydrogenated fractionated palm oil. A confectionery composition containing the fat composition also is provided. The confectionery composition can be used to coat a food product, and can be flavored and/or colored. Methods for making a confectionery composition using the fat composition also are provided.

Insulin-oligomer conjugates, formulations and uses thereof

Radhakrishnan, B., *et al.*, Biocon Ltd., US7872095, January 18, 2011

An insulin compound coupled to a modifying moiety having a formula: –X–R^1–Y-PAG-Z–R (Formula VI) where, X, Y, and Z are independently selected linking groups and each is optionally present, and X, when present, is coupled to the insulin compound by a covalent bond, either R^1 or R^2 is a lower alkyl, optionally including a carbonyl group, and when R^1 is a lower alkyl, R^2 is a capping group, and PAG is a linear or branched carbon chain incorporating one or more alkalene glycol moieties, and optionally incorporating one or more additional moieties selected from the group consisting of –S–, –O–, –N–, and –C(O)–, and where the modifying moiety has a maximum number of 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, or 25 heavy atoms.

Biodiesel processes in the presence of free fatty acids and biodiesel producer compositions

Bunning, D.L., *et al.*, Best Energies, Inc., US7872149, January 18, 2011

Glyceride-containing feed for a base-catalyzed transesterification with lower alkanol to make biodiesel is pretreated with glycerin separated during the transesterification to partially convert glycerides with lower alkanol contained in the separated glycerin using base catalyst in the separated glycerin while reducing the free fatty acid and phosphorus compound concentrations in the glyceride-containing feed. Unique producer compositions are provided by the pretreatment processes.

Anti-skinning composition for oil based coating material

Nowak, M., and L. Gurariy, Troy Corp., US7875111, January 25, 2011

The invention provides anti-skinning compositions for use in manufacturing oil-based coating materials. The novel anti-skinning compositions are clear, homogeneous solutions of cyclohexanone oxime that can be prepared by dissolving cyclohexanone oxime in a suitable carboxylic acid or mixture of carboxylic acids. Suitable carboxylic acids include fatty acids, such as fatty acids of tall oil distillate. Surprisingly, the fatty acids are useful as delivery solvents over a useful range of temperatures and have desirable flash points. They are compatible with many oil-based coating materials. The anti-skinning compositions and manufacturing methods of the present invention are especially useful in the manufacture of oil-based paints containing metal carboxylate driers.

Stabilized ester compositions and their use in film-forming compositions

Bloom, P.D., *et al.*, Archer Daniels Midland Co., US7875664, January 25, 2011

This invention relates to a composition comprising, consisting of or alternatively consisting essentially of a stabilized furfural or glycol ester of a vegetable oil fatty acid and an antioxidant such as butylated hydroxy toluene. This invention also relates to latex film-forming compositions containing stabilized furfural or glycol esters, such as a stabilized propylene glycol monoester (PGME) mixture. This invention is also directed to methods of stabilizing furfural or glycol esters of a vegetable fatty acid by contacting the esters with an antioxidant such as butylated hydroxy toluene. This invention also includes methods of preparing film-forming compositions comprising a stabilized furfural or glycol ester, such as the stabilized PGME mixture disclosed herein.

Cation complexes of insulin compound conjugates, formulation and uses thereof

Radhakrishnan, B., *et al.*, Biocon Ltd., US7875700, January 25, 2011

The invention provides a complex including a cation and an insulin compound conjugate. The insulin compound conjugate includes insulin compound, such as human insulin or an analog thereof, conjugated to a modifying moiety, such as a polyethylene glycol moiety. The invention also includes solids and pharmaceutical compositions including such complexes, methods of making such complexes, and methods of using such complexes in the treatment of insulin compound deficiencies and other ailments. Further, the invention includes novel insulin compound conjugates and modifying moieties for use in making novel insulin compound conjugates. The invention also includes fatty acid compositions for administration of pharmaceutical agents, such as the novel insulin compound

conjugates, and/or the cation-insulin compound conjugate complexes of the invention.

Process for alkaline hydrolysis of carboxylic acid derivatives to carboxylic acids

Krause, E., and V. Rohm, Krause-Rohm-Systeme AG, US7863480, January 4, 2011

The invention relates to a process for alkaline hydrolysis of carboxylic acid derivatives, especially carboxylic esters, to carboxylic acids, wherein, for the alkaline hydrolysis of the carboxylic acid derivatives, red mud which is produced by the Bayer process used for aluminum production is used as a reaction-promoting component, especially as a hydroxide ion source.

Resin composition for organic insulating layer, method of manufacturing resin composition, and display panel including resin composition

Lee, D.-K., *et al.*, Samsung Electronics Co., Ltd., US7879961, February 1, 2011

Disclosed herein is a resin composition for an organic insulating layer, a method of manufacturing the same, and a display panel including an insulating layer formed using the resin composition. The resin composition for an organic insulating layer is produced by polymerizing about 5 to about 35 wt% of an unsaturated carboxylic acid, an unsaturated carboxylic acid anhydride, or a mixture of the unsaturated carboxylic acid and the unsaturated carboxylic acid anhydride, about 5 to about 40 wt% of a styrene compound, about 5 to about 40 wt% of an epoxy compound, about 0.1 to about 10 wt% of an isobornyl compound, and about 20 to about 40 wt% of a dicyclopentadiene compound, based on the total weight of unsaturated carboxylic acid, unsaturated carboxylic acid anhydride, styrene compound, isobornyl compound, and dicyclopentadiene compound.

Paintball formulation and method for making the same

Baggs, Y., JT Sports LLC, US7883774, February 8, 2011

The invention herein provides for an improved fill composition for encapsulation in casing structures adapted for projectile motion and rupture upon contact with a target surface, such as paintballs. The fill composition adapted for use in an impact-rupturable capsule of the invention comprises a water-soluble dye and soy oil. The invention further provides for an improved shell composition for an impact-rupturable capsule containing the fill composition.

Process to produce an enrichment feed

Gibson, P.E., and K.R. Parker, Eastman Chemical Co., US7880031, February 1, 2011

A process is provided for producing enriched carboxylic acid compositions produced by contacting composition comprising a carboxylic acid with an enrichment feed in an enrichment zone to form an enriched carboxylic acid composition. This invention also relates to a process and the resulting compositions for removing catalyst from a carboxylic acid composition to produce a post catalyst removal composition.

Recording sheet and image recording method using the same

Koga, C., *et al.*, Fuji Xerox Co., Ltd., US7883200, February 8, 2011

A recording sheet including base paper including pulp fiber and filler, wherein the recording sheet further includes carboxylic acid. An inkjet recording method and an electrophotographic image recording method using the recording sheet.

Natural vegetable oil concentrated in unsaponifiable matters as food ingredient

Kohler, C., *et al.*, Laboratories Expanscience, US7883729, February 8, 2011

The invention concerns a natural vegetable oil selected among palm oil, corn germ oil, sunflower oil, and canola oil, concentrated in unsaponifiable matters, such that said oil unsaponifiable matter content is 3 to 15% m/m. Said concentrated natural vegetable oil constitutes a novel food ingredient enriched in particular in vitamin E and phytosterol, useful as favored food source in vitamin E and phytosterol, meeting recommended daily intake.

Structured glycerol esters useful as edible moisture barriers

Klemann, L.P., *et al.*, Kraft Foods Global Brands LLC, US7879384, February 1, 2011

Lipid compositions are provided that are effective as edible moisture barriers for reducing moisture migration between food components. The lipid compositions include a mixture of structured glycerol ester (SGE) compositions bearing short-chain (2 to 4 carbons), medium-chain (6 to 12 carbons), and saturated long-chain (14 to 22 carbons) fatty acid residues. The SGE compositions of the invention are reduced calorie and fully saturated, contain essentially zero trans-unsaturated fatty acids, and contain components present in stable alpha crystal forms.

Diglyceride solutions for lipase activity determination

Imamura, S., Asahi Kasei Pharma Corp., US7883862, February 8, 2011

Diglyceride solutions for lipase activity determination, comprising at least one diglyceride, a low concentration buffer, and a nonionic surfactant.

Renewable chemical production from novel fatty acid feedstocks

Franklin, S., *et al.*, Solazyme, Inc., US7883882, February 8, 2011

Disclosed herein are methods of manufacturing renewable chemicals through the manufacture of novel triglyceride oils followed by

chemical modification of the oils. Methods such as transesterification, hydrogenation, hydrocracking, deoxygenation, isomerization, interesterification, hydroxylation, hydrolysis, and saponification are disclosed. Novel oils containing fatty acid chain lengths of C_8, C_{10}, C_{12}, or C_{14} are also disclosed and are useful as feedstocks in the methods of the invention.

Concentrated liquid soap formulations with greater than 50% long chain soap and fatty acid having readily pumpable viscosity

Hermanson, K., *et al.*, Conopco, Inc., US7884061, February 8, 2011

The present invention provided concentrated soap compositions, particularly those where long chain (>C_{14}) soap and fatty acid comprise >50% of soap and fatty acid. The compositions are formulated in such reasons that, quite unpredictably, despite high soap concentration, they have viscosity which allows them to be pumped from, for example, consumer packaging (e.g., bottles) and/or transit or storage points during manufacture (e.g., pipes, storage tanks, etc.).

Process to produce an enriched composition

Parker, K.R., *et al.*, Eastman Chemical Co., US7884231, February 8, 2011

A process is provided for producing enriched carboxylic acid compositions produced by contacting composition comprising a carboxylic acid with an enrichment feed in an enrichment zone to form an enriched carboxylic acid composition. This invention also relates to a process and the resulting compositions for removing catalyst from a carboxylic acid composition to produce a post catalyst removal composition.

Glycerin by-products and methods of using same

Tran, B., and S. Bhattacharja, Nalco Co., US7887630, February 15, 2011

Methods and compositions for grinding materials are provided. In an embodiment, the present invention provides a method of grinding solid materials. For example, the method can comprise mixing the solid material with the grinding aid, and using a grinding media such as steel balls to grind the solids. The grinding aid composition can comprise one or more glycerin by-products derived from a biodiesel manufacturing process. The grinding aid composition can also comprise one or more glycerin by-products of transesterification reactions involving triglycerides. The grinding aid can be added to the grinding process as a solution .

Restructured meat product and process for preparing same

McMindes, M.K., and E. Godinez, Solae, LLC, US7887870, February 15, 2011

This invention relates to a restructured meat product, comprising (i) a fibrous material containing soy protein and soy cotyledon fiber, wherein said soy cotyledon fiber is present in the fibrous material in an amount of from 1% to 8% by weight on a moisture-free basis; (ii) a comminuted meat; and (iii) water. In another embodiment, the invention discloses a process for preparing a restructured meat product, comprising the steps of: hydrating (i) a fibrous material containing soy protein and soy cotyledon fiber, wherein said soy cotyledon fiber is present in the fibrous material in an amount of from 1% to 8%, by weight on a moisture-free basis in water until the water is absorbed and the fibers are separated; and adding (ii) a comminuted meat, wherein the temperature of the comminuted meat is below 10°C; and mixing the fibrous material and the comminuted meat to produce a homogeneous, fibrous and texturized meat product having a moisture content of at least 50%.

Block copolymer modified vegetable oil and polymer blends and methods of making same

Connell, E.J., *et al.*, Toyota Motor Engineering & Manufacturing North America Inc./University of Minnesota, US7888418, February 15, 2011

Embodiments of a polymer and vegetable oil-based composition comprise a polylactide homopolymer, a vegetable oil dispersed inside the polylactide homopolymer, and a block copolymer configured to aid the dispersion of the vegetable oil inside the polylactide homopolymer.

Glycerin by-products and methods of using same

Tran, B., and S. Bhattacharja, Nalco Co., US7892353, February 15, 2011

Methods and compositions for grinding materials are provided. In an embodiment, the present invention provides a method of grinding solid materials. For example, the method can comprise mixing the solid material with the grinding aid, and using a grinding media such as steel balls to grind the solids. The grinding aid composition can comprise one or more glycerin by-products derived from a biodiesel manufacturing process. The grinding aid composition can also comprise one or more glycerin by-products of transesterification reactions involving triglycerides. The grinding aid can be added to the grinding process as a solution.

Contrast agents

Johnson, D., *et al.*, GE Healthcare AS, US7892522, February 22, 2011

Ultrasound contrast agents comprising microbubbles of biocompatible gas, e.g., a sulfur halide or a perfluorocarbon, stabilized by opsonizable amphiphilic material, e.g., a membrane-forming lipid such as a phospholipid, especially a negatively charged phospholipid such as a phosphatidylserine, may exhibit prolonged contrast-generating residence time in the liver following intravenous administration.

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

Extracts & Distillates

Long-chain omega-3 oils: Current and future supplies, food and feed applications, and stability

Wijesundera, C., *et al., Lipid Technol. 23*:55–58, 2011.

Increasing recognition of the health benefits of omega-3 long-chain ($\geq C_{20}$) polyunsaturated fatty acids (LC omega-3 oils) continues. But new sources are needed, with recent developments with novel land plants showing promise. The value of existing and future sources of LC omega-3 oils occurs through aquaculture, livestock, and other feeding. There is also a need to enhance the stability of oils containing LC omega-3 oils. Challenges include increasing docosahexaenoic acid levels in land plants, increasing oxidative stability in food products, and labeling of products. Consumers have difficulty recognizing and differentiating long-chain and shorter-chain (C_{18}) omega-3 PUFA, both of which are referred to as "omega-3" fatty acids.

Fatty acid esters of 3-MCPD: Overview of occurrence and exposure estimates

Weißhaar, R., *Eur. J. Lipid Sci. Technol. 113*:304–308, 2011.

Many studies and surveys concerning the occurrence and exposure of free 3-MCPD (3-monochloropropane 1,2-diol) have been performed in the last 30 years. Although a huge number of food samples, especially fats and oils, were analyzed in the last three years, no systematic study about ester-bound 3-MCPD and the resulting exposure was performed up to now. In this paper published data of 3-MCPD esters in different foods are reviewed, with a focus on fats and oils and infant formula. Concerning fats and oils, only in refined products were significant concentrations of 3-MCPD esters present in a range from 0.25 to 15 mg/kg, with the highest levels found in palm oil. In infant formula, levels of ester-linked 3-MCPD were nearly unchanged in three surveys from April 2009 to May 2010, while levels of ester-linked glycidol decreased dramatically in this period. Based on analytical data of more than 200 refined fats and oils, an average daily intake of 1.5 µg 3-MCPD/kg bw (body weight)/day, respectively, 0.9 µg glycidol/kg bw/day was calculated to result from consumer exposure to ester-bound 3-MCPD and glycidol.

Measurement of conjugated linoleic acid (CLA) in CLA-rich potato chips by ATR-FTIR spectroscopy

Kadamne, J.V., *et al., J. Agric. Food Chem. 59*:2190–2196, 2011.

A conjugated linoleic acid (CLA)-rich soy oil has been produced by photoisomerization of soy oil linoleic acid. Nutritional studies have shown that CLA possesses health benefits in terms of reducing certain heart disease and diabetes risk factors. Potato chips are snacks that are readily produced in the CLA-rich soy oil containing CLA levels similar to those of the oil used for frying. The objective of this study was to develop a Fourier-transform infrared (FTIR) method to rapidly determine the CLA content of oil in potato chips. Photo-irradiated soy oil samples with ~25% total CLA were mixed with control soy oil, and 100 soy oil samples with total CLA levels ranging from 0.89 to 24.4% were made. Potato chips were fried using each of these 300 g CLA-rich soy oil mixtures at 175°C for approximately 3 min. Duplicate gas chromatography-flame ionization detection (GC-FID) fatty acid analyses were conducted on oil extracted from each batch of potato chips. The chip samples were ground and then scanned using attenuated total reflection (ATR)-FTIR spectroscopy with the aid of a high-pressure clamp, and duplicate spectra of each sample were averaged to obtain an average spectrum. Calibration models were developed using partial least squares regression analysis. These correlated the CLA isomer concentrations of potato chips obtained by GC-FID fatty acid analysis with their corresponding FTIR spectral features. The calibration models were fully cross validated and tested using samples that were not used in the calibration sample set. Calibrations for total CLA, *trans,trans* CLA, *trans*-10,*cis*-12 CLA, *trans*-9,*cis*-11 CLA, *cis*-10,*trans*-12 CLA, and *cis*-9,*trans*-11 CLA had coefficients of determinations (R^2_v) between 0.91 and 0.96 and corresponding root-mean-square error of prediction (RMSEP) ranging from 0.005 to 1.44. The ATR-FTIR technique showed potential as a method for the determination of the CLA levels in unknown potato chip samples.

Dual analysis of triglycerides from certain common lipids and seed extracts

Moldoveanu, S.C., and Y. Chang, *J. Agric. Food Chem. 59*:2137–2147, 2011.

A number of reference oils, two commercial oils, and several oil extracts from seeds of *Nicotiana* species were analyzed for the fatty acid content and also for triglyceride composition. The seed oils were obtained using an accelerated solvent extraction procedure, which was proven to be very efficient and reproducible. The fatty acids were analyzed after the hydrolysis of the oils, using trimethylsilylation and gas chromatography/mass spectrometry (GC/MS) analysis. The levels of 16 molecular species of triglycerides in the oils were measured after GC separation using MS for identification and flame ionization detection for quantification. The results for the fatty acids and those for triglycerides were combined to generate uniform information regarding the composition of the analyzed oils. For a number of oils, the individual triglyceride quantification and mass spectra were reported for the first time. The study showed that in some cases, oils with similar fatty acid content do not have the same triglycerides profile. The fatty acids and triglycerides profile for selected *Nicotiana* species were described for the first time in the literature.

A dynamic role for sterols in embryogenesis of *Pisum sativum*

Schrick, K., *et al., Phytochemistry 72*:465–475, 2011.

Molecular roles of sterols in plant development remain to be elucidated. To investigate sterol composition during embryogenesis, the occurrence of 25 steroid compounds in stages of developing seeds and pods of *Pisum sativum* was examined by gas chromatography-mass spectroscopy analysis. Immature seeds containing very young embryos exhibited the greatest concentrations of sterols. Regression models indicated that the natural log of seed or pod fresh weight was a consistent predictor of declining sterol content during embryonic development. Although total sterol levels were reduced in mature embryos, the composition of major sterols sitosterol and campesterol

remained relatively constant in all 12 seed stages examined. In mature seeds, a significant decrease in isofucosterol was observed, as well as minor changes such as increases in cycloartenol branch sterols and campesterol derivatives. In comparison to seeds and pods, striking differences in composition were observed in sterol profiles of stems, shoots, leaves, and flowers and flower buds as well as cotyledons vs. radicles. The highest levels of isofucosterol, a precursor to sitosterol, occurred in young seeds and flower buds, tissues that contain rapidly dividing cells and cells undergoing differentiation. Conversely, the highest levels of stigmasterol, a derivative of sitosterol, were found in fully differentiated leaves, while all seed stages exhibited low levels of stigmasterol. The observed differences in sterol content were correlated to mRNA expression data for sterol biosynthesis genes from *Arabidopsis*. These findings implicate the coordinated expression of sterol biosynthesis enzymes in gene regulatory networks underlying the embryonic development of flowering plants.

Composition and oxidative stability of crude oil extracts of corn germ and distillers grains

Winkler-Moser, J.K., and L. Breyer, *Ind. Crops Prod. 33*:572–578, 2011.

The fatty acid composition, Acid Value, and the content and composition of tocopherols, tocotrienols, carotenoids, phytosterols, and steryl ferulates were determined in corn germ oil and four post-fermentation corn oils from the ethanol dry-grind process. The oxidative stability index (OSI) at 110°C was determined for the five oils, and four oils were compared for their stability during storage at 40°C as determined by peroxide value and hexanal content. The fatty acid composition of all five oils was typical for corn oil. The Acid Value (and percentage of free fatty acids) was highest (28.3 mg KOH/g oil) in corn oil extracted centrifugally from a conventional dry-grind ethanol processing facility and for oil extracted, using hexane, from distillers dried grains with solubles (DDGS) from a raw starch ethanol processing facility (20.8 mg KOH/g oil). Acid Value was lowest in two oils extracted centrifugally from thin stillage in a raw starch ethanol facility (5.7 and 6.9 mg KOH/g oil). Tocopherols were highest in corn germ oil (~1,400 µg/g), but

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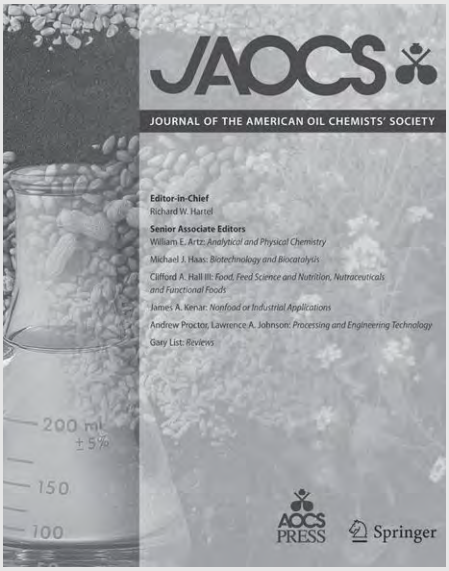

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- Advances in aqueous extraction processing of soybeans, Campbell, K.A., C.E. Glatz, L.A. Johnson, S. Jung, J.M.N. de Moura, V. Capchie, and P. Murphy
- Characterization of fatty oil of *Zizyphi spinosi semen* obtained by supercritical fluid extraction, Weng, F., X. Liu, Y. Chen, and L. Wang
- Production of MLM-type structured lipids catalyzed by immobilized heterologous *Rhizopus oryzae* lipase, Nunes, P.A., P. Pires-Cabral, M. Guillén, F. Valero, D. Luna, and S. Ferreira-Dias
- Aqueous extraction and enzymatic destabilization of coconut milk emulsions, Raghavendra, S.N., and K.S.M.S. Raghavarao
- The efficacy of compounds with different polarities as antioxidants in emulsions with omega-3 lipids, Sørensen, A.-D.M., N.S. Nielsen, E.A. Decker, M.B. Let, X. Xu, and C. Jacobsen
- Chemical compositions of oils from several wild almond species, Moayedi, A., K. Rezaei, S. Moini, and B. Keshavarz
- Regiospecific analyses of triacylglycerols of hoki (*Macruronus novaezelandiae*) and Greenshell™ mussel (*Perna canaliculus*), Miller, M.R., N.B. Perry, E.J. Burgess, and S.N. Marshall
- Kinetic study on oxirane cleavage of epoxidized palm oil, Guo, R., C. Ma, S. Sun, and Y. Ma
- Enzyme treatments to enhance oil recovery from condensed corn distillers solubles, Majoni, S., T. Wang, and L.A. Johnson
- Physicochemical characteristics of nigella seed (*Nigella sativa* L.) oil as affected by different extraction methods, Khoddami, A., H.M. Ghazali, A. Yassoralipour, Y. Ramakrishnan, and A. Ganjloo
- Development and characterization of water-blown polyurethane foams from diethanolamides of karanja oil, Palanisamy, A., M.S.L. Karuna, T. Satyavani, and D.B. Rohini Kumar
- Glycerolysis of soybean oil with crude glycerol containing residual alkaline catalysts from biodiesel production, Echeverri, D.A., F. Cardeño, and L.A. Rios
- Proximate composition and fatty acid profile of *Pongamia pinnata*, a potential biodiesel crop, Bala, M., T.N. Nag, S. Kumar, M. Vyas, A. Kumar, and N.S. Bhogal
- Minimizing the cost of biodiesel blends for specified cloud points, Wang, P.S., J. Thompson, and J. Van Gerpen
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- *Camelina sativa* oil deodorization: balance between free fatty acids and color reduction and isomerized byproducts formation, Hrastar, R., L. Cheong, X. Xu, R.L. Miller, and I.J. Košir
- Production of PUFA concentrates from poultry and fish processing waste, Patil, D., and A. Nag

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- (Editorial) Citations: the rules they didn't teach you, Murphy, E. J.
- Activation of AMP-kinase by policosanol requires peroxisomal metabolism, Banerjee, S., S. Ghoshal, and T D. Porter
- Presence of apolipoprotein C-III attenuates apolipoprotein E-mediated cellular uptake of cholesterol-containing lipid particles by HepG2 cells, Morita, S., A. Sakurai, M. Nakano, S. Kitagawa, and T. Handa
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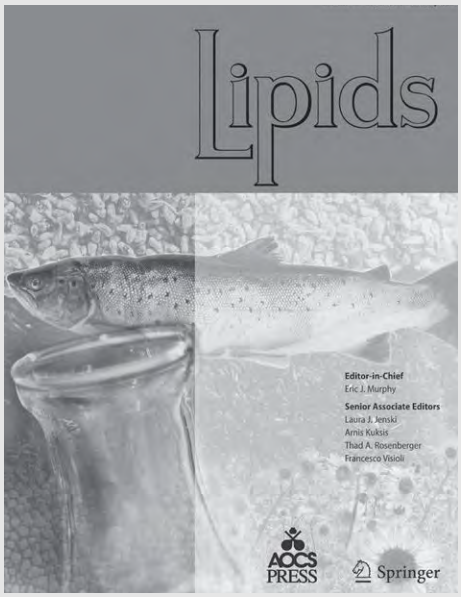

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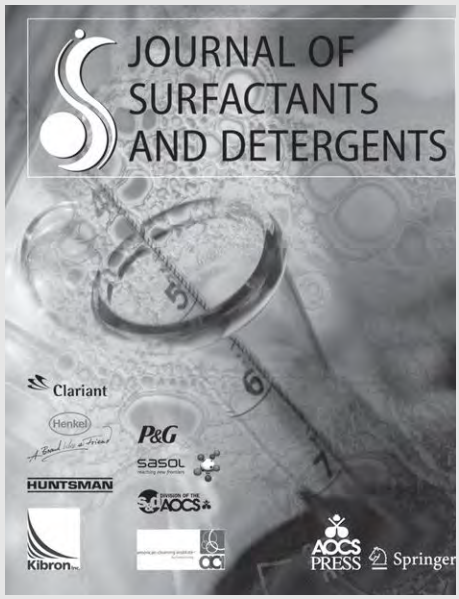

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- Preparation and properties of new ester-linked cleavable gemini surfactants, Kuo, C.–F.J., L.-H. Lin, M.-Y. Dong, W.S. Chang, and K.-M. Chen
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- Resolution of a five-component mixture of quaternary ammonium surfactants on silica gel 60 F_{254} high performance thin layer chromatographic plates, Bhawani, S.A., O. Sulaiman, Z.A. Khan, R. Hashim, and M.N.M. Ibrahim

tocotrienols, phytosterols, steryl ferulates, and carotenoids were higher in all of the post-fermentation corn oils. Hexane-extracted oil from DDGS was the most oxidatively stable as evaluated by OSI and storage test at 40°C, followed by centrifugally extracted thin stillage oil from the raw starch ethanol process, and centrifugally extracted thin stillage oil from the conventional dry-grind ethanol process. Corn germ oil was the least oxidatively stable. When stored at room temperature, the peroxide value of centrifugally extracted thin stillage oil from the raw starch ethanol process did not significantly increase until after six weeks of storage, and was less than 2.0 milliequivalents of peroxide/kg oil after three months of storage. These results indicate that post-fermentation corn oils have higher content of valuable functional lipids than corn germ oil. Some of these functional lipids have antioxidant activity, which increases the oxidative stability of the post-fermentation oils.

Visualization of lipid droplet composition by direct organelle mass spectrometry

Horn, P.J., *et al., J. Biol. Chem. 286*:3298–3306, 2011.

An expanding appreciation for the varied functions of neutral lipids in cellular organisms relies on a more detailed understanding of the mechanisms of lipid production and packaging into cytosolic lipid droplets (LD). Conventional lipid profiling procedures involve the analysis of tissue extracts and consequently lack cellular or subcellular resolution. Here, we report an approach that combines the visualization of individual LD, microphase extraction of lipid components from droplets, and the direct identification of lipid composition by nanospray mass spectrometry, even to the level of a single LD. The triacylglycerol (TAG) composition of LD from several plant sources [mature cotton (*Gossypium hirsutum*) embryos, roots of cotton seedlings, and *Arabidopsis thaliana* seeds and leaves] were examined by direct organelle mass spectrometry and revealed the heterogeneity of LD derived from different plant tissue sources. The analysis of individual LD makes possible organellar resolution of molecular compositions and will facilitate new studies of LD biogenesis and functions, especially in combination with analysis of morphological and metabolic mutants. Furthermore, direct organelle mass spectrometry could be applied to the molecular analysis of other subcellular compartments and macromolecules.

Fat extraction from acid- and base-hydrolyzed food samples using accelerated solvent extraction

Rahmat Ullah, S.M., *et al., J. Agric. Food Chem. 59*:2169–2174, 2011.

This paper describes a new in-cell method for pursuing accelerated solvent extraction (ASE) prior to lipid analysis from food samples. It is difficult to pursue direct ASE with acid- or base-hydrolyzed samples due to the corrosive nature of the reagents and material limitations. In this study ion exchange-based materials were used to remove acid or base reagents in-cell without compromising the recovery of lipids. The performance data are presented here for the new methods for lipid extraction for a variety of food samples and compared to the Mojonnier method. NIST Standard Reference Materials (SRM-1546 and -1849) were used to validate the ASE methods. Excellent fat recoveries were obtained for the ASE methods. The new methods presented here enhance the utility of ASE and eliminate labor intensive protocols.

Rice bran, a potential source of biodiesel production in Indonesia

Gunawan, S., *Ind. Crops Prod. 33*:624–628, 2011.

Biodiesel is a biodegradable, renewable, non-toxic, and environmentally friendly alternative fuel. The cost of raw materials comprises 60–88% of the production cost in commercial biodiesel (fatty acid methyl esters, FAME) production. Therefore, the use of low-cost raw material as a substrate and an *in situ* process for biodiesel production are preferred. In this case, rice bran, which contains 13.5% oil, was an interesting substrate. *In situ* esterification of high-acidity rice bran with methanol and sulfuric acid catalyst was investigated. The individual and interaction effects of methanol-to-rice bran ratio, sulfuric acid catalyst concentration, and reaction time on purity and recovery of biodiesel were discussed. Our results suggest that under the following operation conditions—methanol-to-rice bran ratio of 5 mL/g, sulfuric acid concentration in methanol of 1.5 vol%, and reaction time of 60 min—an *in situ* esterification operated on rice bran could yield FAME with a high purity and recovery. By applying an *in situ* esterification with *n*-hexane/water extractions, Indonesia will be successful in obtaining biodiesel from rice bran up to 96,000 metric tons per year.

Furan formation from lipids in starch-based model systems, as influenced by interactions with antioxidants and proteins

Owczarek-Fendor, A., *et al., J. Agric. Food Chem. 59*:2368–2376, 2011.

The formation of furan upon sterilization of a lipid-containing starch gel was investigated in the presence of various antioxidants, namely, α-tocopherol, β-carotene, and ascorbic acid, with and without proteins. Results indicated that α-tocopherol did not significantly influence furan formation from oxidized lipids. β-Carotene, suggested previously to be a furan precursor itself, did influence the generation of furan in a concentration-dependent manner, although to a limited extent. Surprisingly, the presence of lipids seemed to limit the furan generation from β-carotene. Interestingly, the addition of ascorbic acid to the emulsions containing soybean or sunflower oils considerably enhanced the formation of furan from these oils. This was also the case when fresh oils were applied, shown previously to be nearly unable to generate furan. This observation can be explained by an intensified ascorbic acid degradation stimulated by the presence of lipids.

Recent advances of chromatography and mass spectrometry in lipidomics

Li, M., *et al., Anal. Bioanal. Chem. 399*:243–249, 2011.

Lipidomics, as a novel branch of metabolomics, which is aimed at comprehensive analysis of lipids and their biological roles with respect to health and diseases, has attracted increased attention from biological and analytical scientists. As a result of the complexity and diversity of lipids, accurate identification and efficient separation are required for lipidomics analysis. Mass spectrometry (MS) and chromatography have been extensively developed in the past few decades and hold a distinguished position in qualification and separation science. They are powerful and indispensable tools

for lipidomics. Herein, we present the recent advancement of MS, chromatography, and their hyphenation technologies in lipidomics.

High density lipoprotein: It's not just about lipid transport anymore

Gordon, S.M., *et al.*, *Trends Endocrinol. Metab. 22*:9–15, 2011.

Plasma levels of high density lipoprotein cholesterol (HDL-C) have long been associated with protection against cardiovascular disease (CVD) in large populations. However, HDL-C has been significantly less useful for predicting CVD risk in individual patients. This has ignited a new debate on the merits of measuring HDL quantity vs. quality in terms of protective potential. In addition, numerous recent studies have begun to uncover HDL functions that vary surprisingly from traditional lipid transport roles. In this paper, we review recent findings that point to important functions for HDL that go well beyond lipid transport. These discoveries suggest that HDL might be a platform that mediates protection from a host of disease states ranging from CVD to diabetes to infectious disease.

Monoolein: a magic lipid?

Kulkarni, C.V., *et al.*, *Phys. Chem. Chem. Phys. 13*:3004–3021, 2011.

During the last few years, there has been an extraordinary increase in publications describing the manifold applications of monoolein, one of the most important lipids in the fields of drug delivery, emulsion stabilization, and protein crystallization. In this perspective we present a comprehensive review of the phase behavior of this "magic lipid." An account of various mesophases formed in the presence of water and a collection of formulae for the calculation of their nano-structural parameters are provided. Effects of chemical and biological molecules including lipids, detergents, salts, sugars, proteins, and DNA on the classical behavior are also discussed. Physicochemical triggers such as temperature, pressure, and shearing modulate the phase behavior of monoolein self-assemblies that are covered in subsequent sections. Finally the growing applications of monoolein in various fields are also reported.

Lipins: multifunctional lipid metabolism proteins

Csaki, L.S., and K. Reue, *Annu. Rev. Nutr. 30*:257–272, 2010.

The lipin proteins are evolutionarily conserved proteins with roles in lipid metabolism and disease. There are three lipin protein family members in mammals and one or two orthologs in plants, invertebrates, and single-celled eukaryotes. Studies in yeast and mouse led to the identification of two distinct molecular functions of lipin proteins. Lipin proteins have phosphatidate phosphatase activity and catalyze the formation of diacylglycerol in the glycerol-3-phosphate pathway, implicating them in the regulation of triglyceride and phospholipid biosynthesis. Mammalian lipin proteins also possess transcriptional coactivator activity and have been implicated in the regulation of metabolic gene expression. Here we review key findings in the field that demonstrate roles for lipin family members in metabolic homeostasis and in rare human diseases, and we examine evidence implicating genetic variations in lipin genes in common metabolic dysregulation such as obesity, hyperinsulinemia, hypertension, and type 2 diabetes.

Docosahexaenoic acid is an independent predictor of all-cause mortality in hemodialysis patients

Hamazaki, K., *et al.*, *Am. J. Nephrol. 33*:105–110, 2011.

Background: The dietary n-3 polyunsaturated fatty acids (PUFA) docosahexaenoic acid (DHA) and eicosapentaenoic acid have been shown to reduce cardiovascular mortality. Patients on hemodialysis (HD) have a very high mortality from cardiovascular disease. Fish consumption reduces all-cause mortality in patients on HD. Moreover, n-3 PUFA, especially DHA levels in red blood cells (RBC), are associated with arteriosclerosis in patients on HD. The aim of this study was to determine whether DHA levels in RBC predict the mortality of patients on HD in a prospective cohort study. Method: A cohort of 176 patients [64.1 ± 12.0 (mean ± SD) years of age; 96 men and 80 women] under HD treatment was studied. The fatty acid composition of their RBC was analyzed by gas chromatography. Results: During the study period of 5 years, 54 deaths occurred. After adjustment for 10 confounding factors, the Cox hazard ratio of all-cause mortality of the patients on HD in the highest DHA tertile (>8.1%, 15 deaths) was 0.43 (95% confidence interval 0.21–0.88) compared with those patients in the lowest DHA tertile (<7.2%, 21 deaths). Conclusion: The findings suggest that the level of DHA in RBC could be an independent predictor of all-cause mortality in patients on HD.

Identification of the geometrical isomers of α-linolenic acid using gas chromatography/mass spectrometry with a binary decision tree

Hejazi, L., *et al.*, *Talanta 83*:1233–1238, 2011

Gas chromatography using a highly polar column, low-energy (30 eV) electron ionization mass spectrometry, and multivariate curve resolution are combined to obtain the mass spectra of all eight geometrical isomers of α-linolenic acid. A step-by-step Student's *t*-test is performed on the *m/z* 50–294 to identify the *m/z* by which the geometries of the double bonds could be discriminated. The most intense peak discriminates between *cis* (*m/z* 79) and *trans* (*m/z* 95) at the central (carbon 12) position. The configuration at carbon 15 is then distinguished by *m/z* 68 and 236, and finally the geometry at carbon 9 is determined by *m/z* 93, 173, 191, and 236. A three-question binary tree is developed based on the normalized intensities of these ions by which the identity of any given isomer of α-linolenic is accurately determined. Application of Bayes' theorem to data from independent samples shows that the complete configuration is determined correctly with a minimum probability of 87%.

Chemical composition of distillers grains, a review

Liu, K., *J. Agric. Food Chem. 59*:1508–1526, 2011.

In recent years, increasing demand for ethanol as a fuel additive and for decreasing dependency on fossil fuels has resulted in a dramatic increase in the amount of grains used for ethanol production. Dry-grind is the major process, resulting in distillers dried grains with solubles (DDGS) as a major co-product. Like fuel ethanol, DDGS have quickly become a global commodity. However, high compositional variation has been the main problem hindering its use as a feed ingredient. This review provides updated information on the chemical composition of distillers grains in terms of nutrient levels, changes during dry-grind processing, and causes for large variation. The occurrence in grain feedstock and the

fate of mycotoxins during processing are also covered. During processing, starch is converted to glucose and then to ethanol and carbon dioxide. Most other components are relatively unchanged but concentrated in DDGS about threefold over the original feedstock. Mycotoxins, if present in the original feedstock, are also concentrated. Higher-fold increases in S, Na, and Ca are mostly due to exogenous addition during processing, whereas unusual changes in inorganic phosphorus (P) and phytate P indicate phytate hydrolysis by yeast phytase. Fermentation causes major changes, but other processing steps are also responsible. The causes for varying DDGS composition are multiple, including differences in feedstock species and composition, process methods and parameters, the amount of condensed solubles added to distiller wet grains, the effect of fermentation yeast, and analytical methodology. Most of them can be attributed to the complexity of the dry-grind process itself. It is hoped that information provided in this review will improve the understanding of the dry-grind process and aid in the development of strategies to control the compositional variation in DDGS.

Synthesis of soybean oil-based polymeric surfactants in supercritical carbon dioxide and investigation of their surface properties

Liu, Z., and G. Biresaw, *J. Agric. Food Chem.* 59:1909–1917, 2011.

This paper reports the preparation of polymeric surfactants (HPSO) via a two-step synthetic procedure: polymerization of soybean oil (PSO) in supercritical carbon dioxide followed by hydrolysis of PSO (HPSO) with a base. HPSO was characterized and identified by using a combination of Fourier-transform infrared, ^{1}H nuclear magnetic resonance spectroscopy (NMR), ^{13}C NMR, and gel permeation chromatography methods. The effects of HPSO polysoaps on the surface tension of water and interfacial tension of water-hexadecane were investigated as a function of concentration of HPSO and counterion chemistry. HPSO polysoaps were effective at lowering the surface tension of water and the interfacial tension of water-hexadecane. They displayed minimum values of surface tension in the range of 20.5–39.6 dyn/cm at a concentration range of 3.2–32 μM and minimum values of interfacial tension in the range of 15.6–31.44 dyn/cm. The minimum surface and interfacial tension values were highly dependent on the nature of the counterion and increased in the order $K^+ < Na^+ < TEA^+$ (triethanolamine). These results suggested that a very low concentration of surfactant can be used to reduce the surface tension of water and interfacial tension of water-hexadecane. Water-hexadecane interfacial energy was also calculated from measured surface tension data using Antonoff, harmonic mean (HM), and geometric mean (GM) methods. Measured values agreed well with those calculated using the HM and GM. The HM method predicted slightly higher values than the GM method, but the Antonoff method did not agree with measured values.

Functional proteomic analysis of rice bran esterases/lipases and characterization of a novel recombinant esterase

Chuang, H., *et al.*, *J. Agric. Food Chem.* 59:2019–2025, 2011.

An esterase from rice (*Oryza sativa*) bran was identified on two-dimensional gel using 4-methylumbelliferyl butyrate as a substrate. The esterase cDNA (870 bp) encoded a 289 amino acid protein (designated OsEST-b) and was expressed in *Escherichia coli*. The molecular weight of recombinant OsEST-b (rOsEST-b) was 27 kDa, as measured by sodium dodecyl sulfate–polyacrylamide gel electrophoresis. Biochemical characterization demonstrated that rOsEST-b was active over a broad temperature range (optimum at 60°C) and preferred alkaline conditions (optimum at pH 9.0). The rOsEST-b showed maximum activity toward *p*-nitrophenyl butyrate (C_4) among various *p*-nitrophenyl esters (C_4–C_{18}), indicating that rOsEST-b is an esterase for short-chain fatty acids. The kinetic parameters under optimal conditions were $K_m = 27.03$ μM, $K_{cat} = 49\ s^{-1}$, and $K_{cat}/K_m = 1.81\ s^{-1}\ \mu M^{-1}$. The activity of rOsEST-b was not influenced by ethylenediaminetetraacetic acid, suggesting that it is not a metalloenzyme. The amino acid sequence analysis revealed that OsEST-b had a conserved pentapeptide esterase/lipase motif but that the essential active site serine (GXSXG) was replaced by cysteine (C). These results suggest that OsEST-b is distinct from traditional esterases/lipases and is a novel lipolytic enzyme in rice bran. ■

CALENDAR

(CONTINUED FROM PAGE 264)

October

October 2–6, 2011. FACSS [Federation of Analytical Chemistry and Spectroscopy Societies] Annual Conference, Grand Sierra Resort, Reno, Nevada, USA. Information: www.facss.org.

October 5–7, 2011. oils+fats, the International Trade Fair for the Production and Processing of Oils and Fats made from Renewable Resources, M,O,C, Event Center in Munich-Freimann, Germany. Information: www.oils-and-fats.com/en/Home?3.

October 5–7, 2011. Algae Europe, Milan Exhibition Centre, Milan, Italy. Information: www.algaeurope.eu/en_lfm/index_alg.asp.

October 9–13, 2011. Practical Short Course on Processing and Products of Vegetable Oil/Biodiesel, Food Protein Research & Development Center, Texas A&M University System, College Station, Texas, USA. Information: http://foodprotein.tamu.edu/fatsoils/scvegoil.php.

October 10–13, 2011. World Congress on Oleo Science and 29th ISF Congress—JOCS/AOCS/KOCS/ISF/ISBB Joint Meeting, Tower Hall Funabori, Tokyo, Japan. Information: www2.convention.co.jp/wcos2011.

October 14–20, 2011. ASA-CSSA-SSSA (American Society of Agronomy-Crop Science Society of America-Soil Science Society of American) 2011 International Annual Meetings, San Antonio, Texas, USA. Information: www.acsmeetings.org.

October 16–19, 2011. AACC [American Association of Cereal Chemistry] Annual Meeting, Palm Springs, California, USA. Information: http://meeting.aaccnet.org.

October 17, 2011. Basics of Edible Oil Processing and Refining—AOCS Short

Course, Hilton Cartagena, Cartagena, Colombia. Information: email: meetings@aocs.org; phone: +1 217-693-4821; fax: +1 217-693-4865; www.aocs.org/LACongress.

October 17, 2011. Oilseed Processing and Solvent Extraction—AOCS Short Course, Hilton Cartagena, Cartagena, Colombia. Information: email: meetings@aocs.org; phone: +1 217-693-4821; fax: +1 217-693-4865; www.aocs.org/LACongress.

October 18, 2011. Oils and Fats Modification—AOCS Short Course, Hilton Cartagena, Cartagena, Colombia. Information: email: meetings@aocs.org; phone: +1 217-693-4821; fax: +1 217-693-4865; www.aocs.org/LACongress.

October 18, 2011. SODEOPEC: Soaps, Detergents, Oleochemicals, and Personal Care Products—AOCS Short Course, Hilton Cartagena, Cartagena, Colombia. Information: email: meetings@aocs.org; phone: +1 217-693-4821; fax: +1 217-693-4865; www.aocs.org/LACongress.

October 19–21, 2011. 14th Latin American Congress on Fats and Oils, Hotel Cartagena, Cartagena, Colombia. Information: email: meetings@aocs.org; phone: +1 217-693-4821; fax: +1 217-693-4865; www.aocs.org/LACongress.

October 25–27, 2011. Algal Biomass Summit, Hyatt Regency Hotel, Minneapolis, Minnesota, USA. Information: http://algaebiomasssummit.org/ema/DisplayPage.aspx?pageId=About.

October 26–28, 2011. 8th Lipidomics Meeting: Membranes and Bioactive Lipids, INSA de Lyon, Villeurbanne, France. Information: www.gerli.com/lyon2011Eng.htm.

October 31–November 2, 2011. IFSCC [International Federation of Societies of Cosmetic Chemists] Conference: Effective, Economic and Ecological Cosmetics, Centara Grand and Bangkok Convention Centre, Thailand. Information: email: Rojana@ifscc2011.com; www.ifscc2011.com.

November

November 1–3, 2011. 54th Biennial CHEM SHOW (The Chemical Process Industries Exposition), Jacob K. Javits Convention Center, New York City, New York, USA. Information: email: info@chemshow.com; www.chemshow.com.

November 8–10, 2011. AOSDAC [Asia Oceania Soap & Detergent Association Conference] 2011, incorporating the 31st CASSDI Annual Meeting and Beijing International Cosmetics, Personal Care & Detergents Expo 2011, China National Convention Centre, Beijing. Information: email: zht586@cassdi.org or yanglin@cassdi.org; www.cassdi.org.

November 15–17, 2011. PIPOC 2011, Kuala Lumpur Convention Center, Kuala Lumpur, Malaysia. Information: email: pipoc2011@mpob.gov.my.

November 16–17, 2011. Biofuels International Expo & Conference, Antwerp Expo, Antwerp, Belgium. Information: www.biofuelsinternationalexpo.com/bio_rott.html.

November 29–December 1, 2011. Food Ingredients Europe 2011 Exhibition, Paris, France. Information: www.fi-events.com.

December

December 1–2, 2011. International Algae Conference: Microalgae and Aquatic Biomass, Berlin, Germany. Information: www.algaecongress.com.

December 7–10, 2011. Vinachem International Chemical Industry Exhibition, Tan Binh International Exhibition & Convention Center, Ho Chi Minh City, Vietnam. Information: www.vietfair.vn; www.chemvina.com.

December 8–10, 2011. 17th Lipid Meeting, Leipzig, Germany. Information: www.lipidmeeting.de.

December 11–13, 2011 International Conference on Soaps, Detergents & Cosmetics, Nehru Centre, Mumbai, India. Information: www.isdcconference.com.

2012

March 11–16, 2012. Pittcon 2012, Orlando, Florida, USA.

March 25–29, 2012. 243rd American Chemical Society National Meeting and Exposition, San Diego, California. Information: www.acs.org.

March 25–29, 2012. XVI International Symposium on Atherosclerosis, Sydney Convention and Exhibition Centre Darling Harbour, Sydney Australia. Information: www.isa2012.com.

April 29–May 2, 2012. 103rd AOCS Annual Meeting & Expo, Long Beach Convention and Entertainment Center, Long Beach, California. Information: phone: +1-217-359-2344; fax: +1-217-351-8091; email: meetings@aocs.org; http://AnnualMeeting.aocs.org.

June 18–21, 2012. BIO [Biotechnology Industry Organization] International Convention, Boston, Massachusetts, USA. Information: http://convention.bio.org.

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

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

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

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

Top 10 of 2010

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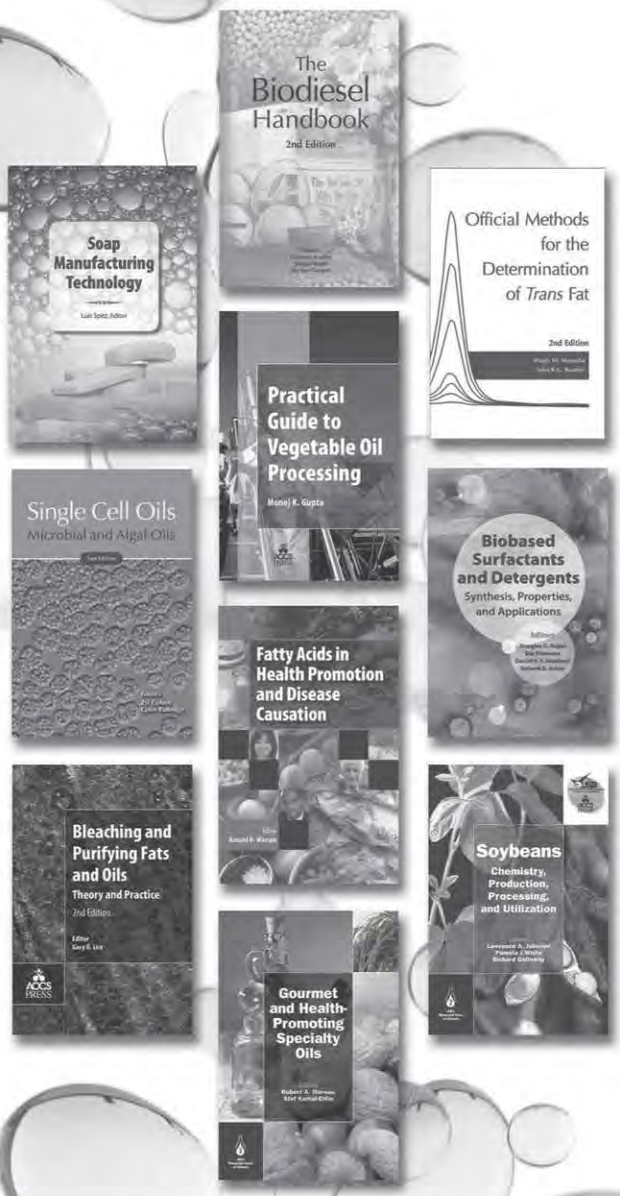

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Beyond texture and mouthfeel: how lipids influence taste perception

Silvana Martini

Considering that consumer acceptance of food products is driven by a combination of flavor, taste, and texture, it is not surprising that lowering the sugar, salt, and/or lipid content of foods usually results in lower consumer acceptability. Understanding the role that each of the major components of foods plays in the sensory profile of a product is critical to predicting changes in consumer acceptance when one or several of these ingredients are reduced or eliminated. Yet little work has been done on the effect of lipids on sensory perception beyond the study of their effect on texture and mouthfeel.

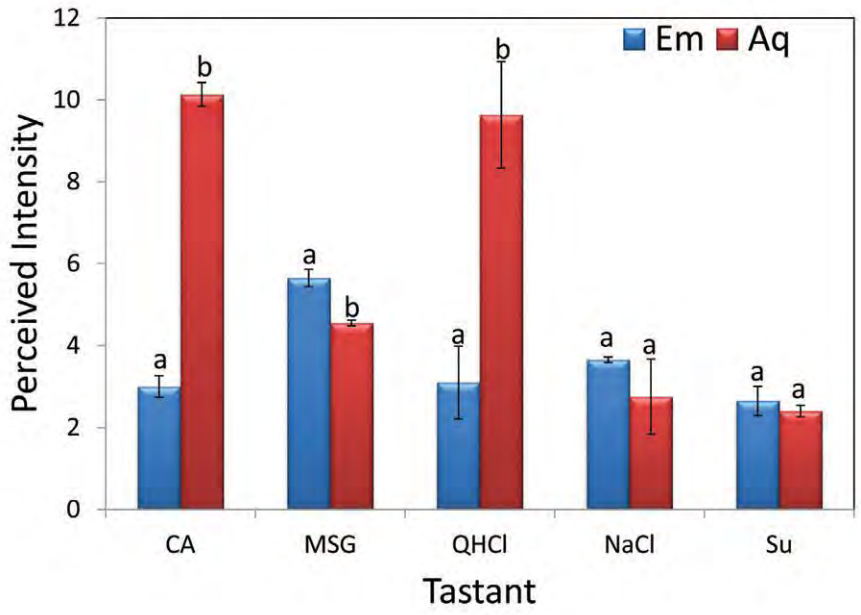

FIG. 1. *Perceived intensity of the five basic tastes in emulsions and aqueous systems. Intensities were measured using a 15-point category scale. CA, citric acid; MSG, monosodium glutamate; QHCl, quinine hydrochloride; NaCl, sodium chloride; Su, sucrose; Em, emulsions; Aq, aqueous. For each tastant, bars with the same letter are not significantly different (p < 0.05).*

Richard Mattes is a pioneer in this area (Mattes, 2007). His first studies were performed with 1% dispersions of linoleic acid in water. He reported that the presence of this fatty acid increased taste detection thresholds for citric acid, sodium chloride, and caffeine. Beyond these findings, our understanding of how lipids are detected by taste receptor cells and of the effects of their detection on various physiological factors and sensory phenomena is still limited, and many questions related to how varying concentrations of specific fatty acids (or combinations of them) may affect taste thresholds and intensities—and whether these effects are strongly dependent on the type of fatty acid(s) or tastant(s) involved—remain unanswered.

For example, relatively little research has considered whether a shift in tastant threshold contributes to differences observed in the perception of the same concentration of tastant in an oil-in-water emulsion vs. an aqueous one. Furthermore, relatively few studies evaluate taste thresholds and intensities in conjunction. It may not be possible to extrapolate variables that affect taste thresholds (minimum concentration of a molecule to produce an identifiable stimulus) to intensity perceived at the supra-threshold level.

Recently, our laboratory studied the effect of lipid addition and lipid composition on taste thresholds and slight supra-threshold intensity perceptions of the five tastes, that is, sour, umami, bitter, salty, and sweet, in 20% oil-in-water emulsions. The five basic tastes were generated using citric acid, monosodium glutamate (MSG), quinine hydrochloride (QHCl), NaCl, and sucrose, respectively. Three different lipid phases were used to evaluate the effect of lipid chemical composition on taste perception. Soybean oil (SBO) was used as a representation of a liquid oil with a high content of unsaturated triacylglycerols (TAG). Anhydrous milk fat (AMF) was used as a representation of a semisolid fat with high content of saturated TAG. Finally, a 50% mixture of SBO and AMF was used as a lipid source with an intermediate level of saturated and unsaturated TAG. The polyunsaturated fatty acid composition of the lipid sources varied from 2.4 to 34.3 to 59.7% for AMF, 50:50, and SBO lipid blends, respectively.

Effect of lipid addition on taste thresholds

A trained sensory panel tasted aqueous and emulsion samples to quantify taste thresholds. Tastants were added to the emulsions to obtain the same final concentration as in the aqueous solutions. No significant differences were found in the taste thresholds among emulsions formulated with different oil phases, suggesting that lipid chemical composition did not play an important role in taste perception. However, the presence of an oil phase did affect threshold values for

some basic tastes. According to Table 1, addition of lipid in an emulsified form significantly increased thresholds for sour and bitter tastes produced by citric acid and QHCl, respectively. These results suggest that a higher concentration of citric acid and QHCl is needed in emulsion systems for panelists to detect the specific taste.

The significantly higher threshold values for citric acid emulsions might be attributable to competition for taste receptors between citric acid and free fatty acids present in the oil phase. However, this is only speculation, and further research at the molecular level should be performed to corroborate this hypothesis. Considering that taste perception is a consequence of the interaction between a taste receptor and molecules solubilized in the water phase, the higher threshold observed in the QHCl emulsions could be explained by the slight solubility of QHCl in the lipid phase. Lipids present in a food matrix might participate in taste perception by limiting the ability of tastants to arrive at and to interact with taste receptor cells. In addition, lipids may affect taste perception by increasing the concentration of water-soluble tastants in the water phase. These two effects may act alone or in combination depending on the food matrix and on the chemical nature of the tastant.

Effect of lipid addition on taste intensities

Slight supra-threshold concentrations were used to measure the intensity of each tastant in the emulsions and aqueous samples. Concentrations of 0.05% were used for citric acid and MSG samples; and concentrations of 0.00125, 0.0313, and 0.25% were used for QHCl, NaCl, and sucrose, respectively. The perceived intensity of these samples is shown in Figure 1. The presence of an oil phase significantly affected the perception of sour, umami, and bitter; whereas there were no statistical differences for the perception of salty and sweet.

For the same tastant concentration, taste intensities for sour and bitter tastes were lower in emulsions compared with the aqueous solutions, which is related to the higher threshold observed in the emulsions. On the other hand, the presence of a lipid phase increased the perception of umami, and judges perceived higher intensity values in the emulsions. In addition, even though the difference in saltiness perception was not statistically significant, a slight increase in saltiness perception can be observed in the emulsions, while a high error was obtained in aqueous samples. Sweetness perception was not affected by the presence of a lipid phase.

It is important to note here that these experiments were performed with a highly trained sensory panel and that emulsions used in this research were stable (destabilization rate not greater than 0.4 mm/day) and had similar droplet size ($D_{3,2}$ = 0.405 ± 0.012 μm) and viscosity (1.85 ± 0.04 cP).

During the course of our studies, we observed different tendencies regarding the threshold and intensity values of the five tastes as affected by lipid addition. Three behavioral groups, encompassing all five tastes, can be identified. The first group includes citric acid and QHCl, where threshold values of the emulsions were significantly higher than the aqueous ones. Therefore, when the same concentration is evaluated for intensity, a significantly lower intensity is obtained in the emulsion, which is related to the proximity of the tastant concentration to the higher threshold. The second group of tastants includes NaCl and MSG, where the threshold values were not significantly different between emulsions and aqueous solutions. However, when the same tastant concentration is evaluated for intensity, a higher

Texture, flavor, and taste: the three drivers of consumer acceptance

Lipids provide an efficient source of energy to our bodies and also play a critical role in delivering flavor and mouthfeel. Food texture (or mouthfeel), flavor, and taste are the major factors that affect consumer acceptance. Whereas texture is determined by the structure or viscoelastic properties of the material, flavor and taste are driven by the chemical nature of the molecules in the product.

Flavor perception is a combination of taste, olfactory stimuli, and chemical sensitivity. Taste, on the other hand, is characterized by the perception of chemical stimuli produced by the five basic tastes: sweet, sour, bitter, salty, and umami. The perception of sweet, salty, and umami is usually associated with a positive experience. This can be correlated to specific survival instincts: Sweetness perception is associated with our need of carbohydrates to generate energy; salty perception is associated with the need of electrolytes for our body to function, umami perception is associated with the need of a supply of amino acids to synthesize proteins.

Similarly, consumers usually have a negative experience with sour and bitter tastes (although these two tastes can become desired through an adaptation phenomenon or acquired taste). People commonly associate sourness with spoiled foods, and bitterness with poisonous products.

It is therefore reasonable to think that there could be a specific taste associated with lipids, due to their importance as a high energy source. Although lipids have not yet been recognized as a basic taste, much progress has been made on identifying the pathways associated with fatty acid perception (Gilbertson *et al.*, 1997).

TABLE 1.
Taste recognition thresholds (%) of the fi e basic tastes for emulsions and aqueous systems[a]

Tastant	Emulsion	Aqueous
Citric acid	0.0346[a] ± 0.0028	0.0233[b] ± 0.0186
MSG	0.0240[a] ± 0.0047	0.0191[a] ± 0.0069
QHCl	0.0011[a] ± 0	0.0008[b] ± 0.0005
NaCl	0.0191[a] ± 0.0036	0.0167[a] ± 0.0047
Sucrose	0.2047[a] ± 0.0486	0.2000[a] ± 0.0555

[a]*Values in a row with different superscript letters are significantly different at a* p = *0.05 level. MSG, monosodium glutamate; QHCl, quinine hydrochloride.*

information

- Gilbertson, T.A., D.T. Fontenot, L. Liu, H. Zhang, and W.T. Monroe, Fatty acid modulation of K^+ channels in taste receptor cells: Gustatory cues for dietary fat, *Am. J. Physiol. Cell Physiol. 272*:C1203–C1210 (1997).
- Mattes, R.D., Effects of linoleic acid on sweet, sour, salty, and bitter taste thresholds and intensity ratings of adults, *Am. J. Physiol. Gastrointest. Liver Physiol. 292*: G1243–G1248 (2007).
- Thurgood, J.E., and S. Martini, Effect of three emulsion compositions on taste thresholds and intensity ratings of five taste compounds, *J. Sens. Stud. 25*:861–875 (2010).

intensity in the emulsions is obtained even with the close proximity of the tastant and threshold concentrations. This suggests that the taste intensity in these systems is increased as a result of the presence of a lipid phase in an emulsified form. Sucrose represents the last behavioral group, in which threshold and sweetness intensities are not affected by the presence of a lipid phase.

This study was performed with three lipid systems with differing fatty acid chemical compositions and a specific emulsifier. Caution must be applied to extrapolate these results to the entire universe of fats, oils and emulsifiers. Similarly, the most representative compounds from each taste group (sucrose for sweetness, NaCl for saltiness, MSG for umami, quinine hydrochloride for bitterness, and citric acid for sourness) were used in this research. In addition, tastant intensities tested in this research were near-threshold intensities. Results obtained in real food systems, with other ingredients (e.g., type and concentration of tastant, lipid and/or emulsifier), might differ from the ones reported in this research.

The results discussed in this article and published in Thurgood and Martini (2010) provide a starting point to better understand the role that lipids play in multicomponent systems. This information can be used to optimize, for example, the flavor profile of foods with low sodium content, or to increase "savory" notes as the ones generated by MSG. The long-term goal of this growing area of research is to understand lipid and taste interaction using applied and basic sensory tools to optimize the sensory characteristics of healthful food products and help enhance human health and quality of life.

Silvana Martini is an assistant professor in the Department of Nutrition, Dietetics, and Food Sciences, Utah State University, Logan, USA. She can be reached at: silvana.martini@usu.edu.

Can a high omega-3 diet prevent obesity-related disease?

Eskimos offer living proof that it's the quality—not the quantity—of the lipids you eat that matters the most. The findings echo the results of a landmark 1975 study of Inuit in Greenland and Denmark.

A study of Yup'ik Eskimos in the US state of Alaska, who on average consume 20 times more long-chain omega-3 fatty acids from fish than people in the lower 48 states, suggests that a high intake of these fatty acids helps prevent obesity-related chronic diseases such as diabetes and heart disease.

The study, led by researchers at Fred Hutchinson Cancer Research Center (Seattle, Washington, USA) and conducted in collaboration with the Center for Alaska Native Health Research at the University of Alaska-Fairbanks, was published online March 23 in the *European Journal of Clinical Nutrition.*

"Because Yup'ik Eskimos have a traditional diet that includes large amounts of fatty fish and have a prevalence of overweight or obesity that is similar to that of the general US population, this offered a unique opportunity to study whether omega-3 fats change the association between obesity and chronic disease risk," said lead author Zeina Makhoul, a postdoctoral researcher in the Cancer Prevention Program of the Public Health Sciences Division at the Hutchinson Center.

The fats the researchers were interested in measuring were those found in salmon, sardines, and other fatty fish: docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA).

Researchers analyzed data from a community-based study of 330 people living in the Yukon Kuskokwim Delta region of southwest Alaska, 70% of whom were overweight or obese. As expected, the researchers found that in participants with low blood levels of DHA and EPA, obesity strongly increased both blood triglycerides (a blood lipid abnormality) and C-reactive protein (CRP; a measure of overall body inflammation). Elevated levels of triglycerides and CRP are associated with an increase in the risk of heart disease and, possibly, diabetes.

Paula Ayunerak and Cecelia Tucker of the Yukon Kuskokwim Delta region of Alaska clean salmon at their fish camp. Many Alaska Natives take time to catch fish to put up for the winter. Photo by Gunnar Ebbesson.

"These results mimic those found in populations living in the lower 48 who have similarly low blood levels of EPA and DHA," said senior author Alan Kristal, a member of the Hutchinson Center's Public Health Sciences Division. "However, the new finding was that obesity did not increase these risk factors among study participants with high blood levels of omega-3 fats," he said.

"Interestingly, we found that obese persons with high blood levels of omega-3 fats had triglyceride and CRP concentrations that did not differ from those of normal-weight persons," Makhoul said. "It appeared that high intakes of omega-3-rich seafood protected Yup'ik Eskimos from some of the harmful effects of obesity."

Although Yup'ik Eskimos have overweight/obesity levels similar to those in the United States overall, their prevalence of type 2 diabetes is significantly lower— 3.3% vs. 7.7%.

"While genetic, lifestyle, and dietary factors may account for this difference," Makhoul said, "it is reasonable to ask, based on our findings, whether the lower prevalence

"If dietary differences are the main reason for the differences in plasma lipid concentrations, the results from the present study point more toward qualitative than toward quantitative differences in respect of fatty acid composition of the food."

—J. Dyberg *et al.* (*Am. J. Clin. Nutr. 28*:958–966, 1975)

Salmon drying in the sun outside a western Alaskan Yup'ik home. Salmon is a staple in Yup'ik diets and the fish is dried for later use. Photo by Camille Lieske, The Center for Alaska Native Health Research

of diabetes in this population might be attributed, at least in part, to their high consumption of omega-3-rich fish."

For the study, the participants provided blood samples and health information via in-person interviews and questionnaires. Diet was assessed by asking participants what they ate in the past 24 hours and asking them to keep a food log for three consecutive days. Height, weight, percent body fat, blood pressure, and physical activity were also measured. The median age of the participants was 45 and slightly more than half were female. The women were more likely than the men to be heavy, and body mass index (height-to-weight ratio) for all increased with age.

"Residents of Yup'ik villages joined this research because they were interested in their communities' health and were particularly concerned about the health effects of moving away from their traditional ways and adopting lifestyle patterns similar to those of residents in the lower 48 states," Makhoul said.

Based on these findings, should overweight and obese people who are concerned about their chronic disease risk start popping fish oil supplements or eat more fatty fish?

"There are good reasons to increase intake of fatty fish, such as the well-established association of fish intake with reduced heart disease risk," Makhoul said.

"But we have learned from many other studies that nutritional supplementation at very high doses is more often harmful than helpful."

Before making a public health recommendation, the researchers said that a randomized clinical trial is needed to test whether increasing omega-3 fat intake significantly reduces the effects of obesity on inflammation and blood triglycerides.

"If the results of such a trial were positive, it would strongly suggest that omega-3 fats could help prevent obesity-related diseases such as heart disease and diabetes," she said. ■

36 years ago, another group studying Eskimos reached a similar conclusion

The new study's findings are consistent with a frequently cited study of Eskimos in Greenland and Denmark by Jorn Dyerberg and coworkers, which appeared in the *American Journal of Clinical Nutrition* in 1975 (*28*:958–966).

Dyerberg and his colleagues used gas-liquid chromatography analyses to compare the composition of esterified fatty acids in the plasma lipids of 130 Greenland Eskimos with those of 32 Greenland Eskimos living in Denmark and 31 Caucasian Danes in Denmark.

While there were no substantial differences between Eskimos living in Denmark and other persons living in Denmark and other Western communities, the Greenland Eskimos demonstrated a much higher proportion of palmitic, palmitoleic, and eicosapentaenoic acids and a markedly lower concentration of linoleic acid. Interestingly, the total concentration of polyunsaturated fatty acids (PUFA) was lower in the Greenland Eskimos than in the other groups—contrary to what would be expected given the generally accepted opinion at the time that a high dietary intake of PUFA has a beneficial effect on plasma lipid levels and on the morbidity of coronary atherosclerosis.

In their paper "Fatty acid composition of the plasma lipids in Greenland Eskimos," Dyerberg and coworkers noted: "If dietary diff rences are the main reason for the diff rences in plasma lipid concentrations, the results from the present study point more toward qualitative than toward quantitative differences in respect of fatty acid composition of the food."

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Global Omega-3 Summit: a Kyoto-type approach

Armand Christophe

On March 3 and 4, 2011, a Global Omega-3 Summit was held in Bruges, Belgium. There, 13 keynote speakers and 60 participants discussed the role of long-chain (LC) omega-3 fatty acids in health and mental health; what the dietary requirements should be; steps needed to improve food quality in developed and developing countries; and how to match omega-3 needs with food availability, sustainability, and alternative sourcing. Participants were scientists and representatives from government bodies as well as food industry and industry associations from 15 countries.

Nutrition panel at the Global Omega-3 Summit (from left to right): Alexandra Richardson (Oxford University, Oxford, UK), Norman Salem (Martek Biosciences Corp.), Nico van Belzen (International Life Sciences Institute Europe, Brussels, Belgium), Clemens von Schacky (University of Munich), Michael Crawford (Imperial College), and Captain Joseph Hibbeln (National Institutes of Health, USA).

By the end of the meeting, participants and leading expert speakers such as Michael Crawford, a professor at Imperial College (London, UK); Clemens von Schacky, a professor at the Medical Center of the University of Munich (Munich, Germany); Fabien De Meester, chief executive officer of DM Frontiers (Brussels, Belgium); Captain Joseph Hibbeln, a lead clinical investigator at the National Institutes of Health (Bethesda, Maryland, USA); and Norman Salem, chief scientific officer at Martek Biosciences Corp. (Columbia, Maryland, USA) had agreed on six consensus statements that should shape future policy development as well as bring the right quality and quantity of LC-omega-3s to people around the world, thus guaranteeing a proper management of the risks linked to low LC-omega-3 consumption.

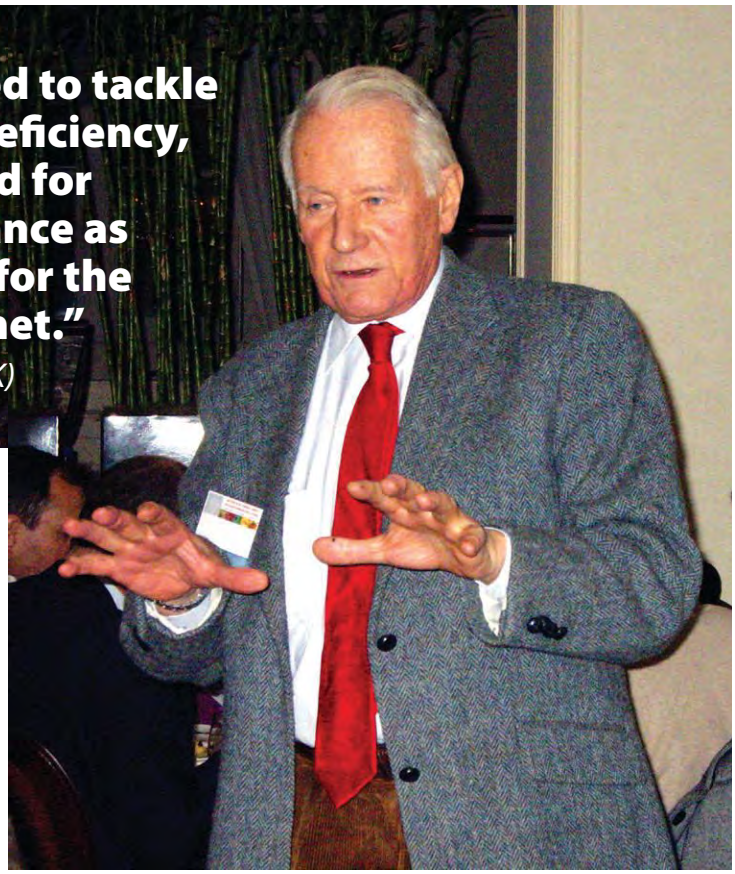
1. Brain and heart disorders resulting from LC-omega-3 (EPA + DHA, i.e., eicosapentaenoic acid + docosahexaenoic acid) deficiency are the biggest challenges for the future of humanity. The associated current and future costs could easily bankrupt health care systems and cause wider economic instability in the world. Mental health issues are already a larger threat to the world than the obesity epidemic.

2. Tissue concentrations of LC-omega-3 (relative to LC-omega-6) are the key variable for health—not dietary intakes. As to dietary requirement of LC-omega-3 fatty acids, consensus was reached that these cannot be given as simple values, as they depend significantly on external factors such as the type of diet, including the presence or absence of omega-6 fatty acids, and/or genetic factors. This uncertainty is reflected by differences in existing official recommendations ranging from 200 mg/day (e.g., Health Council of the Netherlands, 2001) to 1,100 mg/day (e.g., British Nutrition Foundation Task Force, 1992).

It was recognized that what is important is not dietary intake as such but the levels obtained in human tissue: the "Tissue is the Issue." A good idea of tissue levels can be obtained by measuring the Harris–von Schacky Omega-3 Index. The Omega-3 Index is the EPA + DHA level expressed as a percentage of total fatty acids in red blood cells. An alternative could be the "Lands index," which gives a percentage of "higher unsaturated fatty acids" (HUFA) of the omega-3 series to total HUFA (similar in total plasma,

"A Kyoto-type approach is needed to tackle the global issue of LC-omega-3 deficiency, which is of similar size and spread for human (mental) health maintenance as the carbon dioxide issue may be for the environmental health of our planet."

—Michael Crawford, Imperial College (London, UK)



plasma phospholipids, and tissues). These biomarkers can be determined in easily accessible tissues. However, it is emphasized that standardized analytical procedures must be strictly followed.

3. *An intake of at least 1,000 mg EPA + DHA is recommended for people consuming a typical Western-type diet.* For people around the world, an Omega-3 Index of 8 to 11% is considered to be the target. In order to reach this level in 97.5% of a population eating a typical Western type diet, an intake of at least 1000 mg EPA + DHA is recommended. In other parts of the world recommended intake levels could be different. Japanese people, for example, have a very healthy Omega-3 Index of about 12 corresponding with about 50% of HUFA-3 of total HUFA in tissues.

4. *Shorter-chain omega-3 fatty acids (α-linolenic acid, stearidonic acid, and EPA) are poorly converted to DHA in humans.* While EPA and DHA have other effects, it was considered that not enough data are available to make specific recommendations for each of these fatty acids separately, except that both fatty acids are required. Shorter-chain omega-3 fatty acids such as α-linolenic acid, stearidonic acid, and even EPA have poor and variable conversion to DHA in humans. This necessitates the increased availability of DHA for human consumption. To make tissue targets feasible, we also urgently need to reduce consumption of linoleic acid while increasing the consumption of omega-3 fatty acids, including α-linolenic acid, in human and animal diets.

5. *To make these omega-3 targets feasible, we also urgently need to increase the availability of LC-omega-3 fatty acids and especially of DHA for human consumption in a sustainable and environmentally responsible way.* Fish and krill stocks need to be managed and harvested properly; aquatic agriculture is one of the many possible roads to a responsible and sustainable production system. Other sources of LC-omega-3s such as through algae or yeast fermentation, or through production of precursors in crops with, for example, high levels of α-linolenic acid, stearidonic acid, or other omega-3s will equally well be needed to guarantee sufficient supply for the 9 billion people expected to live on Earth by 2050.

6. *Education of all stakeholders is essential to obtain these targets.* Without a broad understanding and acceptance of the preceding statements, it will be difficult if not impossible to prevent a spreading endemic of mental health issues. Communicating effectively about LC-omega-3 deficiencies and needs and developing strategies to produce and make these available in a responsible way will require the support of stakeholders around the globe.

This last point was summarized eloquently by Michael Crawford: "A Kyoto-type approach is needed to tackle the global issue of LC-omega-3 deficiency, which is of similar size and spread for human (mental) health maintenance as the carbon dioxide issue may be for the environmental health of our planet."

The Consensus Statements and PDF copies of the presentations of the Omega-3 Summit can be obtained online at www.omega3summit.org; selected presentations and the consensus conclusions of the summit will also be published by Springer Humana Press in 2012 (De Meester, F., and R. Watson, eds).

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Food oil gels: new strategies for structuring edible oils

Alejandro Marangoni and Nissim Garti

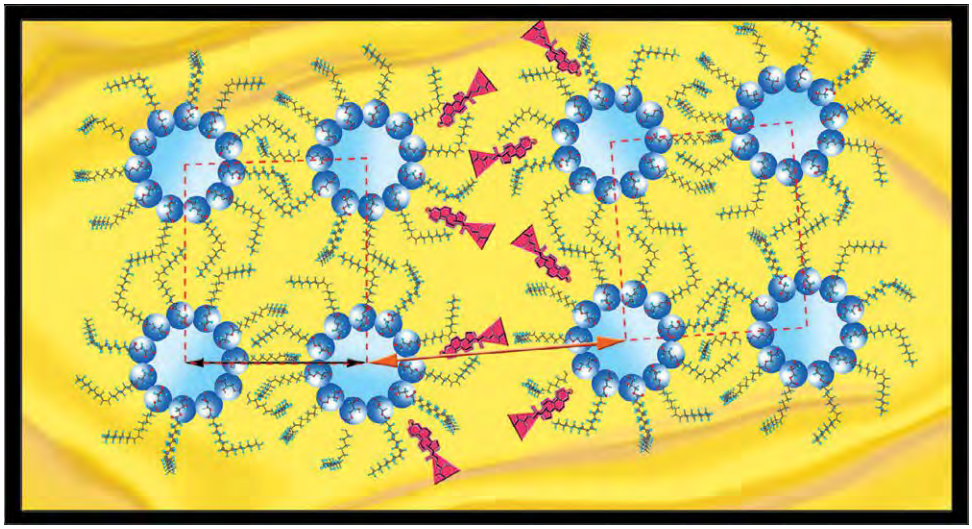

FIG. 1. *Lyotropic liquid crystals forming a channel of hydrophilic liquid in an organic medium.*

Prompted originally by the Center for Science in the Public Interest in 1994, the US Food and Drug Administration (FDA) decreed that as of January 2006, food manufacturers must include the *trans* fatty acid content in product labels. This ruling is an important milestone for public health, but it creates serious technological hurdles for the food manufacturing industry, as it is difficult to eliminate *trans* fats from a food formulation. At the core of the problem is the ability to transform an oil (liquid at room temperature) to a fat ("solid" at room temperature).

The difference between an oil and a fat is subtle. Oils and fats are mostly composed of molecules called triacylglycerols: three fatty acids esterified onto a glycerol backbone. Whether such material is solid or liquid at a particular temperature depends on the chemical nature and physical properties of the constituent fatty acids.

Hydrogenation has been successfully commercially used for almost 100 years to transform oils into fats. From the time the British patent on liquid phase hydrogenation was issued to Norman in 1903 and its introduction in the United States in 1911, few chemical processes have made as great an economic impact on any industry.

Hydrogenation opened new markets for vegetable oil-based specialty products (O'Brien, 2003). Three reactions take place during hydrogenation: (i) the saturation of carbon-carbon double bonds, (ii) the conversion of *cis* geometric isomers into more stable *trans* isomers, and (iii) the creation of new positional isomers, where double bonds are shifted to new positions along the fatty acid chain. Both the saturation of double bonds and the *cis* to *trans* isomerization of double bonds will increase the melting point of a fat. Thus, cooling of this hydrogenated fat below the melting point of the newly created triacylglycerol species containing saturated and *trans* fatty acids will lead to the partial crystallization of the material. The resulting semisolid fat matrix will be a network of fat crystal aggregates with liquid oil trapped inside (Narine & Marangoni, 1990a). The solid-like characteristics of this material are due to this underlying fat crystal network (Narine & Marangoni, 1990b; Marangoni, 2000; Marangoni & Rogers, 2003). The presence or absence of this network of crystallized fat determines whether the material is a fat or an oil, respectively. Thus, the only previously known way to provide structure to an oil, and thus convert it into a plastic fat, is by addition of high-melting-temperature saturated or *trans* fats. This represents a major problem since fats containing high amounts of *trans* and saturated fatty acids are known to be atherogenic—they contribute to the build-up of cholesterol and other substances in artery walls. The American Heart Association discourages the consumption of excessive amounts of saturated animal and vegetable fats such as milk fat, palm oil, palm kernel oil, and coconut oil, as well as *trans* fats (American Heart Association, 2004). A new strategy for structuring edible oils is thus required.

In recent years, scientists have modified the physical properties of oils, which have a low viscosity and no elasticity, to resemble those of fats, which have a solid-like character and are elasto-plastic. Many food products that require a specific texture and rheology can be made with these novel oil-based materials without causing significant changes to final product quality. The major approach to forming these novel oil-based materials is to incorporate oil components that by various molecular interactions will alter the physical properties of the oil so that its fluidity will decrease and the rheological properties will be similar to those of fats. The continuous phase of these oil gels is lipidic, and they exhibit the characteristic physical properties of hydrogels. To distinguish these food oil gels from traditional "organogels," which are usually gels of organic solvents used in various industrial applications in the chemical industry, we call these edible lipid oil gels, oleogels.

Several approaches have been taken to construct oleogels from vegetable oils, and the research experience has brought us to a new area in which our food products will be healthier with no *trans* and minimal saturated fats.

Gels, hydrogels, and oleogels

An organogel or oleogel is a gel where the liquid phase is oil, as opposed to a hydrogel, which is a gel that has a continuous liquid water phase. The definition of a "gel" has been

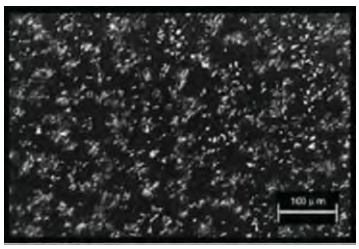

FIG. 2. *Polarized light micrograph of 3% Candelilla wax organogel after 14 days of storage. Source: Toro-Vazquez* et al.*, 2007.*

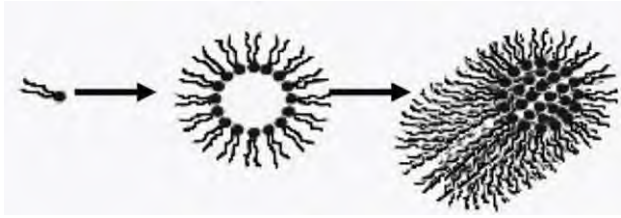

FIG. 3. *Formation of a 3D network of reverse cylindrical micelles in lecithin organogels. Source: Kuman & Katare, 2005.*

evolving since 1861 when Thomas Graham attempted a loose definition. Sixty-five years later, Dr. Dorothy Jordan Lloyd stated, "the colloid condition, the 'gel', is one which is easier to recognize than to define" (Jordan Lloyd, 1926). Her major contribution was in recognizing that all gels must be comprised of at least two components, a liquid and a gelling substance (i.e., a solid), and that the entire system must have the mechanical properties of a solid (Jordan Lloyd, 1926). The major downfall to this definition is that not all colloids are gels and not all gels are colloids.

Over the next 20 years the definition progressed to the point where Hermans proposed that gels are coherent colloid dispersed systems of at least two components. They exhibit mechanical properties that are consistent with the solid state, and both the dispersed (gelator) phase and dispersion medium must extend continuously throughout the whole system (Hermans, 1949). Because of the exclusivity of this definition, Ferry offered a more descriptive definition of a gel: "A gel is a substantially diluted system which exhibits no steady state flow" (Ferry, 1961). Another common definition of a gel is, "if it looks like Jello, it's a gel" (Jordan Lloyd, 1926). From this point, a gel must contain two features: (i) it has a continuous microscopic structure with macroscopic dimensions that is permanent on the time scale of an analytical experiment, and (ii) it is solid-like in its rheological behavior, despite being comprised mostly of liquid (Weiss & Terech, 2006).

Organogelling strategies

Organogels or oleogels offer an alternative to the use of "bad" fats such as saturated and *trans* fats. The building blocks of these organogels can vary widely, mainly falling under the following categories:

(i) Crystalline particles. A network formation of colloidal crystalline triacylglycerol (TAG) particles traps the liquid TAG phase inside, thus causing gelling. The size and shape of the crystals and the interactions between them determine the mechanical properties of the network (Bot *et al.*, 2007; Marangoni, 2004). It is also possible to structure similar edible oils with diacylglycerols (DAG), monoacylglycerols (MAG), and fatty acids (Pernetti *et al.*, 2007a; Ojijo *et al.*, 2004; Wright & Marangoni, 2006). Structuring can also be achieved with wax esters/sorbitan monostearate, ceramides (Daniel & Rajasekharan, 2003; Rogers, 2009), and lecithin/sorbitan tristearate (Pernetti, 2007b).

information

More information as well as the reference list can be found by reading *Edible Oleogels: Structure and Health Implications* by Nissim Garti and Alejandro Marangoni, AOCS #258, ISBN 978-0-980791-1-8. An online description can be found at http://www.aocs.org/Store/ProductDetail.cfm?ItemNumber=16901.

(ii) Crystalline fibers. Self-assembled fibrillar networks (SAFiN) of low molecular weight gelators (LMOG) of phytosterols with oryzanol (Bot & Agterof, 2006; Bot *et al.*, 2008), 12-hydroxystearic acid, and ricinoleidic acid have been reported (Rogers *et al.*, 2008; Rogers *et al.*, 2009), where the structuring agent forms helical and twisted crystalline ribbons hundreds of micrometers long.

(iii) Polymeric strands. Polymers promote gelation of a medium. These gels can be of two types: gels formed by covalent bonding (chemical gel) or gels formed by self-assembly (e.g., van der Waal's force or H-bonding) (physical gel). Formulation of fatty acid based co-monomers and vegetable oil-based polymers (Lu & Larock, 2009; Yilmaz & Kusefoglu, 2005; Sharma & Kundu, 2006) has been reported in the context of sustainable resources, but these systems lack the potential for food applications. An abundance of literature can be found on gelation of biopolymers such as cellulose, starch, gelatin, etc. in aqueous solutions as well as in dispersions (Ruan *et al.*, 2008; Ostrovskii *et al.*, 1999; Frohoff-Hülsmann *et al.*, 1999; Brouillet-Foumann *et al.*, 2003; Lee *et al.*, 2008; Gilsenan & Ross Murphy, 2000; Borchard & Burg, 1990), but similar studies in edible oil medium are scarce (Aiache *et al.*, 1992; Ruiz Martinez *et al.*, 2003).

(iv) Particle-filled networks. A lipid-based product is structured by dispersing a large amount of inert filler particles in the continuous lipid phase. The inert particles may be a solid (suspension) or a liquid (emulsion), and must be at sufficiently high concentrations to exceed the close-packing fraction. This allows mechanical contact between particles forming the network. One such example is peanut butter where peanut oil (which consists of 1–2% hardstock) is structured using 50% solid non-fat particles (Pernetti *et al.*, 2007a). The major disadvantage to using a dispersed system is that it requires large amounts of structurant and is not suitable for most food products.

(v) Liquid crystalline mesophase. This idea is based on forming semi crystalline scaffolds in the oil with gel-like properties. The scaffolds are composed of liquid crystalline mesophases using the oil as the continuous phase spacing the meso structures. Liquid crystals (LCs) are a state of matter with intermediate properties between a liquid and a solid crystal. In this mesophase, the molecules arrange into a short- and/or long-order structured lattice whereas the lattices are partially ordered in space. The lattices may display 1D, 2D, or 3D order. LCs exhibit different physical properties (optical, electrical, and viscoelastic) that distinguish them from one another, depending on their composition and structure. Liquid crystalline mesophases are categorized into three main classes: thermotropic, metallotropic, and lyotropic. The lyotropic liquid crystals commonly used as fat replacers consist of cylinders or channels filled with hydrophilic liquids such as water or polyols (Amar-Yuli *et al.*, 2009; Ben-Ishai *et al.*, 2009; Efrat *et al.*, 2010). See Figure 1.

The field of organogelation in food is in its infancy and requires further research by the fats and oils community. Presented below is a short introduction to some of the most promising food-grade oleogel

systems currently known. The purpose of this monograph is to expand this list significantly and provide further insight into the structure and functionality of this novel class of soft materials.

Monoacylglycerides (MAGs)

MAGs have many different self-assembly structures due to their amphiphilic character. These structures include lamellar, micellar, cubic, and hexagonal mesophases (Michel & Sagalowicz, 2006). MAGs can structure both lipid (Ojijo *et al.*, 2004) and aqueous phases (Sein *et al.*, 2002). In lipids, gel formation by MAGs is believed to occur via the formation of reverse bilayers (Ojijo *et al.*, 2004). MAGs (i.e., monopalmitate and monostearate) showed gel-like behavior above 1.3%; below this concentration an entangled network resulted (Ojijo *et al.*, 2004). At low cooling rates the MAGs align with a lamellar structure acting as a "backbone" for crystallization. Conversely, at high cooling rates, numerous fine crystals are formed in a single crystallization step. A major advantage to these molecules is that they are able to incorporate a large amount of water while maintaining a fat-like consistency (Heertje *et al.*, 1998; Marangoni *et al.*, 2007).

Wax esters

Food-grade waxes, in low concentrations, may also be used to structure edible oils (Daniel & Rajasekharan, 2003). For example, Candelilla wax has been demonstrated to structure safflower oil at 1% (Toro-Vazquez *et al.*, 2007). Candelilla wax is comprised predominately of *n*-alkanes (~50%), which range from 29 to 33 carbons (Toro-Vazquez *et al.*, 2007). It also contains 20–29% high molecular weight esters, 12–14% alcohols and sterols, and 7–9% free acids (Toro-Vazquez *et al.*, 2007). Organogelation of the vegetable oil is achieved by the *n*-alkanes forming small microcrystalline particles of colloidal dimensions that aggregate in time to form a 3D network entrapping the liquid oil (Fig. 2) (Toro-Vazquez *et al.*, 2007).

Lecithin and sorbitan tristearate

Lecithin forms an unstable organogel with small amounts of a polar solvent (Kumar & Katare, 2005). As the amount of polar additive is increased, the reverse micelles begin to form flexible, long tubular micelles of 2.0 to 2.5 nm in radius and hundreds to thousands of nanometers in length (Kumar & Katare, 2005). After reaching a critical length, these extended micelles overlap, forming a transient, entangled 3D network with corresponding increases in the viscosity and viscoelastic properties. The hydrogen-bonded network is built up by the polar head groups of the lecithin molecules, and the glycerol residue stabilizes the micellar aggregates in the organic solvent. As the concentration of polar solvent increases, more solvent is incorporated into the spherical lecithin micelles, increasing the cross-sectional area of the lecithin polar region in which the solvent is arranged (Kumar & Katare, 2005). Further addition of water leads to packing constraints in the spherical micelles, which are diminished during the transition from spherical micelles to cylindrical tubules with a smaller surface curvature (Fig. 3) (Kumar & Katare, 2005).

Lecithin organogels have limited potential for food use due to their extreme sensitivity to water; however, sorbitan tristearate (STS) and lecithin combined in certain ratios may be a suitable replacer for hardstock fats (Pernetti *et al.*, 2007b). Individually, neither lecithin nor sorbitan tristearate (STS) can gel oil at concentrations between 6 and 20% in the absence of small amounts of polar solvents (Pernetti *et al.*, 2007b). Individually they form viscous pourable solutions. However, if specific ratios of lecithin:STS are added between 40:60 and 60:40,

firm gels are obtained at concentrations as low as 4 wt% (Pernetti *et al.*, 2007b). Lecithin:STS has limited use as a hardstock replacer because the gel collapses at approximately 30°C and significant softening begins at 15°C (Pernetti *et al.*, 2007b).

Phytosterols and oryzanol

Some of the most exciting organogelation strategies involve the use of the previously mentioned low molecular weight organogelators (LMOGs), which self-assemble from the melt and grow specifically to form a 3D network that bears no resemblance to a colloidal fat crystal network, but has the ability to bind up to 99% oil in its structure.

LMOGs form gels, which are small molecules that assemble into fibers, rods, liquid crystals, micelles, or ribbons to immobilize oil. A self-assembled fibrillar network (SAFiN) is a specific type of LMOG that forms crystalline fibers to entrap liquid oil. Molecular gels occur when the LMOG undergoes supramolecular aggregation and the corresponding SAFiN forms in a solution (sol) at low concentrations of gelator molecules (~2%) (Weiss & Terech, 2006). In brief, as the sol is cooled, the solution becomes supersaturated, causing a chemical potential that is the driving force for phase separation and nucleation. Gelator molecules begin to self-assemble in stochastic nucleation events that have highly specific interactions, promoting one-dimensional growth. Crystallographic mismatches vary the degree of branching in the network structure. Fibers grow along one dimension and interact with each other to form a three-dimensional network. Some materials that form these types of structures include phytosterols and oryzanol mixtures, 12-hydroxystearic acid, and 12-hydroxy ricinoelaidic acid. Only a limited number of molecules can self-assemble into these structures.

Organogels of vegetable oil have been investigated using γ-oryzanol and phytosterols at concentrations of 2–4% structurant (Bot & Agterof, 2006). Bot and Agterof examined a series of phytosterols and found that dihydrocholesterol, cholesterol, β-sitosterol, and stigmasterol produced firm gels (2006). They reported that stigmasterol was the only compound that did not form a translucent gel (Bot & Agterof, 2006). Upon examination of the phytosterol, the researchers concluded that the presence of the hydroxyl group was critical for the formation of a gel. Gel formation accelerated when the ring structure did not have double bonds present, and if more than one double bond was present, a gel did not form. The composition of the alkyl group did not appear to have a major impact on the gelling ability of the phytosterol (Bot & Agterof, 2006). This group proposed a mechanism for the formation of the gel matrix (Bot & Agterof, 2006). The position of the hydroxyl group is critical because it limits the solubility, hence, upon cooling, the gelator molecules undergo phase separation. The phase separation minimizes the surface free energy, causing the hydroxyl groups to align, which reduces contact with the apolar solvent.

Long-chain fatty acids, fatty alcohols, and their mixtures

12-Hydroxystearic acid (12HSA) was the first long-chain substituted fatty acid reported to thicken oil-based food products (i.e., peanut butter) (Elliger *et al.*, 1972). Since then saturated fatty alcohols have been shown to be less efficient at gelling oil than saturated fatty acids (Daniel & Rajasekharan, 2003). In addition, dicarboxylic acids (adipic, suberic, and sebacic acids) are reportedly more efficient than monocarboxylic acids of the same chain length (Daniel & Rajasekharan, 2003). A possible gelation mechanism for fatty acids is that they align themselves head-to-tail in a linear fashion. The acyl chains may form an irregular network, stabilized by intermolecular hydrogen bonding, which could entrap organic liquids. Alternatively, they could form a large spherical monolayer that entraps liquid oil in the interior hydrophobic environment, resulting in gelation (Daniel & Rajasekharan, 2003).

In a more systematic study, a series of fatty alcohols and fatty acids (FA) with chain lengths ranging from 16 to 22 carbons were evaluated for their oil-structuring potential (Gandolfo *et al.*, 2004). The individual compounds and their mixtures structured several vegetable oils at levels as low as 2% (Gandolfo *et al.*, 2004). Mixtures of the same chain length fatty alcohols and fatty acids resulted in a synergistic effect with gelation observed below 20°C at 7:3 and 3:7(w/w) fatty alcohol/fatty acid ratios. The synergistic effect in the 7:3 stearyl alcohol/stearic acid mixture was due to the microstructure of the composite material. The larger number of small crystals observed in the mixture was attributed to effects on the crystallization kinetics resulting from a minimal interfacial tension at the specific 1:3 and 3:1 molecular ratios (Gandolfo *et al.*, 2004). Monolayer studies of stearic acid/stearyl alcohol showed a minimum area per molecule at the 1:3 and 3:1 molecular ratios (Patist *et al.*, 1999), leading to a decrease in interfacial tension at these particular ratios and therefore a smaller critical radius and hence a greater rate of nucleation. Thus, the crystalline network was comprised of numerous small crystals, allowing for more crystal–crystal contacts in the 3D network and enhanced oil entrainment (Schaink *et al.*, 2007).

Applications of organogels

The potential varied applications for organogels in the food, pharmaceutical, cosmetics, and petrochemical industries have led to an increased interest in these soft materials. The excitement is partly due to the large diversity of microscopic and mesoscopic structures possible (Terech & Weiss, 1997). In the food industry, there is potential to use organogels to minimize oil migration in multi-component foods, such as cream-filled chocolates, and to provide structure to edible oils, thereby reducing the need for saturated and *trans* fatty acids. Other applications include the stabilization of water-in-oil emulsions and controlled release media for nutraceuticals and pharmaceuticals (Hughes *et al.*, 2009). Organogels are also being investigated for topical applications in drug delivery (Giorgano *et al.*, 1998). Investigations are underway in the petrochemical industry to study the prospect of containing oil spills using phase selective gelation with organogelators (Bhattacharya & Krishnan-Ghosh, 2001), in addition to gelling flammable solvents for storage and transport (Abdallah & Weiss, 2000b). Some organogels have the ability to form aerogels that occur when the solvent is removed and the network structure is unaltered. Interest in SAFiNs, which include organogelator molecules, exists in a wide range of research fields and industries. Furthermore, there are many SAFiNs present in nature, including fibrous actin (Greer, 2002), clathrin (Kirchhausen, 2000), tubulin (Oakley & Akkari, 1999), keratin (Fuchs, 1995), insulin (Waugh, 1946), collagen (Caria *et al.*, 2004), silk (Jin & Kaplan, 2003), and amyloid fibrils that are found in Alzh eimer's and other neurodegenerative diseases (Lui *et al.*, 2004). Hence, with such diverse applications, an intimate understanding of the physical chemistry of these systems is of paramount importance. The potential of organogels as novel soft materials has been underutilized thus far, on account of the inability to modify or predict the microstructure of the fibular network (Wang *et al.*, 2006a;b).

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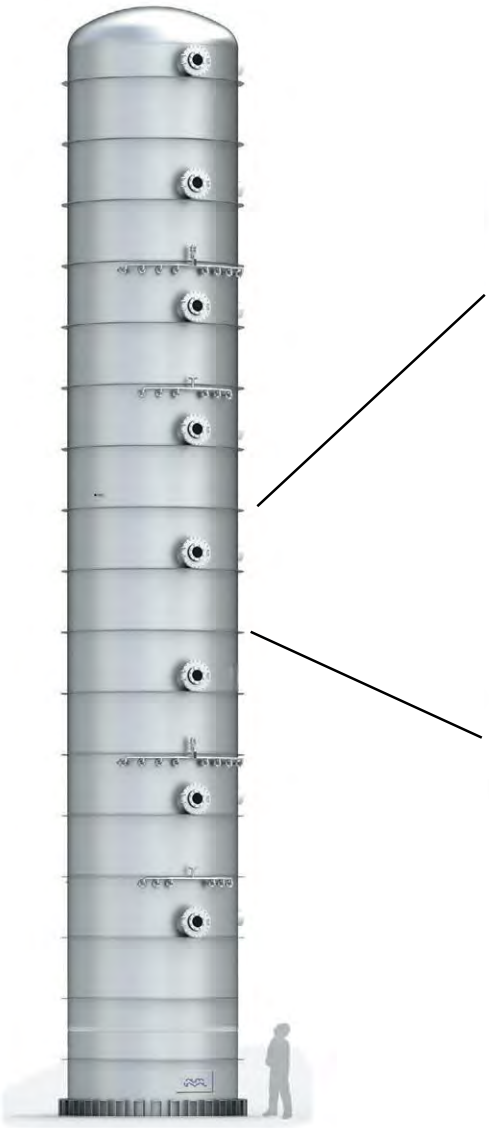

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