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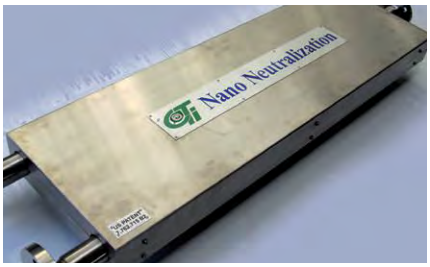

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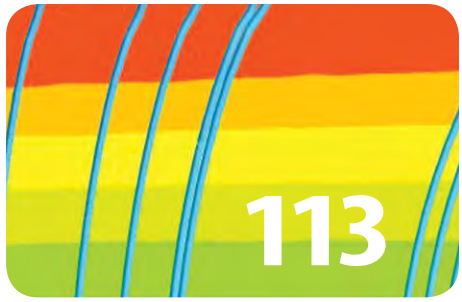

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THE PRESERVATIVE WARS

Laura Cassiday

In 2004, a study published in the *Journal of Applied Toxicology* (Darbre, P.D., et al., DOI: 10.1002/jat.958) detected parabens (a class of preservative commonly used in personal care products and cosmetics) in human breast tumors. The researchers speculated that parabens, previously shown to have weak estrogenic activity, may migrate into breast tissue from antiperspirants or deodorants applied to the underarm area. This finding sparked widespread media coverage and a rash of email warnings proclaiming that antiperspirants cause breast cancer.

- **Preservatives are necessary to curb microbial growth in lotions, creams, makeup, and other personal care products.**
- **Concerns about traditional preservatives have created a substantial market for "natural" preservatives derived from plant sources, but there are many definitions of "natural," and whether natural preservatives are safer than their traditional counterparts is still under debate.**
- **The safety of any preservative depends on the dose, and "natural" preservatives can present challenges of their own.**

Critics point to several shortcomings of the study that ignited this firestorm. For example, the researchers analyzed a statistically insignificant number of breast tumors and no healthy breast tissue, making it impossible to link parabens with cancer. In addition, the levels of parabens that the scientists detected in their control samples—which contained no biological tissue—were similar to those in tumor samples. Therefore, all of the samples could have been contaminated with parabens from laboratory glassware or lab workers' cosmetics. Also, most major brands of antiperspirants and deodorants do not contain parabens.

"This deeply flawed paper almost single-handedly caused all the hysteria over the use of parabens that continues today," says Dene Godfrey, technical sales manager at a major chemical distributor in the United Kingdom and author of a series of articles called "Parabens in Perspective" (http://tinyurl.com/Perspective-parabens). The backlash against parabens and other traditional preservatives—scientifically justified or not—has created a substantial market for "natural" preservatives derived from plant sources. However, experts contest whether natural preservatives are truly safer than, not to mention as effective as, their synthetic counterparts. Meanwhile, manufacturers eager to strike a balance between consumer sentiment and scientific fact are increasingly pursuing effective alternatives to traditional preservatives (Table 1, page 72).

CURBING MICROBIAL GROWTH

Although some factions clamor for "preservative-free" products, most formulators agree that some type of preservative is essential to curb the growth of microorganisms. Because cosmetics have plentiful water and nutrients, as well as a hospitable pH and temperature, products such as lotions, creams, and makeup are potential breeding grounds for microorganisms. Bacteria, yeasts, and molds may be introduced during the manufacture or packaging of a product, or by the consumer during normal use (Fig. 1, page 73).

Improperly preserved personal care products can cause skin irritation, infections, blindness, and even serious illness or death. In 2006, five intensive-care patients at a hospital in Barcelona, Spain, contracted life-threatening infections with the bacterium *Burkholderia cepacia*. Their illnesses were ultimately traced to a moisturizing body milk used in the patients' care. Researchers detected the bacterium in unopened bottles of the body milk.

Preservatives help maintain product integrity by killing microorganisms. Most preservatives are active against a single type of microbe. For example, parabens are most effective at killing fungi (yeasts and molds), whereas formaldehyde donors (discussed below) target bacteria. "No single preservative is equally effective against all types of microorganisms," says Philip Geis, principal consultant at Geis Microbiological Services in Gainesville, Florida, USA. "As a result, a mixture of preservatives is often used by formulators to ensure that a broad spectrum of antimicrobial activity exists."

Cosmetic formulators gauge the efficacy of preservatives with a preservative effectiveness test (PET). They inoculate a product with a mixture of bacteria, yeast, and mold, then measure the levels of the microbes over time, typically 28 days. If the number of microorganisms in the product does

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TABLE 1.
Preservatives for personal care products

Category	Examples	Source
Parabens	Methylparaben, ethylparaben, propylparaben, butylparaben	Found naturally in some plants (e.g., blueberries), but commercially available sources are synthesized
Formaldehyde donors	DMDM hydantoin[a], imidazolidinyl urea, diazolidinyl urea, quaternium 15	Synthetic
Halogenated preservatives	Methylchloroisothiazolinone/methylisothiazolinone (MCI/MI), bronopol	Synthetic
Alcohols	Phenoxyethanol, benzyl alcohol	Found naturally in some plants (e.g., roses, strawberries), but commercially available sources are synthesized
Organic acids	Benzoic acid	Found naturally in some fruits (e.g., apples), but commercially available sources are synthesized
Botanical oils and extracts	Rosemary oil extract, neem oil, lavender oil, tea tree oil, grapefruit seed extract	Natural. Precise chemical constituents are undefined and vary among batches.

[a]Dimethylol-5,5-dimethylhydantoin.

not fall to acceptable levels, the product fails the PET and should not go to market.

Despite recent safety concerns, parabens remain the most widely used preservatives in cosmetics, with a history dating back to the 1920s. Chemically speaking, parabens are esters of *p*-hydroxy benzoic acid (Fig. 2).

The identity of the alkyl group in the ester (e.g., methyl, ethyl, propyl, or butyl) influences the properties of the paraben. Even at low concentrations, most parabens are extremely effective at controlling the growth of yeasts and molds and are also active against many bacteria. Allergic reactions to parabens are rare, ranging from 0 to 4.2% of the population (Cashman, A. L., and Warshaw, E. M., DOI: 10.2310/6620.2005.05008, 2005). Also contributing to parabens' long-standing popularity is their antimicrobial activity over a wide pH range, their heat stability, lack of odor and color, and cost-effective synthesis from petrochemicals.

SAFETY DEPENDS ON THE DOSE

In the late 1990s, various studies began to raise concerns about parabens. A 1998 paper published in *Toxicology and Applied Pharmacology* demonstrated that some parabens can weakly bind to estrogen receptors on cells, making parabens possible endocrine-disrupting chemicals (Routledge, E. J., et al., DOI: 10.1006/taap.1998.8544). Known endocrine disruptors, such as DDT and bisphenol A, can cause cancer, birth defects, early puberty, and problems with sexual development in exposed animals.

When the researchers injected parabens under the skin of rats—a more direct route of exposure than for cosmetics applied to the skin's surface—the parabens activated estrogen receptors only weakly compared with the receptors' natural ligand, estradiol. In fact, the most potent paraben, butylparaben, was about 100,000 times less effective than estradiol at stimulating uterine growth in sexually immature female rats (a measure of early puberty). The researchers calculated that the lowest dose of butylparaben that caused an adverse effect in rats was 200 mg/kg body weight/day.

To put this finding in perspective, a 60 kg person would need to apply 40 kg of 0.03% butylparaben-containing cosmetics every day to experience the weak estrogenic effect observed in rats, says Godfrey. And this assumes that the skin can absorb 100% of topically applied butylparaben; reported estimates range from 4 to 60%. According to Godfrey, this study, like many that reported adverse effects of parabens, was taken out of context by the media, activist groups, and bloggers who often failed to mention that the tested concentrations of parabens bear no semblance to real-life exposures.

National and international regulatory agencies remain unconvinced of parabens' health threats. Parabens are approved worldwide for use in personal care products at specified concentrations. According to a US Food and Drug Administration (FDA) fact sheet on parabens (http://tinyurl.com/FDA-Cosmetic-Ingredients), "[The] FDA believes that at the present time there is no reason for consumers to be concerned about the use of cosmetics containing parabens." Similarly, the European Union (EU) Scientific Committee for Consumer Safety (SCCS) considers methylparaben and ethylparaben safe for use in cosmetics at concentrations up to 0.4%, and propylparaben and butylparaben at maximum total concentrations of 0.19% (http://tinyurl.com/EU-SCCS-parabens).

Still, natural cosmetic formulators such as Barbara Olioso, founder of Forest Secrets Skincare (www.forestsecretsskincare.com), a line of all-natural skincare products based in the United Kingdom (Fig. 3, page 74), are concerned about possible

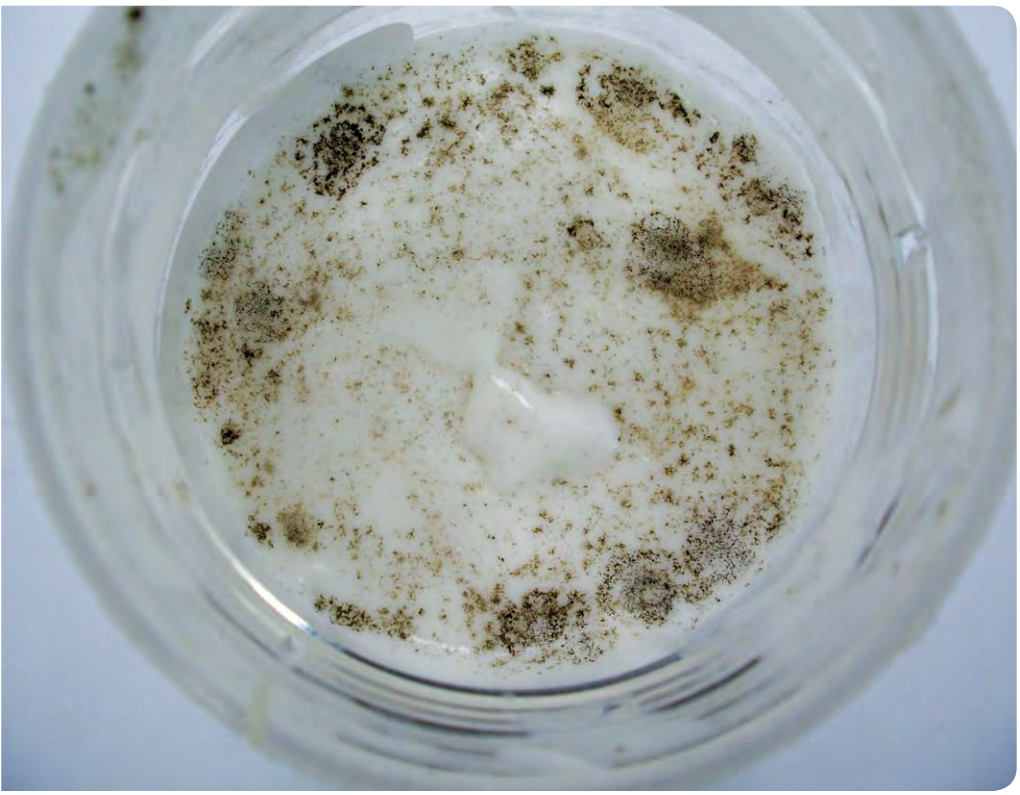

FIG. 1. Moisturizing cream contaminated with mold. Credit: Kevin Roden, Thor Specialties; contact: kevinr@thorchem.com.au.

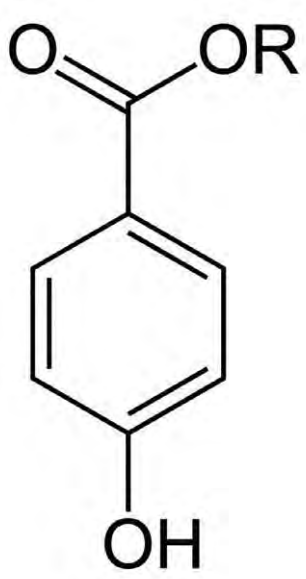

FIG. 2. Paraben structure. R indicates an alkyl group such as methyl, ethyl, propyl, or butyl. Source: http://en.wikipedia.org/wiki/File:Paraben-2D-skeletal.png. Credit: Wikipedia.

long-term effects of parabens. "Just because we lack evidence, doesn't mean that they are safe," she says. "There's a lot of data on rats, but rats can metabolize parabens much better than we can. We need data on humans, and we need to know how much parabens we absorb and what happens once they're absorbed into the body."

Formaldehyde donors, another class of preservative with a long history of use in cosmetics, have likewise attracted the ire of nongovernmental organizations and consumer advocacy groups. These compounds gradually release small amounts of formaldehyde into a product, killing bacteria and fungi. Given that formaldehyde is a well-known toxin, irritant, and carcinogen, it is perhaps understandable why people should object to its use in personal care products.

However, according to David Steinberg, a personal care product consultant at Steinberg & Associates, Inc., in Plainsboro, New Jersey, USA, the dose makes the poison. He recalls a discussion with a woman at a scientific meeting who was adamantly opposed to the use of formaldehyde donors in personal care products. "I asked her to take a deep breath and exhale, which she did," says Steinberg. "I said, 'Do you realize you just exhaled between five and ten parts per billion formaldehyde, which is what you want to ban? How are you still alive?'" He notes that cells produce formaldehyde during normal metabolic processes.

In 2006, Steinberg founded the Cosmetic Preservatives Council, a consortium of preservative manufacturers that defends and advocates the use of traditional preservatives. "We got together to try to save some of our preservatives from these ridiculous attacks, and we've tried to present facts as opposed to emotionalism," he says.

Nevertheless, some cosmetic companies have succumbed to the public backlash against traditional preservatives. Increasingly, products such as sunscreens prominently display the label "paraben-free" on their packaging. In March 2012, the Estée Lauder Companies (New York, New York, USA) issued a statement on parabens explaining that "as a result of previous conversations with our consumers, we have already begun the process of phasing out the use of parabens, without compromising the integrity of our products" (http://tinyurl.com/EsteeLauder-parabens).

For manufacturers seeking alternatives to parabens and formaldehyde donors, blends of methylisothiazolinone and its halogenated derivative methylchloroisothiazolinone have become popular choices. This preservative blend has broad-spectrum activity against bacteria and fungi and is effective at very low concentrations. However, the isothiazolinones, like all preservatives, are not free from controversy: a 2002 report showed that methylisothiazolinone is toxic to cultured neurons (Du, S., B. McLaughlin, S. Pal, and E. Aizenman, *J. Neurosci.* 22:7408–7416, 2002). Yet, again, critics contend that the concentration of methylisothiazolinone tested in the experiments greatly exceeds exposure levels from cosmetics. According to a response statement issued by the Cosmetic, Toiletry, and Fragrance Association, applying the preservative directly to rat

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nerve cells in a petri dish in no way resembles exposure to isothiazolines through the skin.

DEFINITIONS OF "NATURAL"

Consumer sentiment against synthetic preservatives and the allure of "100% natural" labeling have prompted some manufacturers to seek natural alternatives. However, in the minds of consumers and manufacturers alike, the definition of "natural" is often murky at best. "There are different shades of natural," says Olioso. For the purists, oils and extracts distilled or otherwise physically separated from plant sources are the only acceptable naturals. "Nature-derived" or "hybrid" refers to naturally occurring ingredients that are chemically modified to improve their properties in cosmetics. "Nature-identical" preservatives are identical to those found in nature, but are synthesized in a laboratory. "All of these categories can be called natural, but they have different implications on health and the environment, and different prices, as well," says Olioso.

Wendy Robbins, marketing manager at From Nature with Love (www.fromnaturewithlove.com), a wholesale supplier of natural cosmetic ingredients based in Oxford, Connecticut, USA, agrees that the term "natural" is highly subjective. Robbins defines "natural" as "an ingredient derived from natural botanicals and processed in as green a manner as possible—one that retains the 'wholeness' of the botanical." For example, tea tree oil is typically steam distilled from the leaves of the tea tree, *Melaleuca alternifolia*. "The resulting essential oil is generally classified as a natural preservative because the oil is left intact with its balanced ratio of naturally occurring constituents," says Robbins. Scientists have traced the antimicrobial properties of tea tree oil to a mixture of terpenes: chemicals with variable numbers of linked isoprene units.

"NATURAL" IS *NOT* "ORGANIC"

Many people confuse "natural" with "organic," although the two terms are not interchangeable. The term "natural" is not regulated in the United States, but most international regulatory agencies define natural ingredients similarly to the European Union's Registration, Evaluation, Authorisation and Restriction of Chemical Substances (REACH) regulations: " . . . a naturally occurring substance, unprocessed or processed only by manual, mechanical, or gravitational means, by dissolution in water, by flotation, by extraction with water, by steam distillation, or by heating solely to remove water, or is extracted from air by any means." In principle, products labeled "all natural" or "100% natural" should only contain ingredients that comply with this definition.

In contrast, "organic" refers to ingredients produced through organic agricultural practices, without the use of fertilizers or pesticides. The US Department of Agriculture (USDA) label "organic" indicates products that contain at least 95% organically produced ingredients. This distinction between natural and organic means that a personal care product could be 100% natural and not organic, and vice versa. Manufacturers can have their products designated natural or organic by international certifying agencies such as Ecocert and Natrue, but the requirements for certification vary, sometimes substantially, with the certifying body.

Grapefruit seed extract is a liquid derived from the seeds, pulp, and white membranes of grapefruit. Although marketed by suppliers as an effective natural preservative, in 1999 researchers discovered that many commercially available grapefruit seed extracts were contaminated with synthetic preservatives such as parabens, triclosan, and benzethonium chloride (von Woedtke, T., *et al.*, *Pharmazie* 54:452–456). The researchers reported that in the absence of these synthetic preservatives, grapefruit seed extracts had no antimicrobial activity. However, Robbins maintains that "our grapefruit seed extract is paraben-free, unlike many other products being marketed as grapefruit seed extract. The efficacy has been tested against gram-positive and -negative bacteria and fungi, and it has performed exceptionally well."

GOING NATURAL HAS ITS OWN CHALLENGES

A challenge of working with essential oils and extracts is that the same product obtained from different suppliers, or even different batches of a product from the same supplier, can vary considerably in composition. Factors such as the season of harvest, region of cultivation, plant parts used, and type of processing can affect the levels of various chemicals in botanical oils and extracts (Fig. 4, page 76). In addition, botanicals can be contaminated with pesticides or mycotoxins. Essential oils and extracts must often be used at high concentrations (up to 2% of a formula) to be effective preservatives, which can confer unpleasant colors, odors, or textures to personal care products.

Even at these high concentrations, most natural preservatives are not as effective as traditional synthetic preservatives. "Natural substances that show antimicrobial activity are usually not adequate for broad-spectrum preservation," says Robbins. "Natural antimicrobials and natural antioxidants can be combined to protect and extend the shelf life of natural products, but they will not

FIG. 3. Forest Secrets line of natural skin care products. Listed preservatives include honeysuckle flower extract, eugenol (from clove oil), benzyl alcohol (nature-identical), tocopherol (vitamin E), and ascorbic acid (vitamin C). Credit: Barbara Olioso.

offer the extended shelf life that traditional preservatives offer." Although antioxidants such as tocopherols (vitamin E) and ascorbic acid (vitamin C) don't actually kill bacteria, they can help keep oils in personal care products from going rancid, reducing the potential for microbial growth.

While consumers tend to view natural products such as tea tree oil and grapefruit seed extract as more benign than unpronounceable chemicals made in a lab, Steinberg notes that the naturals have not been as extensively tested for safety as synthetic preservatives. "People would much rather use something labeled as natural that has virtually no safety testing and no ability to be reproducible than traditional preservatives that have been safety tested for decades, evaluated by independent peer scientists, and approved by regulatory agencies worldwide," he says.

Olioso argues, "We have evolved with naturals, so in theory they've been tested for much longer, but in a different way. The data haven't been presented to scientific committees and papers haven't been published, but our bodies are more familiar with them." Nevertheless, just as for synthetic preservatives, some studies have reported adverse effects of natural preservatives, including allergic reactions, early puberty, and cancer. And just like the warnings against synthetics, Olioso says that many of these studies have been taken out of context to unfairly condemn natural preservatives.

NATURE IDENTICALS OFFER A MIDDLE GROUND

Godfrey disputes the assumption that natural products are inherently safer and gentler than synthetics. He notes that some of the deadliest toxins on earth are produced naturally by plants and animals, including tetrodotoxin from the pufferfish, ricin from castor beans, and venom from the King Cobra. "It is the height of human arrogance to believe that nature exists purely for the benefit of humans," he says. "Every individual species exists for its own sake. If something produced within a plant happens to be beneficial for humans, that's pure coincidence"—and not evidence of Mother Nature's benevolence toward our species.

However, consumers' infatuation with naturals is unlikely to fade anytime soon. So some natural cosmetic formulators choose to work with nature-identical preservatives as a middle ground between traditional preservatives and botanical oils and extracts. "I'm quite in favor of nature identicals because they are cost effective, they work, and they're the same molecular structure as found in nature," says Olioso. An example of a nature-identical preservative is benzoic acid, which is found in apples but also commercially synthesized. Benzoic acid is most effective against yeast and mold at pH 4, limiting its use to acidic products such as facial peels.

Because some edible botanicals contain parabens, the controversial preservatives could be considered nature-identical. However, few if any natural product aficionados recognize parabens as such. Some consumers worry about trace contaminants derived from the petrochemical sources of commercial parabens. In addition, "Concerns exist over how our bodies process

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FIG. 4. Barbara Olioso, founder of Forest Secrets skin care products, dilutes a new batch of preservative to check the pH. Because each batch of natural preservative is slightly different, Olioso must perform measurements on each new batch before using it. Credit: Barbara Olioso.

synthetic parabens in contrast to parabens found naturally in foods like cucumbers and mangos," says Robbins.

Godfrey disagrees that synthetic preservatives such as parabens pose higher risks than the same preservatives isolated from natural sources. "The body can't distinguish between different sources of the same molecule," he says.

"NATURAL" CAN BE EXPENSIVE

Nonetheless, in the minds of many consumers, preservatives extracted from plants are preferable to those made in factories. Yet because plants usually contain only minuscule (parts per million) amounts of preservatives and other cosmetic ingredients, isolating the chemicals can be cost prohibitive. Back in 1983, Steinberg worked at a chemical manufacturing plant. He recalls that a customer wanted to buy 1 kilogram of the cosmetic ingredient allantoin extracted from comfrey root. "I told him he would have to send me a certified check for 15 million dollars, and I would get him one kilo of naturally obtained allantoin from comfrey root," says Steinberg. "The guy went nuts, and I said, 'Do you know how many millions of pounds of comfrey root I would have to buy?'" Steinberg notes that at that time, the price of one kilogram of synthetic allantoin was $4.00. "You'll never guess what he bought," he says.

Because none of the preservatives currently on the market appeals to everybody, one might expect that developing new preservatives would be fertile ground for research and development. However, Steinberg notes that no truly new preservatives have been introduced for years. "The last preservative that was approved worldwide and is still available [methylisothiazolinone] cost the manufacturer in excess of ten million dollars in safety testing," says Steinberg. "That's a major deterrent for introducing new preservatives."

THE ADVANTAGES OF BLENDS

As a result, most of the innovation in the preservative industry has come from developing new blends of preservatives. Blends offer broader-spectrum microbial coverage and allow formulators to use lower concentrations of each preservative in the blend, improving safety. Nipaguard® POM, a broad-spectrum preservative blend from Clariant (www.clariant.com), contains 80% phenoxyethanol, 15% methylparaben, and 5% piroctone olamine. On the natural side, Bio-Botanica (www.bio-botanica.com) offers Suprapein™ (www.bio-botanica.com/DataSheets/suprapein_ds.pdf), a blend of oregano, thyme, cinnamon, olive, rosemary, peppermint, lavender, goldenseal, and lemon extracts with broad-spectrum antimicrobial activity. Striving for the best of both worlds, RITA Corp.'s (www.ritacorp.com) Ritative SR4L Magnolia combines *Magnolia acuminata* bark extract with the nature-identical preservatives phenoxyethanol and glyceryl caprylate.

The holy grail for personal care product manufacturers and consumers would be a preservative-free system that maintains product integrity. A number of manufacturers have used a loophole in Annex VI of the EU Cosmetics Directive to make deceptive "preservative-free" claims. Annex VI is a list of preservatives permitted in cosmetics sold in the EU. Some fragrances and other chemicals have preservative activity, yet are not listed on Annex VI. The loophole allows manufacturers to include these preservatives in products labeled "preservative-free," if they claim that the chemicals are being used for purposes other than preservation.

True preservative-free personal care products are rare. Homemade or artisanal products lacking preservatives require refrigeration and have extremely short shelf lives (2–4 weeks). For some products, formulators can use the concept of water activity to reduce preservative requirements. Water activity is a measure of the water in a product that is available for microbial growth. Formulators can calculate water activity by measuring the partial vapor pressure or dew point of a product. On a scale of 1.0 (pure water) to 0 (completely dry), a water activity of 0.7

is usually sufficient to prevent the growth of microorganisms. Typical water activities for personal care products range from 0.86 (hand cream) to 0.98 (hand lotion).

WATER ACTIVITY AND PACKAGING

Many cosmetic formulators routinely measure the water activity of new formulations to get an idea of what preservatives they need to add. "The water activity gives us a roadmap," explains Steinberg. "Let's say we determine the water activity is 0.85. At 0.85, no yeast or bacteria will grow in the product, so the only thing we need to worry about is mold." Formulators can add molecules like salts and glycols to lower a product's water activity. However, products with water activities below 0.7, therefore requiring no preservatives, are usually aesthetically unpleasing.

Careful consideration of packaging can also reduce, but not eliminate, the requirement for preservatives. A facial cream in a bottle with a pump is less likely to be contaminated with microbes from a consumer's fingers than the same product in a wide-mouth jar, says Geis.

Although synthetic preservatives bear the brunt of criticism from anti-preservative groups, natural preservatives are not free from controversy. "Methyl eugenol in rose oil is an absolutely amazing preservative," says Olioso. "But because tests in rats showed carcinogenic effects on the liver, rose oil has been restricted to the point that it's almost impossible to use. The maximal allowed concentration of methyl eugenol in leave-on products is only 0.0003%." She thinks that manufacturers of natural ingredients should form an organization in which they can share safety data on naturals, split costs of safety tests, and advocate for natural ingredients, similar to what Steinberg's Cosmetic Preservatives Council does for synthetic preservatives. "Because natural products are not patented, who is going to invest in extensive safety tests?" asks Olioso. "There has to be some kind of movement to safeguard the naturals and put things into perspective."

Currently, there are no signs of a cease-fire in the campaign against preservatives. "You have activist groups who believe that there is no such thing as a good preservative, and that we can't have preservatives, and we shouldn't have cosmetics," says Steinberg. Defenders of synthetic and natural preservatives can perhaps unite in the hope that at the end of the preservative wars, microbes don't emerge as the winners.

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104th AOCS Annual Meeting & Expo:

Expand your knowledge, network, and experience Montréal

Registration is now open for the 104th AOCS Annual Meeting & Expo, which will be held April 28–May 1, 2013, at the Palais des congrès de Montréal in Montréal, Québec, Canada. The premier global science and business forum on fats, oils, surfactants, lipids, and related materials is expected to draw more than 1,600 industry professionals representing 60 countries to the City of Saints, where they will experience an unprecedented assortment of educational sessions and short courses and exciting industry networking opportunities.

"The AOCS Annual Meeting and Expo is truly the only global event covering the depth and breadth of our diverse fats and oils community. Experience it for yourself in Montréal."

Greg Hatfield, Bunge North America, Annual Meeting General Chairperson

1. EXPAND YOUR KNOWLEDGE

- **ABSORB THE BEST EDUCATIONAL PROGRAM IN THE INDUSTRY**
  AOCS is known for its extensive program, which features more than 700 presentations covering 15 interest areas. Leading experts will present the latest information in their field, which will include sessions on health and nutrition, biotechnology, lipid oxidation and quality, surfactants and detergents, and processing.

- **DISCUSS WHAT'S HOT**
  The Forum on Emerging Technologies sessions will encompass global discussions on current critical issues that impact the future of the fats and oils industry. Focus topics may include:
  - ✔ Advanced biobased products
  - ✔ Algal technology
  - ✔ Edible ester technologies
  - ✔ Food security
  - ✔ Nutrition

- **ATTEND A SHORT COURSE**
  In the days before the AOCS Annual Meeting & Expo, short courses will offer a classroom-style training program on key issues affecting the fats, oils, and related materials industry. This year's short course offerings include:
  - ✔ Applied Fundamentals in Interfacial Phenomena
  - ✔ Fundamentals of Edible Oil Processing and Refining
  - ✔ Lecithin Functions in Technology and Nutrition
  - ✔ Analytical Techniques: Quality Control, Process Control, and Refinery Optimization

2. NETWORK WITH COLLEAGUES

- **Eat, drink, and connect**
  The AOCS Annual Meeting & Expo will host several networking activities to help connect industry professionals! Newcomer "Speed" Networking on Sunday evening and Newcomer Networking on Monday are designed to facilitate professional connections for new attendees. Other events include the Opening Mixer on Sunday, the Expo Sweet Retreat Dessert Break on Monday afternoon, and Networking Receptions on both Monday and Tuesday evening. A Student Business Luncheon and Mentoring Program will be hosted on Wednesday. All networking events are held in the Expo Hall and are complimentary to full program registrants, students, and exhibit personnel.

- **Enjoy a superior expo**
  The AOCS Expo showcases over 85 companies from across the globe, highlighting the industry's most prestigious corporate, government, and academic institutions as well as the most current products and services.

- **Find people near you with similar interests**
  In addition to the program sessions, attending a Division or Section event is the best way to meet colleagues in your interest area or from your part of the world. Seven geographic AOCS sections provide a local forum for fats and oils professionals, enhancing networking opportunities in your region. Twelve AOCS divisions (also known as interest areas) allow professionals the opportunity to collaborate with like-minded professionals. Division and section events take place throughout the Annual Meeting, and any registrant is welcome to attend.

- **Attend the AOCS Annual Business Meeting**
  This year's Annual Business Meeting will be accompanied by a luncheon on Monday afternoon, immediately following The Forum on Emerging Technologies. Hear AOCS President Deland Myers and AOCS Vice President Tim Kemper deliver brief addresses, followed by the presentation of the Society and Fellow awards. Routine AOCS business will be conducted after the awards are presented.

3. EXPERIENCE MONTRÉAL

Discover Montréal's bi-cultural heritage and cosmopolitan blend of the old and new on an optional Montréal city tour on Sunday, April 28. Enjoy the city's rich architectural and historical legacy, financial district, museums, performing arts institutions, elegant residential areas, and universities. You will also experience a scenic drive through St-Helen's and Notre-Dame Islands, sites of Expo 67, and the Montréal Casino.

Along the way, the tour includes a stop at the summit of Mt. Royal for a panoramic view of Montréal and a guided visit of Notre-Dame Basilica, an outstanding example of Gothic revival architecture.

For more information visit: AnnualMeeting.aocs.org.

THE GOOD OIL ON MONTRÉAL

Vive la différence! Montréal's French and English heritage has developed into a unique blend of European and North American cultures and innovation. As in European cities, many Montrealers live downtown, so there's always something happening. The city is safe, tourist-friendly, and breathes *joie de vivre*.

*Montréal is a leading center for the technology and manufacture of edible oil products.

*Montréal is a pioneer in the adoption of biodiesel as fuel for public transit. The city's Biobus project in 2002 inspired transport companies elsewhere in Canada to reduce vehicle pollution by using biological oils.

*The Montréal General Hospital is leading a breakthrough study of the possible connection between a soy-rich diet and the prevention of chronic pain after breast cancer surgery.

*McGill's Institute for Global Food Security is recognized as Canada's leading multidisciplinary teaching and research center working on the prevention of world food shortages.

—Tourisme Montréal

Sponsorship and Exhibit opportunities may still be available. For more information, contact:

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BRIEFS

The Danish tax on saturated fat is no more, and the Danish government has said that it will not levy its planned tax on sugar. The fat tax was enacted in October 2011 in order to reduce consumption of saturated fat. "The suggestions to tax foods for public health reasons are misguided at best and may be counterproductive at worst," a statement by the Danish government asserted. The European Public Health Alliance disagreed, according to FoodNavigator.com, suggesting that the tax had not been in place long enough to produce results.

■■■

Pennsylvania (USA) state officials held a public hearing December 13, 2012, regarding two air quality plan approval applications and a storage tank permit application for Perdue Grain & Oil Seed LLC. "The applications relate to the installation of a grain elevator and a soybean oil extraction facility in Conoy Township in Lancaster County," a report in the *Lancaster New Era* newspaper noted. The account also said that the proposed facility is expected to cost $59 million.

■■■

Doris de Guzman, formerly of *ICIS Chemical Business*, has moved her blog on green chemicals to http://greenchemicalsblog.com. There, she recently provided a long post on advances in biorubbers, including word that Bridgestone has teamed with Ajinomoto to investigate biomass-based isoprene. Apparently, Bridgestone has also been conducting testing on Russian dandelion (also called rubber root) at its laboratories in Akron, Ohio, USA, and Tokyo, Japan; according to de Guzman, the company plans larger-scale testing in 2014. The blog entry also details a variety of work being done on rubber from the guayule plant. ■

NEWS & NOTEWORTHY

Canadian food safety law passes

Canada's Safe Food for Canadians Act (SFCA) gained final approval in early December 2012. The act aims to improve food safety by "focusing on unsafe practices, import surveillance, and food traceability," according to Shook Hardy & Bacon LLP, a Washington, DC-based firm of attorneys specializing in regulatory law.

The new law consolidates some of the Canadian Food Inspection Agency's (CFIA) existing legislation—including the Fish Inspection Act, Meat Inspection Act, Canada Agricultural Products Act, and Consumer Packaging and Labeling Act—although the Food and Drug Act will continue to provide "overarching protection for consumers from any foods that are unsuitable for consumption, including those marketed exclusively within provinces," Shook Hardy & Bacon said.

"In particular, SFCA expands CFIA's authority to address food safety risks, deter deceptive practices, and develop regulations for tracing and recalling food," the law firm noted. "The act also gives CFIA the authority to certify all Canadian food commodities destined for export and reinforces import controls by 'including powers to register or license importers,' with mechanisms to hold importers accountable for product safety. By streamlining current food safety provisions, SFCA ultimately seeks to align inspection and enforcement powers, 'making them consistent across all food commodities, enabling inspectors to be more efficient and fostering even higher rates of compliance for industry.'"

In the meantime, the Food Safety Modernization Act (FSMA), which was enacted by the US Congress in 2011, remained without full implementation in the United States, pending final rules from the US Food and Drug Administration (FDA). In late 2011, FDA submitted drafts of four of the most important rules under FSMA for review by the White House Office of Management and Budget, where they remained as *inform* went to press.

The Center for Food Safety and Center for Environmental Health—two activist groups—filed suit at the end of August 2012 to try to force implementation. FDA

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argued in early December 2012 that the suit should be dismissed because "the enormity and scope of the task given to FDA cannot be overstated."

FIRST REGISTRATION SUSPENSION UNDER FSMA

Despite the lack of final rules, FDA flexed its increased food safety muscle for the first time since passage of FSMA. The agency worked with the country's largest processor of organic peanut butter, Sunland Inc. (Portales, New Mexico, USA), for several months after salmonella contamination in the company's peanut butter sickened 41 people in 20 states. Then, FDA suspended Sunland's registration on Monday, November 26, 2012. Sunland said it had planned to resume operations after voluntarily shutting down earlier in the quarter.

FSMA allows FDA to suspend a company's registration when food manufactured or held there has a "reasonable probability" of causing serious health problems or death. Before FSMA, FDA would have to have gone to court to suspend the company's registration.

US, China to cooperate on food safety

The US Food and Drug Administration (FDA) announced in late 2012 that it has renewed an agreement with the General Administration of Quality Supervision, Inspection, and Quarantine of China (AQSIQ) to enhance cooperation between the United States and China on food and feed safety. The two countries entered into the original agreement in 2007 and extended the agreement for an additional five years.

The agreement includes:

- enhancement of FDA's ability to identify high-risk food products entering the United States from China;
- collaboration to facilitate inspections of facilities that process and produce food;
- a focus on high-risk foods frequently exported from China to the United States, including canned and acidified foods, pet food, and fish produced through aquaculture; and
- the creation of processes for FDA to accept relevant, verified information from AQSIQ regarding registration and certification.

In November 2008, after the two countries signed the original agreement, FDA opened offices in Beijing, Shanghai, and Guangzhou.

Alfa Laval Group restructures

Alfa Laval Group of Lund, Sweden, has restructured the company from two selling divisions to three. The existing Process Technology and Equipment divisions remain, and the company added the Marine & Diesel Division as its third unit, according to a presentation by Lars Renström, president and CEO, at Alfa Laval's Capital Markets Day. The event was held in late November 2012 in Copenhagen, Denmark.

"Alfa Laval has almost doubled in size since the present organizational structure was set up 10 years ago," noted Renström. "By combining the recently acquired Aalborg Industries with Alfa Laval's Marine & Diesel segment, we are forming a division focusing on the marine and diesel markets . . . ."

Rabobank on 2013 ag outlook

The outlook for agricultural commodities in 2013 is mixed, according to Rabobank Group, the Dutch-based agricultural banking cooperative.

Despite last year's historic low levels and record high prices for agriculture commodities, Rabobank analysts believe that global

agricultural commodity markets will shift from tight supply to a surplus in 2013, but prices will remain volatile. Particularly for grains and oilseeds, Rabobank says, a supply squeeze will drive prices higher in the first half of the year, followed by price weakening as production rebounds.

Rabobank's annual commodities outlook, titled "Outlook 2013—Rebalancing on a Tightrope," analyzes how global macro uncertainty is shaping the agricultural commodity markets, specifically the impact of a weak US dollar on prices, as well as how speculation will continue to drive trading patterns. It also provides comprehensive 2013 price forecasts and price comparisons against 2012 forecasts across the wheat, corn, soybeans, soy oil, soymeal, palm oil, sugar, coffee, cacao, and cotton sectors.

Prices for grains and oilseeds will be squeezed higher in the first half of 2013, Rabobank predicts, then ease in the second half as production recovers and creates a global surplus. Low global inventory levels will make prices vulnerable to high volatility and production risks. Global stocks-to-use of corn, wheat, and soybean will rise just 1.9 points to 19.9% and remain below 2011/2012 levels, sustaining prices in the second half of the year. Multiseason surpluses will be required to rebuild inventories and rebalance fundamentals.

Grain and oilseed prices are expected to be the most volatile, with a rally in the first quarter, giving way to weakness for the remainder of the year. Soymeal will be the worst-performing commodity through the year. Palm oil could have the most upside as Chinese imports and biofuel demand drive prices higher after the 2012 sell-off.

The Rabobank predictions by commodity follow:

Cotton. Global cotton prices are forecast to plateau in the first half of 2013, as the market faces its largest ever period of oversupply, before the curve lifts modestly by year end.

"Pricing in cottonseed and cottonseed oil markets are quite location specific and driven by supply and demand fundamentals," Rabobank cotton analyst Tracey Allen noted. "We expect that cottonseed and cottonseed oil prices will continue to be determined by seasonal availability in 2013, yet supported by the broader oilseed complex. With tight stock levels and elevated prices across alternate feed markets including corn and soybean markets, cottonseed is expected to play a large role in the fodder mix during 2013."

Soybeans, meal, and oil. Soybean prices are expected to remain supported in the first quarter of 2013 on tight export supplies before declining as production rebounds later in the year, with prices for the year averaging below 2012 levels. Soy oil prices are forecast to remain rangebound (or moving within a relatively tight range) at the beginning of 2013 on high US supplies, before increasing in mid-2013 as supplies are drawn down. Chicago Board of Trade soymeal prices are likely to drop by nearly $75/short ton [$83/metric ton] from current levels by the end of 2013 as demand slows.

Palm oil. Palm oil prices are forecast to rise in the first quarter of 2013 as stocks are drawn down from record high

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SUSTAINABILITY WATCH

Defining sustainable packaging

The Sustainable Packaging Coalition (SPC) is an industry working group based in Charlottesville, Virginia, USA. It aims, in its own words, "to build packaging systems that encourage economic prosperity and a sustainable flow of materials."

According to SPC, sustainable packaging:

- is beneficial, safe, and healthy for individuals and communities throughout its life cycle;
- meets market criteria for both performance and cost;
- is sourced, manufactured, transported, and recycled using renewable energy;
- optimizes the use of renewable or recycled source materials;
- is manufactured using clean production technologies and best practices;
- is physically designed to optimize materials and energy; and
- is effectively recovered and utilized in biological and/or industrial closed loop cycles.

ACS develops climate toolkit

The American Chemical Society (ACS; Washington, DC, USA) has developed a web-based resource to enhance understanding and communication of the science underpinning global climate change. This Climate Science Toolkit is available at www.acs.org/climatescience.

The ACS Climate Science Toolkit discusses greenhouse gases, how the Earth's heating mechanism works, how the vibrational energy from molecules changes into translational kinetic energy, and much more. The toolkit also provides a package of "Climate Science Narratives" that can be adapted and personalized when scientists have the opportunity to speak about climate science to other audiences. ■

levels, before falling later in the year as palm oil and soybean output rebound.

Heat-resistant chocolate

Sticky fingers from melting chocolate may be a thing of the past, thanks to Mondelēz International's Cadbury unit. (Mondelēz International comprises the global snacking and food brands of the former Kraft Foods Inc. Mondelēz is based in Deerfield, Illinois, USA.)

Cadbury researchers in the United Kingdom recently announced they have developed a type of chocolate that remains solid even after more than three hours at 104°F (40°C). These temperature-tolerant chocolates will soon be available in countries such as India and Brazil, the company said, where sweltering temperatures are the norm.

Cadbury's patent application states that it achieved the unique property by "refining the conched chocolate after the conching step." The process of conching yields cocoa and sugar particles smaller than the tongue can perceive, leading to a smooth mouthfeel.

An article in the UK's *Daily Mail* newspaper says that during the process, "sugar particles are broken down into smaller pieces." According to the report, this minimizes the amount of fat that covers the sugar particles, which makes the bar less susceptible to heat.

Cadbury is not the first company to work on heat-resistant chocolate, according to ConfectioneryNews.com. Barry Callebaut created Volcano chocolate in 2009, which has a melting point of 55°C because it uses less cocoa butter. In 2011, "UK confectioner Choc-o-Bloc introduced its answer to heat-resistant chocolate with Magic Choc, a Play-Dohlike chocolate that melts at 37°C," the online news source reported.

In related news, Mondelēz recently opened a new £500,000 (about $800,000) laboratory for three-dimensional microscopy in Reading, UK. The technology will allow researchers to view a product's full microstructure and, therefore, to control the number of air gaps in products. The company used the new technology in developing its Crispello and Bubbly aerated chocolate products, according to FoodManufacture.co.uk.

Fatal explosion at Canadian krill oil plant

The Neptune Technologies & Bioressources Inc. krill oil production facility in Sherbrooke, Québec, Canada, was destroyed on November 8, 2012, when acetone used for oil extraction exploded. Three employees were killed and 18 others were hospitalized.

The explosion and fire completely destroyed Neptune's current production plant and inventory of krill oil, but damages to an expansion facility adjacent to the original plant were minimal, the company said.

Neptune was also in the news recently regarding its court battle with fellow krill oil producer, Norway's Aker BioMarine ASA. The companies, which are embroiled in a patent suit in the United States, are now also battling in Australian courts. At question is Aker's patent application AU2008291978 titled "New Method for Making Krill Meal."

Neptune claims the invention is "neither new nor inventive," according to FoodNavigator.com. ■

FIGHT OVER ANIMAL FATS:

Oleochemical industry fears loss of key raw material to biodiesel

This month's Biofuels News features a special report from ***Chemical & Engineering News (C&EN)*** on the recent decision by the US Environmental Protection Agency (EPA) to increase the amount of biomass-biodiesel that must be blended into the fuel supply in 2013, and how that mandate could affect the supply and price of a key raw material used to make soaps, detergents, and personal care products. *Inform* will be offering more extensive, global coverage of this issue as the situation unfolds.

Glenn Hess

The US Environmental Protection Agency's (EPA's) recent decision to increase the amount of biomass-based diesel that must be blended into the U.S. fuel supply in 2013 under the Renewable Fuel Standard is creating more headaches for the makers of soap and detergent products.

The steady growth of the biodiesel industry over the past decade has already curtailed supplies and raised prices of animal fats such as beef tallow, say officials at the American Cleaning Institute (ACI), a trade association that represents both cleaning-product companies and oleochemical makers.

For more than 100 years, the oleochemical industry has turned animal fats into fatty acids, fatty alcohols, and other chemicals that are widely used to manufacture soaps, detergents, and personal care products. But since 2004, federal policymakers have increasingly driven and subsidized the diversion of animal fats to biofuel production through tax credit supports and guaranteed markets under the Renewable Fuel Standard, explains ACI President Ernie Rosenberg.

"We regret that once again, EPA has dismissed the concerns of the domestic oleochemical industry relating to the Renewable Fuel Standard's impact on the price and availability of animal fats," Rosenberg says.

The American Jobs Creation Act of 2004 included a $1.00 per gal tax credit to create incentives for the production and use of biodiesel by making renewable fuel competitive with conventional diesel fuel. The subsidy aimed to boost profits, help existing biorefineries remain solvent, and create a financial climate that would encourage the construction of new plants.

The credit for biodiesel production expired at the end of 2011 along with a group of other tax breaks that Congress generally renews each year. It's unclear whether lawmakers will reinstate the targeted tax breaks during the postelection lame-duck session.

The Renewable Fuel Standard was created by Congress in 2005 to ensure that transportation fuel sold in the U.S. contains a minimum volume of biofuel in order to reduce air pollution and greenhouse gas emissions. Two years later, lawmakers expanded the biofuels blending mandate to include diesel fuel, in addition to gasoline.

The Energy Independence & Security Act of 2007 required biodiesel to be included in U.S. diesel fuel markets beginning in 2010. The level was initially set at 800 million gal in 2011 and was increased to 1 billion gal in 2012.

EPA has the discretion to set the volume higher on an annual basis, depending on environmental, market, and energy-related factors.

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BRIEFS

The European Union (EU) is providing approximately €10 million to fund a 36-month project aimed at expanding the commercial development of aviation biofuel. Neste Oil (Porvoo, Finland) will produce 4,000 metric tons of this fuel, with most of it sourced from Spanish camelina oil and used cooking oil, in accordance with sustainability standards set by the EU Renewable Energy Directive. According to Argus Media, the project will feed into the European Aviation Biofuels Flightpath initiative of producing 2 million metric tons per year of renewable fuel for airline use by 2020 (http://tinyurl.com/EU-biofuel).

State-run television in Cuba announced in December 2012 the opening of the country's second biodiesel plant, as well as plans to build three more plants. Currently about 110 hectares of *Jatropha curcas* are being cultivated in the island nation to provide feedstock for these facilities. ■

In September, EPA announced that it would boost the biodiesel volume requirement to 1.28 billion gal in 2013. "This action, which meets goals designated by Congress, is another step that strengthens America's energy security by reducing dependence on foreign oil," EPA Administrator Lisa P. Jackson said when announcing the increase.

PRODUCING MORE BIODIESEL STRENGTHENS ENERGY SECURITY

Biodiesel remains the only advanced biofuel in commercial production across the country. EPA estimates that biomass-based diesel reduces greenhouse gas emissions by more than 50% when compared with petroleum diesel.

Biodiesel producers lobbied the Obama Administration to raise the target for next year to continue growth in the industry, which in 2011 produced a record 1.1 billion gal of the renewable fuel made mostly from soybean oil but also from recycled cooking oil and animal fats (Table 1).

"This was an incredibly important decision, and the Obama Administration got it right," says Joe Jobe, chief executive officer of the National Biodiesel Board, the industry's trade association. "It will allow biodiesel plants across the country to invest and expand, creating thousands of jobs," he says. "At the same time, it sends a strong signal that the U.S. is standing firm behind its commitment to producing clean, American-made energy to strengthen our energy security and break our dependence on petroleum."

But oleochemical producers are concerned that a further increase in biodiesel production will tighten the tallow supply, which will put upward pressure on pricing for the key raw material. The supply of animal fats is inelastic; livestock production is geared to food supply, not fuel, says Dennis Griesing, principal at DCG Public affairs and a lobbyist for ACI.

Before Congress began creating a demand for biofuels in the mid-2000s,Griesing notes, tallow cost about 13 to 16 cents per lb. Earlier this month, tallow was trading for 39 cents per lb, compared with 47 cents per lb for soybean oil. "So long as tallow tracks lower than soybean oil, it will be the price-preferred raw material. That's the problem," Griesing says.

Another factor affecting tallow availability is the drought that gripped much of the U.S. this year. Faced with shortages of feed, water, and healthy pastureland, many ranchers sent their cattle herds to slaughter earlier than usual. "So the cows had less fat on them and therefore less tallow," Griesing says. "This is going to have an impact on supply."

ACI has pressed EPA to limit the use of animal fats for biofuel production. But in its final rule on the 2013 biodiesel requirement, EPA says it does not have the authority to prevent feedstocks that meet the statutory definition of renewable biomass from being used in the production of renewable fuel. The choice of which feedstocks will be used to produce biomass-based diesel will be determined by the market," the agency says in the final rule, which was published in the *Federal Register* on Sept. 27.

TABLE 1. US biodiesel production[a]

Year	Production	
	106 gallons	106 liters
1999	0.5	1.9
2000	2	7.6
2001	5	18
2002	15	57
2003	20	76
2004	25	95
2005	112	420
2006	250	950
2007	450	1,700
2008	700	2,600
2009	545	2,100
2010	315	1,200
2011	1,100	4,200

[a]Source: National Biodiesel Board annual estimates

EPA says it agrees with ACI that an increase in the use of animal fats to produce biofuel could raise the price of those fats or reduce their availability for the production of oleochemicals. "Such circumstances could in turn compel the oleochemical industry to use a greater fraction of alternative feedstock sources such as cottonseed oil," the agency says. "However, there could be sufficient sources of other feedstocks to produce 1.28 billion gal of biomass-based diesel without using any animal fats."

EPA estimates that about 600 million gal of the 1.28 billion-gal biodiesel requirement will be produced using soybean oil as the feedstock, and 270 million to 380 million gal will be made from recycled cooking oil and animal fats.

PRICE DEPENDS ON GENERAL DEMAND

Moreover, the agency notes that the price of animal fat is dependent on general demand for the material, which is only in part affected by its potential use as a bio-

CONTINUED ON PAGE 90

BRIEFS

Is it possible that a single meal of junk food—loaded with saturated fat—is measurably detrimental to the health of the arteries?

That is the conclusion reached by Anil Nigam, director of research at the Cardiovascular Prevention and Rehabilitation Centre of the University of Montréal in Canada. Nigam and colleagues presented their small study of 28 nonsmoking men at the Canadian Cardiovascular Congress (doi:10.1016/j.cjca.2012.07.367, 2012). In brief: The researchers measured the subjects' vascular endothelial function after two meals. The first had 51% of total calories from fat (largely mono- and polyunsaturated fats). The second meal (egg, sausage, cheese, and three servings of hash brown potatoes) had 58% of total calories from fat (mainly saturated fat). Nigam's team found that after eating the junk food meal, the subjects' arteries dilated 24% less than they had when in the fasting state. In contrast, their arteries dilated normally and maintained good blood flow after the first Mediterranean-type meal.

■■■

An international team of researchers led by Gregory P. Levin of the University of Seattle in Washington, USA, has found that the vitamin D receptor gene (VDR), which senses and communicates the presence of vitamin D to the body, influences the chance that people with vitamin D deficiency develop negative health outcomes. Apparently, some variants of VDR may have a protective effect, whereas others may increase the predisposition for the negative outcomes, specifically hip fracture, heart attack, cancer, and even death. These findings help explain why some persons with vitamin D deficiency have few health issues and others have life-threatening complications. The work appeared in the *Journal of the American Medical Association* (doi.org/10.1001/jama.2012.17304, 2012). ■

HEALTH & NUTRITION

Soy foods safe for cancer patients

Breast cancer patients are safe eating moderate amounts of soy foods, according to a new review conducted by the American Institute for Cancer Research (AICR). AICR is a nonprofit organization based in Washington, DC, USA, that aims to foster research on the relationship of nutrition, physical activity, and weight management to cancer risk.

The latest update of *AICR's Foods That Fight Cancer™*, an online educational tool, answers one of the most frequently asked questions relating to how diet may affect breast cancer risk. "*AICR's Foods That Fight Cancer™* is an independent review of the literature and does not receive support from trade associations or food advocacy groups," the group noted in a news release.

"Determining whether it is safe for breast cancer survivors to eat soy has been one of the big research questions under study and now we know it is safe—the evidence is so consistent," said AICR Nutrition Advisor Karen Collins.

For all cancers, human studies show soy foods do not increase risk and in some cases may even lower it, the review finds. Previous concerns with soy and increased breast cancer risk stemmed from the presence in soy foods of isoflavones—a group of compounds that in some ways mimic the action of estrogen. High blood levels of estrogen are linked to increased breast cancer risk. The fears that soy foods would increase the risk of breast cancer were heightened by rodent studies that suggested two isoflavones—genistein and daidzein—stimulated breast cancer cell growth.

Scientists now know that rodents and most other laboratory animals metabolize soy isoflavones differently from humans, IACR notes in its written statement. And soy consumption does not lead to increased estrogen levels in humans, the group says. "Six recent human studies and one major meta-analysis have found that consuming moderate amounts of soy foods does not increase a breast cancer survivor's risk of recurrence or death," AICR states.

A moderate amount of soy is one to two standard servings daily of whole soy foods, such as tofu, soy milk, and edamame. Studies have demonstrated as many as three

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servings a day are not associated with increased breast cancer risk, the group says.

Some preliminary human studies suggest that soy foods may be most protective among breast cancer survivors who are taking tamoxifen, but this research is not final.

For breast cancer risk among cancer-free women, studies on soy consumption show either no link or a slightly protective link to breast cancer. Some research suggests that protective effects may come primarily from consuming soy during childhood and adolescence.

"There are numerous ways in which soy foods may protect against cancer," notes Collins. Laboratory studies show that soy isoflavones inhibit a number of cell signaling pathways linked to cancer growth. And research suggests some individuals may benefit more from soy's compounds than others."

AICR estimates that 38% of US breast cancer cases every year—approximately 86,000 cases—could be prevented if women were to maintain a healthy weight, be physically active, drink less alcohol, and breastfeed their children.

To reduce risk of recurrence and secondary cancers, survivors are encouraged to follow these same recommendations.

"The evidence is not quite there to start saying soy reduces the risk of cancer," says Collins. "But for breast cancer survivors who want to eat less meat, get protein, and enjoy a more plant-based diet, soy is a healthy food and everyone—including breast cancer survivors—can feel comfortable eating it."

For a review of research on soy and breast cancer that appeared in the October 2011 *inform*, see http://tinyurl.com/AOCS-soy.

Coconut oil and tooth decay

Digested coconut oil can attack the bacteria that cause tooth decay and could be incorporated into commercial dental care products, say scientists at Ireland's Athlone Institute of Technology (AIT).

The team from AIT, which was led by Damien Brady, tested the antibacterial action of coconut oil in its natural state and coconut oil that had been treated with enzymes, in a process similar to digestion. The oils were tested against strains of *Streptococcus* bacteria that are common inhabitants of the mouth. The researchers found that enzyme-modified coconut oil strongly inhibited the growth of most strains of *Streptococcus* bacteria including *S. mutans*—an acid-producing bacterium that is a major cause of tooth decay.

The work was presented at the Society for General Microbiology's conference at the University of Warwick in early September 2012.

Many previous studies have shown that partially digested foodstuffs are active against microorganisms. Earlier work on enzyme-modified milk suggested that it was able to reduce the binding of *S. mutans* to tooth enamel, which prompted Brady's research group to investigate the effect of other enzyme-modified foods on bacteria.

Further work will examine how coconut oil interacts with *Streptococcus* bacteria at the molecular level and which other strains of harmful bacteria and yeasts it is active against. Additional testing by the group at AIT found that enzyme-modified coconut oil was also harmful to the yeast *Candida albicans*, which can cause thrush.

The researchers suggest that enzyme-modified coconut oil has potential as a marketable antimicrobial that could be of particular interest to the oral healthcare industry. Brady said: "Incorporating enzyme-modified coconut oil into dental hygiene products would be an attractive alternative to chemical additives, particularly as it works at relatively low concentrations. Also, with increasing antibiotic resistance, it is important that we turn our attention to new ways to combat microbial infection."

The work also contributes to an understanding of antibacterial activity in the human gut. "Our data suggest that products of human digestion show antimicrobial activity. This could have implications for how bacteria colonize the cells lining the digestive tract and for overall gut health," explained Brady.

"Our research has shown that digested milk protein not only reduced the adherence of harmful bacteria to human intestinal cells but also prevented some of them from gaining entrance into the cell," he said. "We are currently researching coconut oil and other enzyme-modified foodstuffs to identify how they interfere with the way bacteria cause illness and disease." ■

LOW VITAMIN D LEVELS AND LONGER LIFESPAN:

Did we hear that correctly?

Brant Cebulla

A new study published in the *Canadian Medical Association Journal* (doi:10.1503/cmaj.120233, 2012) reports that offspring who have parents living past 90 years of age have lower vitamin D levels than their spouses. While there may be a study or two that cast doubts on higher vitamin D levels, this is probably not one of them. We'll explain.

The Leiden Longevity Study is a population of 421 families, consisting of nonagenarian (over the age of 90) white siblings, their offspring, and their offsprings' partners. Researchers gathered this study population to attempt to identify genetic and phenotypic (physical characteristics) markers related to longevity.

Families were only included if at least two nonagenarian siblings were still alive. Since it is difficult to match controls to people of this advanced age, offspring were asked to participate because they have a propensity to reach that older age. And, furthermore, researchers have the benefit of matching the offspring to spouses, who usually match well in age, BMI (body mass index), and exposures. Researchers are likely using these families to study and publish many findings, not just on vitamin D levels and vitamin D genetics.

In this study, the researchers, led by Raymond Noordam and colleagues of Leiden University Medical Center in the Netherlands, found that offspring of nonagenarians had a mean vitamin D level of 25.7 ng/mL, while the offspring's partners had mean levels of 27.4 ng/mL. When they excluded supplement users from the analysis, the levels remained nearly the same. When they adjusted for tanning exposure habits, the difference between the offspring and partners' levels still stayed nearly the same.

Keep in mind that while the difference between 25.7 ng/mL and 27.4 ng/mL is very small, particularly at the individual level, this may be significant when examining a large population. The inference here is that even if you exclude supplement users and adjust for tanning, there may be something going on genetically. Something about the nonagenarians' offsprings' genetics might cause their levels to be slightly lower than their spouses.

From here, we can't infer much else, and it doesn't squelch the idea that vitamin D reduces mortality and thus increases longevity. There is little in the study that suggests that low vitamin D levels are the key to offspring reaching their parent's age. There is little in the study that suggests that the nonagenarians reached that age because they have lower vitamin D levels.

There is little to suggest that if you supplement with vitamin D, you reduce your chance of living until the age of 90. There is little to suggest that if you sunbathe, you reduce your chance of living until the age of 90.

There is little in the study that suggests that vitamin D levels are even central to longevity. It could well be the case that there is some other gene crucial to longevity that is merely associated with genes that dispose a person to have slightly lower vitamin D levels. In other words, if all offspring and all spouses supplemented with the same amount of vitamin D, there could still likely be a difference of 1–2 ng/mL between the two groups. And this study still very much leaves room for the possibility that both the offspring and spouse would

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be better off raising their vitamin D levels via supplementation or exposure.

In conclusion, if you took the study at face value, it is not offering much insight into vitamin D. Even if it had found the opposite, that offspring had slightly higher levels than their spouses, there still would be little to conclude with the same set of questions remaining. That being said, there are also a few flaws and assumptions in the study:

1. The assay they used to measure 25-hydroxy vitamin D (25OHD) is no longer on the market due to lack of accuracy.
2. If we did draw any conclusions, we are assuming that 25OHD status in offspring is closely correlated with their parents' 25OHD levels.
3. If we did draw any conclusions, we are assuming that genetics are more important in vitamin D than sun exposure, supplements, and food, which we have reasonable evidence suggesting that this is not the case.

Again, this study does not contribute much to the literature on vitamin D and does not answer the question, what level is going to get me to the age of 90? And I don't believe the researchers are trying to answer that question, either. The study is interesting but not insightful.

The best evidence to date that looks at mortality (the opposite of longevity) and the use of vitamin D supplementation in an elderly population was a systematic review published in the distinguished *Cochrane Database* (doi:10.1002/14651858.CD007470.pub2, 2011). Goran Bjelakovic and colleagues analyzed 50 randomized controlled trials and found that vitamin D3 supplementation decreases mortality in elderly women who are mainly in institutions and dependent care.

Brant Cebulla is development director of the Vitamin D Council (www.vitamindcouncil.org), a nonprofit organization based in San Luis Obispo, California, USA. He can be reached at bcebulla@vitamindcouncil.org.

Fight over animal fats (cont. from page 86)

fuel feedstock. As a result, EPA says, it does not believe that oleochemical production "will be significantly impacted by the potential use of rendered fats as a biofuel feedstock if some portion of the 280 million-gal increase in the biomass-based diesel standard is produced from rendered fats

Griesing says EPA has been "a little dismissive" of the oleochemical industry. The price and availability of tallow "is a twofold concern, and I don't think they gave it reasonable consideration," he remarks. "Maybe market conditions aren't their concern, but it will be if we begin to lose an industry."

Palm oil, which is produced in Southeast Asia, can substitute for tallow as a feedstock. But switching to palm oil would not be a simple matter for personal care product companies. "If they reformulate, they would have to go through the process of obtaining approvals by the Food & Drug Administration," Griesing notes. "And once they make that conversion, it's not likely that they would go back. That would be a significant shift."

COULD CONVERTING TO PALM SHIFT OLECHEMICAL MANUFACTURING TO SOUTHEAST ASIA?

If palm oil gets a foothold in the United States, oleochemical makers are worried that foreign-government-supported enterprises in Indonesia and Malaysia would start manufacturing the chemicals, too. Not only would U.S. oleochemical producers be put out of business, Griesing warns, but affected consumer product manufacturing could shift overseas as well. "Then what happens to the 25,000 jobs the oleochemical industry supports in this country?" he asks.

ACI's Rosenberg says EPA has sent a clear message that this issue must be resolved by Congress. The use of animal fats for oleochemical production has historically allowed the US industry to compete in the global market by providing a cost-competitive raw material. But that raw material edge "is now being profoundly eroded," he says. "While biofuels have an important place in our energy future, their success should not come at the expense of established industries which happen to share a raw material stock."

ACI has been trying to find congressional sponsors for legislation that would remove animal fats from any biofuel tax credit scheme and from the list of approved biomass under the Renewable Fuel Standard program. "We want to take animal fats out of both of those market-distorting schemes and leave it to the free market," Griesing says. "Equity is all we want on this issue."

But with Congress facing crucial year-end deadlines on major budget and tax issues, the oleochemical industry will likely have to wait until 2013 to find an opportunity to advance its legislative agenda.

"We've had a lot of sympathy on Capitol Hill, but I don't think anybody has focused on this," Griesing tells *C&EN*. "Members of both parties understand our concerns. We'll just have to see what happens."

Glenn Hess is a senior editor for* C&EN *in Washington, DC. This article is reprinted with permission from Chem. Eng. News 90(47): 32–34 (2012).

BRIEFS

Citizens of the state of California (USA) in November 2012 voted 53% to 47% against requiring the labeling of foods containing ingredients from genetically modified organisms (*inform 24*:30, 2012). The public interest group Non-GMO Project (nongmoproject.org) is continuing its efforts, however. Anne Brown, senior manager of the food ingredients marketing group at the Scoular Company, which supplies identity-preserved non-GMO grain in North America, told NutraIngredients-usa.com, "I think that in Europe, consumers really drove the trend and the legislation followed, and I think that is what is going to happen in the US" (http://tinyurl.com/Nutra-Scoular). She pointed out that several companies provide competitively priced non-GMO soy products, but non-GMO corn-based sweeteners come at a premium.

■■■

On November 21, 2012, the Kenyan Ministry of Public Health (MOPH) ordered public health officials to remove all genetically modified (GM) foods on the market in the country and to enforce a ban on GM imports until they can certify that they have no negative impact on people's health. The Minister for Public Health, Beth Mugo, had presented concerns about the safety of GM foods to a meeting of the Kenyan Cabinet chaired by President Mwai Kibaki on November 8. Mugo recommended an immediate ban on GM imports and products in Kenya, citing the discredited study released by Gilles-Eric Séralini and coworkers (*inform 24*:30,47, 2012) that linked cancer in rats to the consumption of GM foods. The Kenyan Medical Research Institute, under MOPH, also supported the ban based on this study (http://tinyurl.com/GM-Kenya).

Miriam Kinyua, chair of the government's National Biosafety Authority, said that biotechnology research in Kenya will continue, as the ban does not infringe on existing research and development activities (http://tinyurl.com/SciDevNetKenya). ■

BIOTECHNOLOGY NEWS

Plants producing DHA

CSIRO researchers published results in November 2012 showing that the long-chain n-3 fatty acid docosahexaenoic acid (DHA) can be produced in land plants in commercially valuable quantities (*PLoS ONE* 7(11):e49165. doi:10.1371/journal.pone.0049165).

James Petrie and Surinder Singh, along with six other CSIRO associates, genetically engineered *Arabidopsis thaliana*, a well-studied plant that is related to rapeseed (*Brassica napus*), to produce DHA at levels of 15%. This is the first time a level of 12% has been exceeded, the level at which DHA is generally found in commodity bulk fish oil.

The authors suggest that the technology should be applicable in oilseed crops. They point out, "One hectare of a *Brassica napus* crop containing 12% DHA in seed oil would produce as much DHA as approximately 10,000 fish." (This calculation is based on 10,000 kg fish = 1,000 kg oil = 120 kg DHA. The following assumptions were incorporated: Average fish = 1 kg; fish oil yield = 10% by mass; average DHA content = 12%. Calculations would change for smaller fish and for less oily fish. Assumptions in developing the comparison were that 1 hectare yields 2.5 metric tons of *B. napus*, which corresponds to 1,000 kg oil or 120 kg DHA, if the seed contains 40% oil by weight.)

Furthermore, the authors reported the plant produced oil with a high n-3/n-6 ratio (>10), a ratio that is similar to what occurs in many marine oils.

The key to the CSIRO discovery was the use of a transgenic pathway to increase the content of C_{18} α-linolenic acid, which was then converted to DHA via a microalgal Δ6-desaturase pathway.

What happens when GE patents expire?

The US agricultural industry will be discovering the answer to that question over the next few years. In 2014, the patent on the first genetically engineered (GE) trait, Roundup Ready soybeans, will expire, and the first cotton trait will expire in 2016. The industry is exploring the idea of what a potential generic trait market will look like. Another important issue will be how, or whether,

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international regulatory approvals presently in place will be maintained. If they are not, trade could be disrupted.

In light of these questions, the Biotechnology Industry Organization (BIO) and the American Seed Trade Association (ASTA) announced a framework, referred to as The Accord, to develop answers. Their Generic Event Marketability and Access Agreement (GEMAA) took effect on November 15, 2012. Signatories to the agreement include BASF Plant Science, Bayer Crop Science, Dow Agro Sciences, DuPont Pioneer, and Monsanto Company. The agreement addresses the transition of commercial biotechnology events as they go off patent.

According to Andrew LaVigne, president and chief executive officer of ASTA, "The expiration of patents for biotechnology events not only creates opportunities for growers and the seed industry but also creates challenges that must be addressed." He added, "The most pressing challenge presented by patent expirations of biotechnology events is the maintenance of global regulatory authorizations for these events as well as associated stewardship obligations so that farmers can continue to cultivate their crops grown from seed varieties containing off-patent events without jeopardizing US export markets" (http://tinyurl.com/BIO-patents).

According to a statement from BIO, signatories to GEMAA that have developed proprietary regulatory information to support the authorizations for events globally would be required to provide notice of patent expiration three years before the last patent on the biotechnology event expires and provide access to the generic event at patent expiration. Furthermore, the owner of the regulatory data must decide whether to main regulatory responsibility on its own for the whole marketplace for at least four years after the last sale of the product, or to share or make arrangements to transfer this responsibility to others. If none of the other signatories express interest, the owner could discontinue the event.

For more information see www.AgAccord.org.

Patent rights on soybeans

Monsanto. The Monsanto Company (St. Louis, Missouri, USA) has created hard feelings among some farmers who plant its genetically modified (GM) seeds for checking to seeing whether they are complying with the soybean seed patents that Monsanto holds. Farmers have been required to sign a contract when purchasing bags of GM soybean seeds not to hold back seeds from the harvest for replanting in subsequent years.

Sometime in 2013, the US Supreme Court will hear oral arguments involving the patent rights of Monsanto's Roundup Ready soybeans, which are engineered to be immune to the herbicide glyphosate (Roundup).

The case in question concerns the actions of Indiana farmer Vernon Hugh Bowman, who initially planted GM soybean seeds according to the parameters that Monsanto had established. For a late-season crop, which was much less likely to "make" and for which he did not want to spend a lot of money, he purchased commodity soybeans from the local grain elevator. According to Food Business News (http://tinyurl.com/Commodity-Soybeans), Bowman's action was based on his knowledge that about 90% of the less-expensive seeds would be immune to Roundup because the trait has spread through almost all US soybean seeds. Monsanto sued Bowman, and lower courts have ruled in favor of Monsanto.

Food Business News also pointed out, "The agricultural law community has assumed that the Supreme Court is interested in this case because it explores patents rights for agricultural biotechnology that may be replicated, such as seeds."

DuPont Pioneer. The *Des Moines Register* newspaper reported that DuPont Pioneer (Johnston, Iowa, USA) expects to check Iowa farm fields during the upcoming growing season to see whether farmers are complying with its soybean seed patents (http://tinyurl.com/SeedPatentMonitor). It will be making random checks to see if farmers are holding back GM seeds planted under contract and then replanting the progeny in subsequent years.

The *Register* indicates that Pioneer has hired Agro Protection (Saskatoon, Saskatchewan, Canada) to provide the investigators. The number of investigators to be deployed in Iowa has not yet been announced. Kerri Taylor, of Agro Protection, told the *Register* that most of the investigators are retired law enforcement officials with expertise in seed technologies.

Over the years, Monsanto has licensed its Roundup Ready trait to DuPont Pioneer and other seed companies. The patent for Roundup Ready expires in 2014, leaving Pioneer and other seed companies to enforce other biotechnology or breeding patents that they may have incorporated into a single soybean plant.

Detecting GMO in bread

In a recent paper in the journal *Food Chemistry*, authors T.J.R. Fernandes, M.B.P.P. Oliveira, and I. Mafra, of the University of Porto (Portugal), discussed experiments showing that particle size is important for detecting products of genetically modified organisms (GMO) in bread (doi: 10:1016/j.foodchem.2012.10.068). Their studies involved a Portuguese maize (corn) bread called *broa*. Three different breads were made—one with corn semolina containing the MON810 event and TC1507 event, and the other two with MON810 corn flour. (Broa can also contain additional grains such as rye or wheat.)

Samples were taken before and after the steps of sourdough leavening and baking. Samples taken after baking were taken from the crust, under the crust, and in the middle (soft) part of the bread.

GMO content was assessed by DNA extraction, followed by amplification of target sequences by quantitative polymerase chain reaction.

The researchers found that estimates of GMO content from broa made with corn semolina were "very close to the actual values." In breads prepared with corn flour, subjected to the same baking treatment, the contents of MON810 corn were "considerably underestimated."

The authors concluded that heat processing was not responsible for the differences in their observations. Rather, the smaller particle size of the corn flour compared to corn semolina and the

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BRIEFS

Swiss specialty chemical company Clariant and Singapore-based agribusiness firm Wilmar International Ltd. have formed a 50:50 joint venture for the production and sale of amines and selected amine derivatives. Clariant will contribute its Industrial & Consumer Specialties business unit's sales activities of relevant amines and derivatives as well as its amines plant in Germany and production output from its amines plant in Brazil. Wilmar will contribute a new plant in China as well as its oleochemical expertise, including access to renewable raw materials.

■■■

MWV Specialty Chemicals, a division of MeadWestvaco Corp., has purchased the remaining stake of Resitec Industria Quimica, Ltda., a Brazilian company that serves the Latin American pine chemicals industry, from South Africa-based AECI Ltd. Resitec's operations include a manufacturing facility in the city of Duque de Caxias, Rio de Janeiro; an administrative office in Barra da Tijuca, Rio de Janeiro; and a tall oil refinery in the city of Palmeira, Santa Catarina, Brazil.

■■■

Honduran company Aquafinca Saint Peter Fish S.A. hopes to export 700,000 kilograms or about $600,000 worth of tilapia skin for the cosmetic industry in 2013. Fish Information & Services, a web-based news source, says tilapia skin is widely used by cosmetic and fragrance manufacturers in France, Italy, and other European countries to produce collagen.

■■■

Desmet Ballestra S.p.A. (Milan, Italy) is building a second sulfonation plant for Kuala Lumpur Kepong Bhd. (KLK; Malaysia). The facility will have a capacity of 100,000 metric tons (MT)/year of dry sulfonated methyl ester (SME). It is expected to open by the end of 2013. KLK's first SME plant, with a capacity of 50,000 MT/year, has been in operation in Malaysia for two years, the companies said in a statement. ■

SURFACTANTS, DETERGENTS, & PERSONAL CARE NEWS

Researchers at Nationwide Children's Hospital partnered with the Department of Design at The Ohio State University to design a new child-proof spray bottle.

Child-proof spray bottle developed

Researchers at The Research Institute at Nationwide Children's Hospital (Columbus, Ohio, USA), in partnership with The Ohio State University (OSU; also in Columbus), have developed a prototype for child-proof spray bottles for household cleaning products. If produced, the prototype would provide an alternative to current spray bottles while still meeting US Consumer Product Safety Commission standards for child resistance.

A Nationwide Children's study in 2010 revealed that spray bottles were the most common source of exposure to injury in children five years of age or younger treated in US emergency departments for household cleaning product-related injuries; 267,269 were treated between 1990 and 2006. These spray bottles are the largest dispensing system type by volume in North America, commonly used for household cleaning and garden products.

The study, led by Lara McKenzie, principal investigator in the Center for Injury Research and Policy at Nationwide Children's, was the basis for the spray bottle prototype.

"Existing spray bottles for household cleaning products cannot be designated as truly child-resistant," explained McKenzie, who is also a faculty member at the OSU College of Medicine. "While many spray bottles contain a nozzle that controls the stream configuration or closes the spray bottle, these nozzles are not effective if the user does not turn the nozzle back to the 'closed' or 'off' position after each use. These nozzles are also relatively easy for young children to manipulate on their own."

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In a pilot study including 25 families with young children, Nationwide Children's investigators found that 75% of the nozzles on the cleaning product spray bottles were not in the "closed" or "off" position and therefore posed a potential hazard to young children in the household.

To develop concepts and design a child-resistant spray bottle, McKenzie's research group collaborated with Carolina Gill and Scott Shim from the Department of Design and Blaine Lilly from the Department of Mechanical and Aerospace Engineering, both at OSU. Together, they developed a distinct method for making spray bottles that are essentially unusable by children younger than six years of age.

"The two-stage trigger mechanism design restricts the ability of young children to trigger spray bottles because they lack the development capability to perform the correct operational sequence and because their hand size and strength are not sufficient to activate the mechanism," said Lilly. "The spray mechanism is designed to be extremely challenging for young children to operate, yet will allow adults comfortable use."

Most notably, the prototype features a two-stage trigger mechanism that must be sequentially engaged in order for the spray mechanism to function. The spraying mechanism then automatically returns to a locked state after each use without requiring the user to consciously apply a locking feature, setting it apart from any other existing technology.

"Our long-term goal is to reduce the number of household cleaning product-related injuries in young children through widespread adoption of our product," said McKenzie. "This technology may set a new 'gold standard' for child-safe spray bottles."

Next, the team plans to identify commercial partners to bring the technology to the public sector. Both the mechanism and design of the spray bottle are patent-pending and available for licensing through the Nationwide Children's Hospital Office of Technology Commercialization at +1 614-355-2818 or Tech.Commercialization@NationwideChildrens.org.

FDA cracks down on cosmetics firms

HAPPI magazine reports in its December issue that the US Food and Drug Administration (FDA) "is continuing its crackdown against companies that are marketing cosmetics with claims of biologically enhanced benefits."

According to the article, FDA issued six warnings to cosmetic companies—"including some of the world's largest"—in a period of just one month. This level of activity is, the authors suggest, "one of the most significant enforcement crackdowns against the cosmetics industry since the inception of the Federal Food, Drug, and Cosmetic Act."

The authors, who are attorneys at Arent Fox LLC in Washington, DC, USA, believe the effort is part of a "well-orchestrated enforcement scheme" that will continue. "Obviously, such action could threaten the economic viability of industry members and their promotion of cosmetic products, particularly those that are labeled with scientific language to describe their unique, enhanced benefits."

Personal care market in Ghana and Nigeria

The rising demand for personal care products is triggering greater demand for crude palm oil by local manufacturers in Ghana, according to a recent market analysis by Frost & Sullivan. Because local production is unable to keep pace with escalating demand, Ghana remains a net importer of palm oil. Similarly, Nigeria is also still a net importer of palm oil, despite being the fifth-largest producer of palm oil globally.

Personal care product marketers in Ghana and Nigeria earned revenues of $53.2 million and $205.3 million in 2011, respectively, and Frost & Sullivan estimates revenues will reach $72.8 million and $290.4 million in 2016. The research covers applications in all-purpose soaps, beauty soaps, shower gels, and body lotions.

In Nigeria, consumer goods manufacturers face several challenges that are affecting their production and revenues. Here, an unreliable power supply and poor infrastructure have resulted in high production costs, Frost & Sullivan said. "This has forced manufacturers to look to cheaper raw materials in order to drive down the cost of production, decreasing the demand for high-quality materials and thus opening up the market for cheap, low-quality imports," the company said in a statement.

Government policies that are expected to boost local production include high import taxes on finished goods and external investments in Nigeria's palm oil sector. In Ghana, government initiatives have sought to develop the agricultural sector and increase local palm oil production, while decreasing the need for imports.

P&G celebrates partners in innovation

They helped get products to market in half the time. They drove global innovation breakthroughs and helped build connections, collaborations, and product equity.

"They" are Procter & Gamble's (P&G) top Connect+Develop open innovation partners. And P&G recently recognized seven, among its hundreds of partners, for their innovation and collaboration that have driven business results.

P&G's 2012 Connect+Develop Partner of the Year was MonoSol of La Porte, Indiana, USA. MonoSol partnered with P&G to develop Tide Pods, which were introduced in 2012. They achieved a 68% share of the unit-dose market segment "in just months," according to P&G.

Tide Pods are three-chamber liquid unit dose sachets that clean, remove stains, and brighten fabrics. Key to their success was MonoSol's creation of a clear film that separates the chambers, dissolves completely even in cold water, and yet holds up to wet hands.

P&G's James N. Gamble Product Innovation Award went to the Zobele Group of Trento, Italy. This award celebrates innovation in product formulation, packaging, or technology that has proven to be "game-changing," in P&G's words. Zobele teams collaborated with P&G to create a special scent-releasing membrane for Febreze Set & Refresh air fresheners. In addition, "Zobele helped deliver the innovation to market in months versus years," P&G said.

The Trademark Licensee Partner of the Year was Butler Home Products of Marlborough, Massachusetts, USA. Butler became the first company to introduce a nationally recognized consumer brand into the household cleaning tools category with its Mr. Clean partnership. They then expanded to include Dawn cleaning tools and, to date, sell more than 100 P&G-branded cleaning tools and accessories across North America, with an average 20% sales growth for the last several years. Butler also developed the Mr. Clean Magic Eraser mop, which became the top-selling mop in North America.

P&G says its Connect+Develop program has linked with thousands of external innovators from big businesses to individual entrepreneurs, "delivering breakthroughs in packaging, manufacturing, new business models, trademarks, and licensing as well as technology and innovations for new products." Today, more than 50% of P&G's innovations contain a key element of external partnership, the company noted.

ACI elects new leaders

Amway's Catherine Ehrenberger and Sasol's Tom O'Brien are the new leaders of the American Cleaning Institute® (ACI) Board of Directors. ACI is a trade association based in Washington, DC, USA.

At its most recent meeting, the Board elected Ehrenberger, vice president, R&D, Quality and Regulatory, Amway, as Board chair. O'Brien, group vice president and general manager, Sasol Marketing & Sales, will serve as vice chair.

The Board also elected as a new director Kelly Semrau, who is senior vice president, Global Corporate Affairs, Communication & Sustainability, SC Johnson. ■

Biotechnology News (cont. from page 92)

higher level of mechanical processing in making corn flour led to the underestimate (http://tinyurl.com/GMOcornbread).

Indian scientists in GM cotton scandal

A five-member committee headed by Sudhir Sopory, plant biologist and vice chancellor at Jawaharlal Nehru University (New Delhi), submitted a 129-page report in August indicting scientists at the Indian Council of Agricultural Research (ICAR) for unethical, unscientific, and irresponsible actions.

The report, released only on December 14, 2012, was developed as a response to the revelation in February 2012 that India's first public sector-developed genetically modified (GM) cotton, called Bikaneri Narma-Bt (BN-Bt) by its ICAR originators, did not contain an "indigenously" created gene sequence, as claimed. Instead, the gene, which they called BNLA106, came from Monsanto's Mon531. The latter is available in over 2,000 cottonseed varieties sold in the Indian market. Monsanto's patent on Mon531 expired in 1985, according to the newspaper *The Telegraph* (Nagpur, India; http://tinyurl.com/Cotton-ICAR).

The collaborators who developed the gene sequence—from the National Research Centre on Plant Biotechnology, New Delhi; University of Agricultural Sciences, Dharwad; and the Central Institute for Cotton Research, Nagpur—published their results in *Current Science* (*93*:1843–1847, 2007).

The Nagpur institute carried out biosafety and field trials of BN-Bt. Once the Genetic Engineering Approval Committee (GEAC), which functions under the Ministry of Environment and Forests of the Government of India, had reviewed the results, it approved the release of the variety for commercialization in mid-2009.

In December 2009, ICAR withdrew the seeds from distribution, and in December 2011 admitted that the gene sequence in the BN-Bt had not been developed in-house. *The Telegraph* said, "The Sopory panel confirmed that the 'contamination' . . . by Mon531 happened before the commercialization but went undetected by the GEAC."

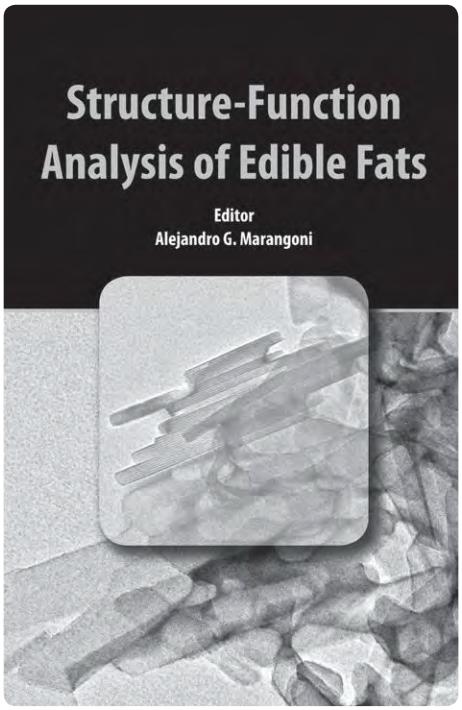
The Times of India reported that the World Bank had funded the development of BN-Bt cotton over a span of almost 12 years (http://tinyurl.com/Cotton-indicted). ■

BOOK REVIEW

Structure-Function Analysis of Edible Fats
Alejandro G. Marangoni, ed.,
AOCS Press, 2012
322 pages, $175 (nonmembers)
or $125 (members),
ISBN: 978-0-9830791-3-2

Silvana Martin

Structure-Function Analysis of Edible Fats describes methods commonly used for the characterization of lipid functional properties. The book is organized into eight chapters.



Depending upon the temperature, lipids can be semi-solid materials characterized by various functional properties, which are also a function of the processing conditions used. Those functional properties can include texture or hardness, viscoelastic behavior, melting behavior, microstructure, polymorphism, and flavor. The quantification of these properties of lipid systems is vital to evaluate the quality of lipid-based foods and to predict their physicochemical stability.

The book focuses on a description of the methods commonly used to characterize properties such as viscoelasticity, polymorphism, structural components of lipid networks, crystallization, and melting behavior. One of the highlights of the book is the detailed description of the experimental methods used by the editor's research group. Important details and helpful advice are provided on how to perform the experiments, the type of data obtained, data analysis, and interpretation.

This is particularly the case in Chapters 1, 7, and 8 where, in my opinion, an ideal balance between theory and application is achieved. Detailed explanation of the characterization of structural components of lipid crystals (Chapter 1), measurement of oil migration in fats (Chapter 7), and the use of different techniques to characterize the functional properties of fats (Chapter 8) are presented. The use of X-ray diffraction and cryo-transmission electron microscopy techniques to characterize structural components of lipid crystals is included in Chapter 1. Chapter 7 introduces theories related to oil migration in fats and provides information on techniques used to measure oil migration. Included is a discussion of a scanning imaging technique and magnetic resonance imaging. The techniques described in Chapter 8 include X-ray diffraction, proton nuclear magnetic resonance, differential scanning calorimetry, and rheology. This chapter would be an excellent resource for any food scientists seeking information regarding basic theories and specific uses of these methods.

In addition to the unique approach of providing detailed experimental set ups for characterizing the physicochemical properties of lipids, this book also provides a significant amount of information regarding the theories on crystallization kinetics of lipids (Chapter 2), X-ray diffraction techniques (Chapter 3), phase behavior of lipids (Chapter 4), viscoelastic properties (Chapter 5), and modeling of intercrystalline interactions (Chapter 6). These chapters include a good introduction to the basic concepts related to the structure of lipids and the typical techniques used to characterize these materials. Chapter 2 approaches the nucleation and crystallization of lipids through extensive mathematical equations. Isothermal and nonisothermal theories and models are discussed using specific practical examples. The theories of X-ray diffraction are explained in Chapter 3 with a specific focus on lipid materials. This chapter, in particular, is a valuable resource for food scientists since the concepts are very clearly explained and helpful, and practical examples are provided. Chapter 4 describes basic concepts related to the phase behavior of lipids from the description of single component systems to phase behavior equilibrium calculations. Techniques used to measure the viscoelastic properties of lipid soft materials are described in Chapter 5. The highlight of this chapter is the detailed description of the various methods available to measure the viscoelastic properties of lipids. Functional properties of lipids are ultimately driven by intermolecular and intercrystalline interactions. Chapter 6 describes the nature of these intercrystalline interactions and provides examples of different modeling techniques based on computer simulations.

Overall, the book will prove to be a very useful resource for food science students, technicians, researchers, and instructors in this subject area. The theoretical models discussed are well explained and the concepts are easy to understand. The applications of these techniques are clear and provide a valuable practical guide for laboratory work.

Silvana Martini is an associate editor of the* Journal of the American Oil Chemists' Society *and is a faculty member at Utah State University.

PATENTS

Tire with component containing polybenzobisoxazole short fiber and epoxidized palm oil

Mruk, R., *et al.*, Goodyear Tire & Rubber Co., US8261796, September 11, 2012

The present invention is directed to a pneumatic tire comprising at least one component, the at least one component comprising a rubber composition, the rubber composition comprising a diene-based elastomer and from 1 to 30 parts by weight, per 100 parts by weight of elastomer, of a polybenzobisoxazole (PBO) short fiber having a length ranging from 0.5 to 20 mm and a thickness ranging from 10 to 30 microns, and from 1 to 30 parts by weight, per 100 parts by weight of elastomer, of an epoxidized palm oil.

Method and compositions to reduce serum levels of triacylglycerides in human beings using a fungal lipase

Schuler, C., *et al.*, Bio-Cat, Inc., US8268305, September 18, 2012

The invention relates to methods and compositions for reducing serum levels of triacylglycerides in human subjects. In particular, the invention relates to the oral administration of an effective amount of a fungal lipase formulation, to a human subject having borderline-high or high serum levels of triacylglycerides, for a time period sufficient to reduce serum triacylglyceride levels.

Indulgent edible composition

Bellody, Jr., W.J., *et al.*, Mars, Inc., US8263168, September 11, 2012

The present invention is directed to an indulgent edible composition that provides an orally pleasurable eating experience similar to chocolate as the chocolate melts in the oral cavity comprising (i) a starch that when combined with water in a weight ratio of 5:95 starch to water, has a viscosity at 22°C of about 0.03 Pa·s to about 2 Pa·s at a shear rate of 10 sec^{-1}; (ii) a protein-containing component that will substantially hydrate in water and will not coagulate; (iii) a sweetener that when substantially hydrated is at least 90% free of crystals in said edible composition; (iv) a fat-containing component that melts at a temperature of about 45°C or less; (v) a hydrocolloid gelling agent that facilitates the formation of a gel matrix that will break down at a temperature of about 45°C or less; and (vi) an edible surfactant that is food grade and has a hydrophilic-lipophilic balance value of about 0 to about 12, wherein the edible composition has a total moisture content from about 10% to about 50% moisture by weight of the composition.

Nucleic acids useful in the manufacture of oil

Franklin, S., *et al.*, Solazyme, Inc., US8268610, September 18, 2012

Novel gene sequences from microalgae are disclosed, as well as novel gene sequences useful in the manufacture of triglyceride oils. Also disclosed are sequences and vectors that allow microalgae to be cultivated on sugarcane and sugar beets as a feedstock. In some embodiments, the vectors are useful for the purpose of performing targeted modifications to the nuclear genome of heterotrophic microalgae.

Method for extracting cocoa procyanidins

Hammerstone, J.F., and M.J. Chimel, Mars, Inc., US8268373, September 18, 2012

A cocoa extract which is rich in procyanidin monomer and oligomers is made by extracting de-fatted, unroasted, unfermented cocoa beans with organic solvents. The yield of procyanidins in an extract varies with the type of solvent used, reaction temperature, reaction pH, and whether or not the solvent is an aqueous solution. Extraction parameters can be optimized to increase procyanidin yield, and different conditions result in the preferential extraction of the higher or lower oligomers. A preferred extraction method is countercurrent extraction method.

Integrated methods for processing palm fruit bunches

Eyal, A., and C. Raz, Eyal Researach Consultants Ltd., US8268595, September 18, 2012

This invention is directed to an integrated method for the processing of palm fruit bunches to oil and other products. The method comprises *inter alia* separating palm fruit carrying bunches into fruits and lignocellulosic empty fruit bunches, processing the fruits to form palm oil, and at least one lignocellulosic processing co-product; generating an aqueous stream; producing a non-oil, non-alcohol, non-fatty acid ester third product from the oil, the lignocellulosic processing co-product, the aqueous stream or from a combination thereof; processing at least a portion of the lignocellulosic empty fruit bunches, lignocellulosic processing co-product or a combination thereof into a fourth product and optionally producing at least one fifth conversion product from the fourth product; and using at least a portion of the fourth product or a product of its conversion or a combination thereof.

CONTINUED ON NEXT PAGE

PUBLICATIONS

Monitoring of frying oil quality using combined optical interrogation methods and devices

Wei, A.-P., *et al.,* 3M Innovative Properties Co., US8257976, September 4, 2012

Herein are disclosed methods and devices for optically monitoring multiple parameters of an oil sample. In one embodiment, the methods and devices can be used for determining the quality of cooking or flying oil in terms of the free fatty acid content and total polar compound content of the oil. The methods use an optical absorptive/reflective property in evaluating the free fatty acid content, and use optical fluorescence in evaluating the total polar compound content, with both measurements using a single sampling substrate and a single measuring device.

Fast symptom glyphosate formulations

Wright, D.R., *et al.*, Monsanto Technology LLC, US8268749, September 18, 2012

Aqueous herbicidal glyphosate compositions are provided, particularly sprayable, ready-to-use (RTU) formulations that are capable of inducing early visually apparent phytotoxic effects while minimizing antagonism to the glyphosate component of the composition and preserving the equally desirable attribute of prolonged control of the treated plants. The compositions combine a glyphosate component and a fatty acid component as a fast symptomology active ingredient and, in one embodiment, are enhanced by the concentration of the fatty acid component utilized and the inclusion of an agronomically acceptable inorganic ammonium salt, preferably ammonium sulfate. In another embodiment, the compositions of the present invention include a nonionic surfactant component comprising certain water-soluble alkoxylated alcohols.

Laundry article having cleaning and conditioning properties

Meine, G., *et al.*, Henkel AG & Co., KGaA, US8268771, September 18, 2012

The present invention is a laundry article used for both cleaning and conditioning fabrics, which comprises a water-insoluble nonwoven substrate, coated with at least one zone each of a detergent composition and a fabric-conditioning composition. The fabric-conditioning composition comprises a quaternary ammonium cationic surfactant, an alkoxylated fatty alcohol, and a fatty acid.

Process for the partial hydrogenation of fatty acid esters

Papadogianakis, G., *et al.*, Cognis IP Management GmbH, US8263794, September 11, 2012

Disclosed is a process for the manufacture of unsaturated fatty acid alkyl esters or glycerides having a total content of C18:1 of about 30 to about 80 mol%, by partial hydrogenation of unsaturated fatty acid esters having a total content of (C18:2 + C18:3) of at least 65 mol%, calculated on the total amount of C18 moieties in the ester, wherein the hydrogenation is conducted in an aqueous/organic two-phase system in the presence of a water-soluble catalyst consisting of a Group VIII, Group IX, or Group X metal and a hydrophilic ligand.

Lunaria annua, Cardamine graeca and *Teesdalia nudicaulis* FAE genes and their use in producing nervonic and eicosenoic acids in seed oils

Katavic, V., *et al.*, National Research Council of Canada, US8269062, September 18, 2012

This invention relates to nucleic acid sequences coding for a *Lunaria annua*, *Cardamine graeca*, or *Teesdalia nudicaulis* fatty acid elongase [FAE], yeast cells expressing the genes/enzymes, plants themselves and cells of such plants and seeds which contain a heterologous gene coding for a *L. annua*, *C. graeca*, or *T. nudicaulis* FAE gene, the plant or seed being capable of producing increased proportion of a very long chain monounsaturated fatty acid, especially nervonic acid and eicosenoic acid, beyond that of a control plant or seed lacking the heterologous FAE gene or genes.

Method and apparatus for refining biodiesel

Pelly, M.F., US8269028, September 18, 2012

Method and apparatus for producing biodiesel fuel, i.e., alkyl ester, from vegetable and/or animal oil. A transesterification

AOCS MEETING WATCH

April 3–4, 2013. AOCS Oils and Fats World Market Update 2013, Ukrainian House, Kiev, Ukraine. http://worldmarket.aocs.org

April 28–May 1, 2013. 104th AOCS Annual Meeting & Expo, Palais des congrès de Montréal, Montréal, Québec, Canada. http://AnnualMeeting.aocs.org

July 16–17, 2013. AOCS Technical Services Workshop: Laboratory Methods, Des Moines, Iowa, USA. http://www.aocs.org/labworkshop

August 20–23, 2013. XV Latin American Congress and Exposition on Fats and Oils, Sheraton Santiago Hotel and Convention Center, Santiago, Chile. http://lacongress.aocs.org

November 6–8, 2013. Australasian Section AOCS Biennial Meeting and Workshops, NOAH's on the Beach, Newcastle, New South Wales, Australia. http://www.aocs.org/australasian

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

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

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

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catalyst is prepared in a base catalyst tank by spraying alkyl alcohol under pressure through jets at metal hydroxide pellets until the pellets have fully reacted with the alcohol. The oil is heated and transesterified in the presence of alkyl alcohol and the transesterification catalyst in a closed, recirculating transesterification flow system under slight cavitation to yield product alkyl ester and product glycerol. Cavitation is achieved by permitting air to enter the transesterification flow system through an adjustable air inlet valve. When permitted to stand, product alkyl ester forms an upper layer that is decanted and subjected to purification steps, to remove particulates and alkyl alcohol from the product alkyl ester, and a lower layer of product glycerol is drained away. Purification of the product alkyl ester preferably includes subjecting the product alkyl ester to an overhead water mist in a wash tank with simultaneous infusion of a stream of air bubbles. Alcohol vapor is reclaimed as liquid alcohol within an alcohol condenser and stored for reuse. If the oil contains free fatty acids, prior to transesterification, the oil is heated and the free fatty acids are esterified in the presence of an esterification catalyst and alkyl alcohol. For safety, baffles and explosion damper/flame arresters are provided in locations where flammable vapors pose a risk.

Method of converting a polyol to an olefin

Bergman, R.G., *et al.*, Regents of the University of California, US8273926, September 25, 2012

A method of preparing an olefin comprising: reacting a polyol in the presence of a carboxylic acid, such that an olefin is produced by the deoxygenation of the polyol. The reacting step can comprise (i) providing a composition comprising the polyol, (ii) heating the composition, and (iii) introducing the carboxylic acid to the composition wherein the introducing step occurs prior to, at the same time as, or subsequent to the heating step. In one embodiment, the polyol is glycerol, the carboxylic acid is formic acid, and the olefin is allyl alcohol, which is produced at a yield of about 80% or greater.

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

EXTRACTS & DISTILLATES

Free sterols and steryl glycosides in sunflower seeds with high phytosterol contents

Aguirre, M.R., *et al., Eur. J. Lipid Sci. Technol. 114*:1212–1216, 2012.

In this paper, the distribution of sterol compounds has been analyzed in 10 samples of new sunflower seeds with high contents of phytosterols. The sunflower seeds were first extracted with hexane and the residual oil was then extracted with a mixture of chloroform/methanol (2:1). In addition, the lipids from the defatted seeds and from the total seeds were analyzed after acid hydrolysis and subsequent extraction. The evaluation of the sterol compounds was performed by high temperature gas chromatography directly in the silanized unsaponifiable matter using α-cholestanol as internal standard. This procedure allows for the quantification of free sterols and steryl glycosides in the oils extracted by hexane and chloroform/methanol (2:1) while in defatted meal and total seeds, they are determined as free sterols. The main characteristics of the fractions extracted by hexane were a variable oil content (19.8–38.7%) with medium unsaponifiable matter (1.4–4.8%). The major sterol compounds in the oil extracted by hexane were free sterols (4,034–8,507 mg/kg) while steryl glycosides were in low concentrations (80–280 mg/kg). On the contrary, the fraction extracted by chloroform/methanol had low lipid content (2.2–6.7%) with a high unsaponifiable matter (12.6–28.2%). The major sterol compounds in this fraction were steryl glycosides (9,711–22,514 mg/kg). Finally, a third of the total sterols remained in the meal after the extraction of edible oil by hexane.

Carrot β-carotene degradation and isomerization kinetics during thermal processing in the presence of oil

Knockaert, G., *et al., J. Agric. Food Chem. 60*:10312–10319, 2012.

The effect of thermal processing (85–130°C) on the stability and isomerization of β-carotene in both an olive oil/carrot emulsion and an olive oil phase enriched with carrot β-carotene was studied. During processing, degradation of total β-carotene took place. Initially, total β-carotene concentration decreased quickly, after which a plateau value was reached, which was dependent on the applied temperature. In the oil/carrot emulsion, the total β-carotene concentration could be modeled by a fractional conversion model. The

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- Oil production from de-shelled *Aquilaria crassna* seeds using supercritical carbon dioxide extraction, Chen, C.-R., Y.-J. Cheng., C.-J. Shieh, D. Hsiang, and C.-M.J. Chang
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- Fatty acid composition and some physicochemical properties of oils from *Allanblackia gabonensis* and *A. stanerana* kernels, Pengou, M., G.B. Noumi, and E. Ngameni
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- Liquid–liquid equilibria in biodiesel production, Rostami, M., S. Raeissi, M. Mahmoodi, and M. Nowroozi
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- A novel tetrahydrofuranyl fatty acid from a new microbial isolate, *Pestalotia* sp. YIM 69032 cultivated in extract of potato, Yang, X., Y. Yang, L. Zhao, H. Zhou, L. Xu, and Z. Ding

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- Novel amide-based cationic surfactants as efficient corrosion inhibitors for carbon steel in HCl and H2SO4 media, Yldlrlm, A., S. O¨ ztu¨rk, and M. C¸etin
- Thermodynamic parameters of aionic surfactant-quaternary phosphonium bromides systems at the cloud point, Khan Z.A., H.M. Albishri, A. Ghazali, and T. Ahmad
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- Substituted thiadiazole, oxadiazole, triazole, and triazinone as antimicrobial and surface activity compounds, El-Sayed, R.
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- Cytotoxic petrosiacetylenes from the marine sponge *Petrosia* sp., Lee, Y.-J., S.-J. Yoo, J.S. Kang, J. Yun, H.J. Shin, J.S. Lee, and H.-S. Lee

temperature dependence of the degradation rate constants was described by the activation energy and was estimated to be 45.0 kJ/mol. In the enriched oil phase, less degradation took place and the results could not be modeled. Besides degradation, β-carotene isomerization was studied. In both matrices, a fractional conversion model could be used to model total isomerization and formation of 13-*Z*- and 15-*Z*-β-carotene. β-Carotene isomerization was similar in both the oil/carrot emulsion and enriched oil phase as the simultaneously estimated kinetic parameters (isomerization reaction rate constant and activation energy) of both matrices did not differ significantly. The activation energies of isomerization were estimated to be 70.5 and 75.0 kJ/mol in the oil/carrot emulsion and enriched oil phase, respectively.

Analysis of bioactive oxysterols in newborn mouse brain by LC/MS

Meljon, A., *et al., J. Lipid Res. 53*:2469–2483, 2012.

Unesterified cholesterol is a major component of plasma membranes. In the brain of the adult, it is mostly found in myelin sheaths, where it plays a major architectural role. In the newborn mouse, little myelination of neurons has occurred, and much of this sterol comprises a metabolically active pool. In the current study, we have accessed this metabolically active pool and, using liquid chromatography/mass spectrometry (LC/MS), have identified cholesterol precursors and metabolites. Although desmosterol and 24*S*-hydroxycholesterol represent the major precursor and metabolite, respectively, other steroids, including the oxysterols 22-oxocholesterol, 22*R*-hydroxycholesterol, 20*R*,22*R*-dihydroxycholesterol, and the C_{21}-neurosteroid progesterone, were identified. 24*S*,25-Epoxycholesterol formed in parallel to cholesterol was also found to be a major sterol in newborn brain. Like 24*S*- and 22*R*-hydroxycholesterols, and also desmosterol, 24*S*,25-epoxycholesterol is a ligand to the liver X receptors, which are expressed in brain. The desmosterol metabolites (24*Z*),26-, (24*E*),26-, and 7*α*-hydroxydesmosterol were identified in brain for the first time

Experimental improvement of cow milk fatty acid composition in organic winter diets

Baars, T., *et al., J. Sci. Food Agric. 92*:2883–2890, 2012.

Organic milk is seen as more healthy in terms of its fatty acid (FA) profile. In three on-farm crossover trials with 10–12 cows in each group, different forages were compared for their potential to improve the FA composition. Different hay qualities (hay of pasture vs. hay of leys), additional energy sources (fodder beets vs. wheat) and roughage qualities (hay of pasture vs. grass silage) were compared for their effect on the FA composition of the milk. Rumenic acid (CLA *cis*-9, *trans*-11) and α-linolenic acid (ALA) were selected as principal markers to evaluate effects. The overall CLA *cis*-9, *trans*-11 was low (3.6–6.3 g kg^{-1} fat), whereas ALA levels were intermediate (6.8–9.4 g kg^{-1} fat). Differences between the forages were explained by the fat metabolism of the ruminants. Organic winter milk is low in several desirable FA. Diets rich in mature fodder and sugar were a poor choice for an improved FA composition.

Dietary fatty acid intervention of lactating cows simultaneously affects lipid profiles of meat and milk

Angulo, J., *et al., J. Sci. Food Agric. 92*:2968–2974, 2012.

The present study investigated tissue-specific responses of muscle and mammary gland to a 10 week intervention of German Holstein cows (n = 18) with three different dietary fat supplements (saturated fat; linseed oil or sunflower oil plus docosahexaenoic acid-rich algae) by analyzing fatty acid profiles and quality parameters of meat and milk. Plant oil/algae intervention affected neither fat content nor quality parameters of meat but decreased fat content and saturated fatty acid amounts of milk. Linseed oil/algae intervention caused significantly higher concentrations of C18:3n-3 (meat, 1.0 g per 100 g; milk, 1.2 g per 100 g) and C22:6n-3 (meat, 0.3 g per 100 g; milk, 0.14 g per 100 g). Sunflower oil/algae intervention increased n-6 fatty acid contents in milk (4.0 g per 100 g) but not in meat. Elevated amounts of C18:1*trans* isomers and C18:1*trans*-11 were found in meat and especially in milk of plant oil/algae-fed cows. C18:1*cis*-9 amounts were found to be increased in milk but decreased in meat after plant oil/algae intervention. The present study demonstrated that dietary fatty acid manipulation substantially shifted the fatty acid profiles of milk and to a lesser extent of meat, whereas meat quality traits were not affected. Indications of tissue-specific responses of mammary gland and muscle were identified.

Determination of estrogens in pork and chicken samples by stir bar sorptive extraction combined with high-performance liquid chromatography–ultraviolet detection

Hu, C., *et al., J. Agric. Food Chem. 60*:10494–10500, 2012.

A poly(dimethylsiloxane) (PDMS)/β-cyclodextrin (β-CD)/divinylbenzene (DVB)-coated stir bar was prepared by the sol–gel technique for the stir bar sorptive extraction (SBSE) of four estrogens from animal-derived foods, followed by liquid desorption (LD) and high-performance liquid chromatography–ultraviolet (HPLC–UV) detection. The influence of the coating composition on SBSE of target estrogens was investigated by an orthogonal experiment design, and the prepared PDMS/β-CD/DVB-coated stir bars show good reproducibility. Under the optimal experimental conditions, the limits of detection (S/N = 3) of the developed PDMS/β-CD/DVB SBSE–LD–HPLC–UV method were 0.21–1.6 μg/L for the target estrogens with enrichment factors of

19- to 51-fold, the dynamic linear range was 2–2,000 μg/L, and the relative standard deviations of the method ranged from 6.0% to 9.7% (n = 8, c = 100 μg/L) and from 8.4% to 11.7% (n = 8, c = 10 μg/L). The developed method was simple, sensitive, and selective and was successfully applied to the analysis of estrogens in pork and chicken samples.

Triacylglycerol profile as a chemical fingerprint of mushroom species: evaluation by principal component and linear discriminant analyses

Barreira, J.C.M., *et al., J. Agric. Food Chem. 60*:10592–10599, 2012.

Mushrooms are becoming relevant foods due to their nutritional, gastronomic, and pharmacological properties, namely, antioxidant, antitumor, and antimicrobial properties. However, although several mushroom species have been chemically characterized, the evaluation of the triacylglycerol (TAG) profile remains nearly unknown. Because TAG was formerly used to assess the authentication of highly valued commercial oils, and the distribution of fatty acids on the glycerol molecule is genetically controlled, the potential of the TAG profile to act as a taxonomical marker was evaluated in 30 wild mushroom species. Principal component analysis and linear discriminant analysis were used to verify the taxonomical rank (order, family, genus, or species) more related with the detected TAG profile. The results pointed out that the ability of the TAG profile to discriminate mushroom samples increased for the lower taxonomical ranks, reaching a maximal performance for species discrimination. Because there is a high resemblance among mushroom species belonging to the same genus and considering that conservation techniques applied to mushrooms often change their physical properties, this might be considered as a valuable outcome with important practical applications.

Effect of high hydrostatic pressure on the production of conjugated fatty acids and *trans* fatty acids by *Bifidobacterium breve* LMC520

Park, H.G., *et al., J. Agric. Food Chem. 60*:10600–10605, 2012.

This study was performed to investigate the effect of high hydrostatic pressure (HHP) on the conversion of linoleic acid, conjugated linoleic acid (CLA), and α-linolenic acid (α-LNA) as substrates by *Bifidobacterium breve* LMC520 and to optimize the HHP condition. Cell mixtures were tested under HHP in a variety of conditions such as temperature, time, pressure, and pre- or post-treatment with substrates. The *cis*-9,*trans*-11 CLA producing activity of *B. breve* LMC520 was increased by HHP, whereas *trans*-9,*trans*-11 CLA producing activity was decreased. Optimal HHP conditions for the highest CLA production were obtained at 100 MPa for 12 h at 37°C. Post-treatment groups showed higher conversion activity of substrates than pretreatment groups. Post-treatment groups decreased *trans*-9,*trans*-11 CLA and other CLnA [conjugated linolenic acid], whereas the pretreatment groups increased them. It is concluded that HHP treatment could be an important factor to enhance CLA and CLnA production and for reducing *trans*-fatty acids. ■

[FAST FACTS]

WANT A SIDE OF ACRYLAMIDE?

Potato crisps, instant coffee, French fried potatoes, and baked goods, such as biscuits and crackers, top the list of products in Europe that are most likely to contain worryingly high levels of the suspected carcinogen acrylamide. The following data from 2007-2010 shows the proportion of various products that exceeded the indicative acrylamide values recommended by the European Commission in 2011. (**Update on acrylamide levels in food from monitoring years 2007 to 2010, European Food Safety Authority,** *EFSA Journal 10*: 2938, 2012.)

Food category[a]	Number code[a]	Indicative value[a]	Proportion of MB acrylamide levels exceeding the recommended indicative values			
		(μg/kg)	n	2007-2010 (%)	n	2010 (%)
French fried, sold as ready-to-eat	1	600	1968	12	256	15
Potato crisps Soft	2	1000	1481	17	242	18
bread Breakfast	4	150	790	7	150	3
cereals	5	400	675	6	174	3
Biscuits, crackers, crisp bread and similar[b]	6	500	3262	8	462	12
Roast coffee (dry)	7.1	450	745	8	103	11
Instant (soluble) coffee	7.2	900	160	10	15	20
Baby foods (excl. cereal based)	8	80	425	7	55	15
Biscuits and rusks for infants and young children	9.1	250	301	9	46	7
Other processed cereal based foods	9.2	100	271	11	82	6

[a]Food categories, number codes and indicative acrylamide values as defined in Commission Recommendation of 10.1.2011 C(2010) 9681 final (EC, 2011)
[b]excluding ginger bread

Singapore 2012:
Why business as usual won't work anymore

- **The world is changing, and not all for the better.**
- **During October 29–31, 2012, approximately 600 business professionals from 36 countries representing 197 companies assembled for Singapore 2012: AOCS' World Conference on Fabric and Home Care, where industry leaders grappled with the complexities that define the new normal.**
- **The program was led by keynote presentations from leading industry CEOs including Paul Polman, Unilever; Bob McDonald, The Procter & Gamble Co.; and Motaki Ozaki, Chairman of the Board of Kao Corporation Their consensus: Innovation is the answer.**

Tom Branna

Laundry detergents get clothes clean, eliminate stains, and keep fabric looking like new. That's all good stuff, but how about tackling really stubborn issues such as the environment, water shortages, and poverty? Unilever chief executive officer Paul Polman insisted that the global detergent industry has an important role to play in some of the biggest problems that are impacting the world.

"It's the end of abundance," warned Polman, noting that the amount of sea ice is dwindling and climate change may have reached the point where it is irreversible. "We face major challenges."

And while Polman leads one of the biggest companies on earth, he acknowledges that free market capitalism has its limits.

"Two-and-a-half billion people have no access to [clean] drinking water, and 1.2 billion live in poverty," he noted. "I've seen the power of capitalism, but it has its shortcomings. We need something more functional. The status quo is not an option. We have to change the way we do business."

Polman issued these warnings at the World Conference on Fabric and Home Care held in Singapore in October 2012. The event attracted more than 600 industry executives from around the world who came to hear from some of the leading voices in the global household and personal products business.

"The diversity of the audience is amazing," said Keith Grime, conference chairman. "There is no other forum where you can hear from the CEOs of Unilever, Kao, and Procter & Gamble."

True, but what the Unilever CEO had to say, was difficult to accept, let alone implement. Polman called for changes at a time when the world is changing dramatically. He noted that since the Fabric & Home Care Conference in Montreux in 2010, China has become the No. 2 economy in the world. Observers say China is poised to overtake the United States as No. 1 as early as 2015, while others say it will happen by 2030. Elsewhere, the Arab Spring bloomed in the Middle East when Egyptians overturned their government in just 17 days and the Occupy Wall Street Movement took hold in cities around the United States and the world.

All of these events, and many others, were recorded on Twitter, Facebook and other social media platforms, which are proving to be powerful new forms of communication and change agents in their own right. Polman went on to say that the home and fabric care industry can be an agent of change as well, and it must be as the new world order evolves.

AGENTS OF CHANGE?

Polman insisted that brands, companies, the industry, and individuals must be part of the solution. He pointed out that 3,000 children die each day owing to infectious diseases, many of which could be eradicated with proper hand washing. But rather than wait for guidance from health officials, Unilever's Life Buoy brand instituted a hand wash campaign that educates people about the importance of proper washing, with the goal of reaching one billion consumers.

Besides using brands as change agents, companies must undergo dramatic change as well. When he became CEO in 2009, Polman said that his first order of business was to stop issuing financial guidance, which he said fosters short-term thinking.

"You have to look long-term to grow sustainably," he said. "[But] cutting carbon output and reducing packaging is not enough."

That's why Unilever has set the seemingly outrageous goal of doubling turnover as it reduces the amount of resources it uses.

"We are audacious, but no one else is following our lead," he observed

.And that's where industry comes into the equation. Polman acknowledged that anytime companies discuss working together, everyone (including regulators) gets nervous. But with the average tenure of CEOs lasting just three years, solution to so many vexing problems will take the efforts of hundreds of companies and thousands of employees, he predicted.

According to Polman, 20% of climate change is due to illegal deforestation. He urged the industry to join Unilever in purchasing raw materials such as sustainable palm oil and called for the industry to be sustainably sourced by 2020—for its own good.

"Do we want to be policy makers or policy takers?" he asked.

All of these initiatives, of course, require leadership. Unilever executives are in touch with policy makers, environmentalists and others on a daily basis. In fact, the company is working with the United Nations for sustainable, equitable growth on a global level. In closing, Polman urged the audience to move quickly to build a better outcome for the next generation.

"We can't tell our children that we made things worse," he said. "We have to stop stealing from future generations. What we hand over to them has to be better."

INNOVATION IS THE ANSWER

Polman's sobering message was countered by a bit of optimism from Procter & Gamble CEO Bob McDonald, who told the audience that they must embrace the challenges ahead and view them as opportunities. He noted that if the Chinese, Indian, and other emerging market consumers were

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Already looking forward to Montreux

The AOCS-hosted Singapore 2012: World Conference on Fabric and Home Care, held October 29-31, 2012, continued the tradition of the Montreux World Conference, a premier industry event held every four years in Montreux, Switzerland.

AOCS has decided to host a global conference on fabric and home care every two years, with the location alternating between Montreux and Singapore. "We recognize that technology is moving too fast to have a meeting every four years," explained Keith Grime, chairman of the conference. "It is crucial that we pull the fabric and home care industry leaders together more frequently to ensure that we are staying ahead of the latest issues and trends and to watch the evolution of this and other important industry topics in real time."

Plans are already in place for the conference in Montreux, October 6–9, 2014. Topics under discussion include feedstocks, water and energy, consumer understanding and convenience, and value creation in cleaning categories.

For more information on the conference series, visit montreux.aocs.org, or contact Mindy Cain, meetings specialist, by phone (+1 217-693-4827) or email (mindyc@aocs.org).

Clariant expands presence in Asia

In recent years, Clariant (Muttenz, Switzerland) has stepped up its visibility in the Asia-Pacific region, with new facilities, new ventures, and new products that meet the needs of consumers in the fastest-growing part of the world.

Singapore is the headquarters of the company's Asia-Pacific operations, and from there Clariant serves customers in nine countries, including Singapore, Malaysia, Indonesia, Thailand, Australia, New Zealand, Vietnam, Bangladesh, and the Philippines. The company also has operations in other key Asian markets including China and India.

In November 2011, Clariant inaugurated an ethyoxylation plant in Daya Bay at Huizhou, Guangdong Province, China. The plant was Clariant's first ethoxylation plant in Asia, as well as the largest Asian site under its global Industrial and Consumer Specialties (ICS) Business Unit. According to Clariant, the plant will enhance regional offering for a wide range of industries including crop protection, construction, personal care, and industrial and home care. Applications from these industries will help satisfy the rapidly growing demand in China and other Asian markets.

Overall, Clariant operates two plants in China, and one each in Japan, India, and Indonesia. Most recently, Clariant signed a 50:50 joint venture (JV) with Wilmar International for the production of amines and amine derivatives. The JV is expected to be operational in the second quarter of 2013.

"We are expanding aggressively in Asia," explained Michael Willome, head of business unit for ICS. "Asia-Pacific is now our biggest growth market. We look forward to doing more JVs in the future."

At the same time, Clariant is expanding its consumer knowledge in the region

"Sustainability has become very important to consumers in China and India," explained Gregor Keil, head of sales and applied consumer care, Asia-Pacific. "To meet their needs we are supplying products derived from sustainable palm."

Clariant is a member of the Roundtable on Sustainable Palm Oil, an international multi-stakeholder organization and certification program for sustainable palm oil. To meet this growing demand for sustainability, Clariant is rolling out a new, mild, sustainably produced surfactant. The surfactant, which is billed as a replacement for sodium lauryl ether sulfate, will debut in the first quarter of 2013; and company executives say they are committed to expanding Clariant's range of sustainable solutions in the future.

"Innovation is a pillar of Clariant," concluded Willome. "And it starts with social responsibility."

to increase their household product expenditures to the level of Brazilians ($43/household/year), global category sales would soar to $162 billion. How can the industry reach this lofty level? Through empathy-driven innovation that's inspired by core human needs, according to McDonald.

"Understanding the consumer and understanding her tension creates deep empathy that leads to insights to big ideas that can grow an industry," he told the audience. "You have to know the consumer's culture and his language."

For example, Procter & Gamble (P&G) researchers lived with Filipinos to discover that it normally takes three buckets of water to rinse laundry detergent residue completely from clothes. That insight led to the creation of Downy Single Rinse, which has saved 35 billion liters of water.

Another consumer insight, this one in the United States, found that only 68% of consumers were satisfied with the laundry process. That revelation led P&G researchers to develop Tide Pods that, along with similar polyvinyl alcohol (PVA)-based delivery systems, have gone on to capture more than 6% of the US laundry category, according to experts.

Innovation comes from multiple sources, as McDonald noted that researchers can take the knowledge gained from bleach laundry systems and apply it to hair color or teeth whitening.

"Innovation is everybody's job," he explained. "P&G is in 38 product categories. We want every P&Ger in the innovation game."

With everyone "all-in" when it comes to innovation, P&G is able to pursue the next "Big Idea."

"We need to avoid narrow incrementation," insisted McDonald. "We need innovation that is discontinuous."

That kind of thinking, he explained, led to the creation of Febreeze, which, in turn, created a billion-dollar fabric refresher category.

But it's not enough to have a great idea—you've got to sell it to the consumer. And that's where effective communication comes in. As McDonald explained, innovation is the conversion of an idea to the consumer. P&G's legendary marketing might convinced Japanese consumers that while detergent was for clothing, Febreze was for everything else, and fragrance-conscious Japanese flocked to the brand to freshen sneakers and other items that they wouldn't put in a washing machine.

Finally, innovation drives sustainability initiatives. Tide Pods, for example, represent an eightfold compaction rate, and Tide Cold Water helps save energy. In fact, P&G is determined to get 70% of consumers washing in cold water by 2020—up from 40% today.

"Innovation improves lives and it can lift the industry," McDonald concluded.

INNOVATION AND THE ENVIRONMENT

Kao chairman Motoki Ozaki blended the concepts of the previous two keynotes with his presentation on Eco-Innovation. He explained that two megatrends, the environment and an aging population, will have tremendous impact on society and the industry for decades to come.

Three key problems—global warming, water shortages and waste issues—are shaping the environment megatrend according to Ozaki, and he detailed his company's 2020 target goals to tackle all three. He said life cycle analysis is critical to good product development and explained how "Genba-ism," or keeping close to the consumer, led Kao to create Attack Easy, which helps consumers wash clothing more easily.

EMERGING STRENGTH

Nearly every speaker at the conference noted that emerging markets will play a key role in future growth, yet they also noted that these markets are highly complex and require successful companies to rethink their traditional strategies—especially when it comes to retail. Damien Veilleroy, regional operating officer at retailer Metro AG (Düsseldorf, Germany), noted that low-end products hold dominant positions in Asian emerging markets. To increase the value proposition to consumers, marketers must understand the complex distribution system. For example, in Vietnam, with its population of 90 million, 87% of retail is still conducted by *tap hoa*, traditional mom-and-pop stores that range in size from 20 to 200 square meters and have an average turnover of €80 a day.

There are more than 190,000 of these establishments throughout Vietnam, and their sales continue to grow even as multinationals eye the Vietnamese market. Detergent is the No. 7 category in these outlets, trailing items such as beverages, milk, and cigarettes. Many shop owners purchase products not on a monthly or even weekly basis, but rather on a daily schedule. How, then, can marketers reach these companies? Certainly not through traditional methods, as Veilleroy figures that if the typical sales rep could handle 50 stores, it would take 4,000 reps in Vietnam alone! Therefore, Metro AG has built a system to train store owners, help them manage their inventory, and provide display assistance.

"FMCG [fast-moving consumer goods] companies, as well as retailers, need to address the complexities of emerging markets and intelligently manage the channel portfolio," he concluded.

If Vietnam, with its 90 million consumers, is difficult to navigate, what does that say about India with its 1 billion consumers? Saikiran Krishnamurthy, a partner with McKinsey & Company, Inc. of India, acknowledged that it is difficult to get a manufacturing facility up and running, let alone get consumers to purchase products. "Most multinationals don't get it right," he observed. "Eighty percent of companies don't properly address the growth opportunities in India."

To be among the 20% of companies that do get it right, Krishnamurthy explained that there are eight factors that must be met in order to win in India. They are:

- Establish high aspirations for growth and empower the top management team;
- Shape market demand by improving sales skills, customer insights, and key account management functions;
- Develop a unique business model for India;
- Develop local products at the right price and prevent commoditization by innovative service models;
- Use M&A [mergers and acquisitions] and partnerships to grow;
- Leverage India's strength in manufacturing and research globally;
- Work actively with end-use industries and regulators to shape relevant standards; and
- Build a strong value proposition to attract talent; focus on getting the organization right.

According to Krishnamurthy, companies that have successfully implemented all eight factors include Asian Paints and United Phosphorous. He noted that, in order to win in India, companies must understand the consumer and the culture and that means visiting India on a regular basis to understand the market's unique attributes.

SUSTAINABLE SOLUTIONS

Regardless of the region, sustainability plays an important role in all product development, and ingredients are a key element of any sustainable product development program. For example, Per Falhout, executive vice president and chief science officer, Novozymes (Bagsværd, Denmark), noted that incorporating enzymes into a formula enables detergents to clean clothes as effectively at 20°C as they do at 30°C. In a typical Chinese detergent formula, the addition of enzymes reduces CO_2 emissions by 30%, according to Falhout.

3,000 children die each day due to infectious diseases, many of which could be eradicated with proper hand washing.

"Biotechnology has a large role to play in sustainable laundry applications," he maintained. "We are paving the way for a bio-based society."

Like enzymes, PVA films have had an enormous impact on laundry detergent formulas. P. Scott Bening, president of Monosol LLC (Merrillville, Indiana, USA), said PVA could have the same impact on several CPG [consumer packaged goods] categories, as the product form enables formulators to

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"We can't tell our children that we made things worse. We have to stop stealing from future generations."

keep disparate ingredients from interacting with one another until they dissolve. That means creating products without stabilizers, which leaves more room for active ingredients and ultimately more compaction. Monosol is putting perfume boosters in PVA film to help put expensive fragrance on clothing and keep it from going down the drain.

As Bening noted, when the chemistry is right, the film becomes an active part of the formulation and that improves product performance.

Thomas Müller-Kirschbaum, senior VP, Henkel AG, concurred, noting that the delivery form drives innovation and sustainability. He predicted that integrated product design, which combines technical and emotional innovations, will ultimate replace classic product development.

For example, Henkel relied on integrated product design to launch Bref Power Active with chlorine power balls within the toilet bowl cleaner segment. The product's novel, four-ball design clearly conveyed how it delivers four functions—cleaning foam, long-term protection, fresh scent, and hygiene—with every flush, according to the speaker. Similarly, the company introduced a boat-shaped toilet bowl cleaner that plays off the consumer's desire for fun-to-use products.

"Traditionally, consumers do not want to see their in-bowl toilet bowl cleaners," Müller-Kirschbaum reminded the audience. "But if they do see them, they have to be fun. Emotional innovation drives purchasing."

SUPPLY-SIDE VIEWS

When it comes to feedstock choices, is green the new black? That was the question asked by Frank Pacholec, vice president R&D and corporate sustainability officer, Stepan Company USA (Skokie, Illinois). He predicted that green feedstocks such as biomass would grow from 3% of the market in 2010 to 17% by 2025. But if formulators are hoping these green raw materials will lead to price stability—think again. Raw material price volatility will continue as long as the food vs. fuel debate rages, according to the speaker.

"As the technology evolves, you move away from that debate," explained Pacholec, who predicted algae will play an important role in the future. "Algae is exciting because it has a high volume of oil, but it is process intensive."

To overcome processing obstacles, Stepan teamed with Elevance to effectively use metathesis catalysis to unlock the potential of raw materials such as rapeseed, soy, palm, and algae to create low-cost, superior-performance surfactants.

"These emerging technologies come with risk, along with superior opportunities and potential," Pacholec reminded the audience. "You have to be in the game; don't wait for perfection. You can make your companies more sustainable while you help create a more sustainable world."

"CEOs want sustainable solutions by 2020. We're giving it to them today," insisted Andy Corr, platform leader, consumer intermediates and ingredients, Elevance Renewable Sciences (Bolingbrook, Illinois, USA). Using olefin metathesis, the company has developed an elegant conversion process that relies on flexible feedstocks to create detergent raw materials with improved cold water performance and compaction. In hard surface cleaners, these raw materials provide better stability and cleaning properties, with low VOC [volatile organic carbon] emission and odor.

The company has production facilities in Indonesia and the United States, with plans to add another plant in either Southeast Asia or South America, according to Corr.

LS9 Inc. (South San Francisco, California, USA) has created fatty alcohols, derived from a wide range of renewable feedstocks such as bagasse, corn stover, and wood chips, that are obtained through biotechnology. LS9 obtains this biomass and ferments it with the bacterium *E. coli* to produce a range of alcohols, acids, and esters. According to Gary Juncosa, executive vice president-chemicals, the LS9 technology can replace refineries with bacteria, while the supplier will rely on software to decide what feedstock is developed from *E. coli*.

"It represents a real opportunity for change in the supply chain," observed Juncosa. In September, the company started up a pilot plant in Okeechobee, Florida, USA, and production will expand this year. Juncosa expects to start making products in 2014, and he predicted that the interest of detergent makers in LS9 will grow as they learn how the low-cost process reduces greenhouse gas emissions, pollutant levels, and water consumption.

"Our industry faces big challenges," noted Gabriel Tanbourgi, president, care chemicals, BASF. "But they are huge opportunities for us and for you."

BASF is tackling these challenges with an R&D budget that exceeded $2.2 billion in 2011. Company researchers worked on more than 2,000 projects, and BASF was ranked No. 1 in the Patent Asset Index. Tanbourgi predicted that Asia will lead in R&D spending by 2020. BASF, he noted, already has eight R&D sites in the region with an innovation center set to open soon in Singapore. More investments are in the works as BASF expands production at its Geismar, Louisiana, plant in the United States and builds a surfactant facility in India. These global capabilities enabled BASF to develop solutions such as Lutropur MSA, a high-purity, biodegradable methanesulfonic acid for the I&I [industrial and institutional] market; Trilon M, a biodegradable chelating agent for detergent and cleaning formulas; and Glucopon, a range of nonionic surfactants derived from vegetable oils and starch.

"We work in the B-to-B environment, but we think B-to-C," insisted Tanbourgi. "We have deep market knowledge and regional supply of innovative materials."

INNOVATION FOR THE NEXT GENERATION

As the conference entered its final session, speakers focused their remarks on the future. For example, Hiromitsu Takaoka, Lion's director of fabric care, predicted that odor reduction will be the primary goal of laundry detergents in the future. He noted that clothes just don't get all that dirty anymore as consumers throughout the world spend more time indoors.

"Odor is the target soil in the next generation," he insisted.

He described the seven types of odor, which include moldy and musty, sour, and sweaty, and explained how Lion researchers used gas chromatography to identify the medium-chain fatty acids and aldehydes that cause these odor. Using palm oil, Lion chemists developed a methyl ester sulfonate that eliminates these odors better than alcohol ethoxysulfates or linear alkylbenzene sulfonate. Lion also developed a methyl ester ethoxylate that removes these odors better than alcohol ethoxylates, according to Takaoka, noting that other key laundry ingredients in odor removal are enzymes and chelants.

The automatic dish detergent category is a tremendous growth opportunity, according to Jürgen Kielholz, vice president-R&D, Reckitt Benckiser. After all, household penetration of laundry machines is nearly 56%, compared to just 16% for dishwashing machines. Moreover, while Asia accounts for 60% of the world's population, it represents just 10% of the world's dishwashing machine market. Despite this relatively low penetration rate, autodish detergent sales have accounted for 46% of household cleaning product growth in recent years, according to Kielholz. In contrast, laundry detergent sales have accounted for just 3% of category growth.

At the same time, the sector has a good sustainability record as US products have been phosphate free since 2010 and European formulas will be phosphate free by 2017.

As suppliers and marketers work together to solve the next generation of cleaning products, they must not forget appliances, the third part of the equation, according Dave Szczupak, executive vice president, Whirlpool.

Since high-efficiency laundry machines debuted in the United States in 2010, 10 trillion liters of water have been saved in North America alone. Now, appliance makers and their partners are bracing for new regulations in China that, if they go into effect, will reduce energy and water use levels. Still, the speaker remained optimistic.

"With innovation, you can deliver clean and green and at a reasonable price point," explained Szczupak.

The final conference presenter, David Jago, Mintel's director of insight and innovation, emphasized the important role that Asia plays in the industry's success—now and in the future. For example, from 2005 to 2015, Asia is expected to post a 35% increase in household cleaner sales, compared to a 5% decline in North America. Within laundry care, sales in Asia will grow 125%, compared to no growth in North America; and while dish detergent sales are expected to grow 35% in North America, they will double in Asia during the 10-year period.

"It's all due to the growing middle class," explained Jago. "Forty-two percent of the middle class in China have purchased a major appliance in the past three months, and 43% say they will make a similar purchase in the next three months."

To reach these consumers, marketers must go mobile, as Jago predicted that by 2015 there will be 7.1 billion mobile devices in the world. By that time, 788 million consumers will only access the Internet via their mobile devices, compared to just 14 million in 2010. These consumers expect to access anything, anywhere, and they will rely on apps to tell them what to buy and when to clean.

"Forty-seven percent of US consumers say that their mobile phone is an essential part of their lives," he explained. "Forty percent of people in the US put off cleaning their house for as long as possible. BrightNest is an online organizational tool that tells them when to clean."

Other technologies that are impacting the way people clean include smart fabrics, apps to indicate the presence of bacteria, and washing machines that wash, dry, iron, and dry clean all in one. Through it all, of course, will run the sustainability thread.

In his closing remarks, Grime reminded the audience that the World Detergent Conference will take place every two years, rather than four, with the next event set for Montreux, Switzerland, in 2014.

"It keeps things dynamic," explained Grime. "It gives us continuity of theme. Sustainability was PR five years ago. Now it's real chemistry, with real technology and real raw material choices."

Grime continued, "The barrier (to sustainability) is less in the technology and more in the business model."

Tom Branna is editorial director of HAPPI *magazine. Reprinted from the January 2013 issue of* HAPPI. *For more information, visit www.happi.com.*

"The status quo is not an option. We have to change the way we do business."

How to save water in oilseed processing

Michael J. Boyer

- **Water savings can be achieved through controlling in-plant water use, choosing processes and equipment that are designed to minimize water use, and treating wastewater effluent for reuse.**
- **Such programs and activities are driven by increased regulatory pressure on effluent quality, economic savings from water use and wastewater discharge, and corporate sustainability considerations.**
- **To be successful, water use reduction programs must have support from senior management and "ownership" by onsite operations personnel.**

The following article explores water as a resource in oilseeds processing, oil refining and processing, and related food products. The concepts and ideas can, in some cases, be extended to other interests in related industries.

WATER MANAGEMENT YESTERDAY AND TODAY—WHAT IS DRIVING CHANGE?

A recent analysis of current water use in North America compared to the early 1970s finds an agribusiness industry that has reduced water consumption by approximately one-half over the past 40 years. This substantial decrease in water use was due to a variety of factors, including industry retooling and consolidation and plant size scaleup, so some of the reduction occurred as an unintended consequence of overall industry change. Much of it, however, reflects efforts focused directly on water and energy conservation.

Virtually every company in this industry today is very focused on water use and consumption reduction. Worldwide concerns for population growth, demands on resources, climate change, and related considerations have ushered in a new age of genuine corporate, individual, and stakeholder concern for the environment. This has manifested itself in the form of sustainability programs and practices, as well as transparent corporate and social responsibility (CSR) annual reports. Such initiatives reflect the culture and commitment focus of the company as it relates to these matters.

As these sustainability programs mature, it becomes apparent to stakeholders that what is good for the environment is also often good for the bottom business line. Using less water results in reduced incoming water purchase costs and corresponding reduced sewer usage fees. In other instances, the need to comply with more stringent regulatory control of water use and wastewater discharge requirements provides a major incentive.

Regulatory pressure is not necessarily as much from new regulations as it is from enforcement of more stringent discharge standards. This applies to the industry discharge itself as well as to the discharge from a receiving municipal sewer system that may result in more stringent pretreatment limits to the industrial source. For example, if it becomes necessary to treat an industrial discharge to lower levels of BOD (biological oxygen demand) and total suspended solids (TSS), each of which has a limit of 5–10 mg/L, this requirement will drive the technology decision for wastewater treatment to create an effluent suitable for reuse.

So, drivers for improvement in water and wastewater management are:

- money savings for water use reduction and wastewater discharge costs
- increased regulatory pressure related to wastewater discharge requirements
- sustainability and CSR considerations

WHERE ARE THE OPPORTUNITIES?

Improvements in water and wastewater management fall into three general categories:

- in-plant efforts to reduce direct water usage
- process and equipment changes directed at reducing water usage (and wastewater generation, in most cases)
- recycling/reuse of treated wastewater effluent

In addition, the tendency is toward constructing larger, higher-capacity processing plant facilities that use less water per unit of production just due to economies of scale. A soybean plant that processes 5,000 tons per day uses less water per ton overall than a facility that processes 1,000 tons per day. Some water streams, such as cleanup and sanitation, will remain the same as capacity increases. Newer, larger facilities often use even less water and energy per unit of production due to improved process equipment technology.

In-plant improvements in the first category are usually the easiest to define and address. These may involve improvements as simple as turning off hoses and eliminating other inefficiencies during plant sanitation activities. While neglecting to turn off hoses may seem to be the simplest—and worn-out—example, it is still a very prevalent problem/opportunity at plant sites. Beyond this, some of the more modest equipment and process changes include elimination of one-pass liquid seal vacuum pumps and elimination of uncollected steam condensate blowdowns, and proper management of cooling tower chemistry and blowdown quantities.

Major process change and improvements include areas such as freeze condensers on deodorizers and recovery of extraction sewer water evaporator flows for steam use. These are obviously larger undertakings and require larger expenditures. Caustic wash streams on conventional deodorizer condensers will generate 15 to 20 gallons per minute (gpm), or 57–76 liters per minute, of flow. A freeze condenser system will generate less than 20% of this amount.

Recycle of wastewater effluents and zero (or near-zero) wastewater discharge has been the stretch goal standard of the industry. Currently, about a half-dozen plant sites in this industry in North America have wastewater systems in place or in the implementation phase that can produce this quality of treated water from wastewater.

Fuji Vegetable Oil in Savannah, Georgia, USA, has embraced this water-saving mission. Starting over a decade ago, Fuji developed and implemented an approach to this on several fronts. Water use and wastewater generation management starts in the process facility. Fuji developed an operations management and feedback program to reduce water consumption and improve loss control that impacts wastewater. On the back end, Fuji installed one of the first membrane bioreactor (MBR) wastewater treatment facilities in this industry. All process wastewater effluent from this MBR facility is recycled for clean cooling tower makeup needs. Like all progressive programs, Fuji has used this experience as a learning tool and refines its programs and procedures based on results.

THE REAL WORLD—WHAT IS HAPPENING ON THE GROUND?

All of this sounds great and like something you would expect to read about in a magazine article, but what are most people really doing?

Inplant recycle. I have an opportunity to assist a great many existing plant sites in North America on this issue. My observation would be that about 10 to 15% are very much on top of the issue relative to in-plant water management control. Another large percentage has some level of awareness and programs. A small percentage of sites, probably 5%, have water usage that is way in excess of industry norms.

Water-saving opportunities pursued at many plants include:

- installing hoses with automatic shutoff; can save up to 10 to 20 gpm
- recycling cleaner water streams (condensates, centrifugal seal water, tower blowdowns) to lower-demand water uses for caustic vat makeup, sanitation water in some areas, air scrubbers; can save 5 to 10 gpm

Process and equipment design and operations. Processing plants that are being built now incorporate much of the state-of-the-art process technology for minimizing water consumption as part of the initial design (freeze condensers, sewer water evaporator water recovery, and the like). If these streams are eliminated or minimized through process design and reconfiguration, the amount of effluent water can be reduced by 20 to 30% or more. On the other side of the equation, these processes are usually more expensive to install at the outset and require more focus to maintain proper operations. Programmable logic control (PLC)

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Treated water can be used for a variety of needs, including sanitation, land application, and cooling tower makeup . . .

systems have been used in this industry for many years to streamline and add reliability to process control operations. Applications of PLC made the operation of these advanced processes much more manageable.

Some existing plant sites are being retrofitted with such process-improving equipment, but this usually corresponds to a major improvement project rather than solely as water efficiency undertakings.

Effluent recycle. The potential to reuse treated effluent and reach a zero or near-zero discharge is an idea that is starting to gain favor in the industry. Currently, the best wastewater treatment process for achieving this is MBR technology. MBR-based systems use ultrafiltration (UF) membranes and are capable of producing a treated effluent with very low levels of BOD, COD (chemical oxygen demand), and suspended solids.

MBR technology comes in two versions: submerged membranes that actually reside in a biological aeration basin, and remote tube-type membranes. I have installed both types in oilseed- and oil-processing facilities. Both work well if designed properly with the right pretreatment ahead of the MBR unit. Both also can and will have challenges if not designed and operated properly.

The Fuji MBR system uses a submerged membrane system technology provided by Kubota (tinyurl.com/kubata-MBR). Another main provider of the submerged membrane technology is GE Water (www.gewater.com).The primary provider of the eternal tube-type membrane technology in North America is Dynatec-tube (http://dynatecsystems.com/index.asp?PageID=126), although several other companies also offer MBR systems equipment.

Treated water can be used for a variety of needs, including sanitation, land application, and cooling tower makeup, depending on incoming water chemistry and other factors. The UF/MBR effluent can be further treated with disinfection to expand its use. Other applications add a reverse osmosis (RO) step to reduce dissolved solids in the water stream. This increases the ability to reuse the effluent for cooling tower and boiler feed makeup. One word of caution on the RO addition: The process will generate a 20%-plus reject flow containing the dissolved solids load from the entire flow. There must be a "home" for the dissolved solids. This is most likely a municipal sanitary sewer that is serving the facility. Be certain that this receiving sewer system can handle the dissolved solids loading and concentration to be discharged. Dissolved solids are becoming a much more regulated parameter in municipal wastewater effluents and in many cases the city/county is not focusing on this.

Tips on managing and conducting a water use and consumption study

1. **Get all players** in the "decision-making tent" and **involved** in the process upfront.
2. **Map out the program.** Define goals and objectives and create a current flow diagram of sources, uses, and effluents. Obtain accurate, current data—if you don't measure it you cannot manage it!
3. **Check out the facts yourself.** Don't assume because Joe says something that it is necessarily correct. Bad data and information lead to wasted effort and bad decision making.
4. Examine the **high/low end point conditions.** Averages are nice but don't often guide ultimate decision making about water resources.
5. When assessing opportunities for water savings, at least initially, throw out conventional thinking on ROI (return on investment) spending. View savings as a sustainability benefit and move forward from there. The sum of the parts will be greater than the whole, and **the money will take care of itself if the plan is good**.

MAKING THE PROGRAM RUN SMOOTHLY

Management commitment is essential to making water reuse an effective and dedicated program. Additionally, once a high standard of performance is attained, it is essential that someone in operations take "ownership" of the issue and facilities to ensure long-term success. Using company sustainability goals and objectives as performance metrics will help facilitate the program.

Few plant site locations cannot benefit from a focused investigation of water uses and consumption. Do that first and come up with a plan. This should be a well thought-out strategy with very specific details about what waters will be recycled, how, and where—as my former boss used to ask, "Boyer, how's this gonna work?"

Mike Boyer is president of Agribusiness and Water Technology, Inc. (AWT). He and his firm have worked extensively in wastewater and by-products management in agribusiness, foods, and biofuels. Boyer is a graduate (BS/MS) from the civil engineering program at the University of Missouri–Columbia (USA) and a registered professional engineer in six states. He has been a member of AOCS since 1976, is a former AOCS treasurer and board member, and is currently the CEO/president for the AOCS Foundation. He can be contacted at mboyer@aesms.com.

Continuous crystallization: The next big thing in palm oil fractionation

Gijs Calliauw

Palm oil is the most fractionated edible oil in today's oils and fats business. The largest industrial installations can fractionate up to 3,000 metric tons per day, in a reliable and automated way. Dry fractionation, also called "fractional crystallization," is a pure physical process. Consequently, its operating cost is primarily determined by (refrigeration and heating) energy consumption, and all innovations and improvements that can lead to lower energy consumption will make dry fractionation more cost efficient.

Continuous crystallization is widely regarded as a sound pathway to achieve a substantial reduction of energy consumption. Moreover, the performance figures of the most recently installed continuous fractionation plants indicate substantial technical advantages over conventional batch systems. This article aims to explain how and why such remarkable results have been achieved.

- **Continuous fractional crystallization is widely regarded as an appealing way to reduce energy consumption during dry fractionation.**
- **Now that the required technology has become affordable and is in full-scale operation at some industrial plants, the technical and performance advantages are being mapped and measured.**
- **The energy savings, higher efficiency, and ease of operations that are being achieved at these plants will likely popularize the continuous fractional crystallization of commodity fats in the commodity oils industry.**

EASIER ECONOMIZATION

Any successful fractional crystallization of oil requires that the latent heat of crystallization (approximately 50 kcal/kg crystals formed) be efficiently removed from the system.

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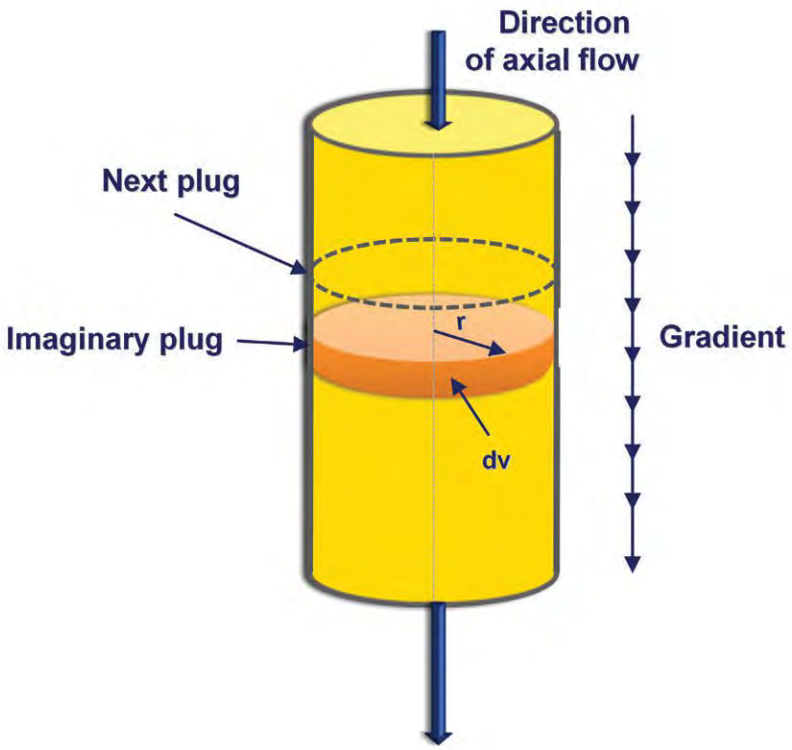

FIG. 1. Schematic representation of an ideal plug-flow reactor, in which the plugs of infinitely small thickness dv are moving in an axial sense from inlet to outlet. Each plug is supposed to behave like a small, ideally mixed crystallizer.

TABLE 1. Tabular comparison of energy consumption for heat and refrigeration of a continuous and a batch fractionation producing palm olein with an iodine value (IV) of 56 from refined, bleached, and deodorized (RBD) palm oil (for a 1000 metric tons per day plant)

Steam consumption (kg/metric ton of oil)	Batch	Continuous
Heating of incoming oil	14	5
Olein heating	9	0
Re-heating of crystallizer at end of cycle	3	0.3
Stearin heating	17	17
Miscellaneous (feed tanks, wash oil, tracing…)	5	5
SUM	48	27
Cooling tower water in circulation (m^3/metric ton)	**Batch**	**Continuous**
For chiller	3.1	2.4
For process	2.9	1.9
SUM	6	4.3

Especially in fast crystallizing processes, the need to remove this vast amount of energy can be quite demanding for the water cooling system, and large energy buffers (i.e., cold-water tanks) must be installed to cope with highs and lows of refrigeration demand in a batch process. In a continuous, steady-state operating plant, however, every calorie of heat is removed just as fast as the previous one; thus, the peak loads on the refrigeration group are actually spread over one single constant load during the whole production run time. Consequently, refrigeration needs less cooling power. Such a production line can operate virtually without any water buffers. Note that the same is true for the mass transfer: Every kilogram is pumped just as fast as the previous kilogram by a pump running 24 hours a day, 7 days a week. This allows the selection of pumps that deliver the nominal flow, and nothing more.

It follows that, when all pumps operate at constant flows and all heat fluxes are stable, crossing hot ingoing streams with cold outgoing streams is a lot easier in simple heat exchangers. This maximizes heat recuperation in a similar way to what happens in winterization lines, bleaching sections, or deodorization plants.

A continuous process can offer another significant energy economy: The longer a crystallizer can run in a continuous mode at the same temperature, the more equivalent "batches" it will produce without reheating and recooling the crystallizer's steel and water. For a conventional batch plant, such reheating and recooling happens typically three to five times a day for every crystallizer. Table 1 summarizes the main heat and refrigeration economies of a continuous vs. a batch fractionation for the production of palm olein with an iodine value (IV) of 56 from refined, bleached, and deodorized palm oil.

The benefits of a continuous dry fractionation process are primarily achieved in the crystallization part of the plant, and less so in the filtration section. There are two main reasons for this: Compared to the crystallization section, very little cooling and heating energy is consumed in the filtration, so the returns of energy savings in that field are proportionally smaller. A more likely reason why there is a lower demand for continuous filtration systems is that the separation efficiency of (batch) membrane press filters is far better than what can be achieved by continuous separation systems such as centrifuges, vacuum belt filters, or even hyperbaric

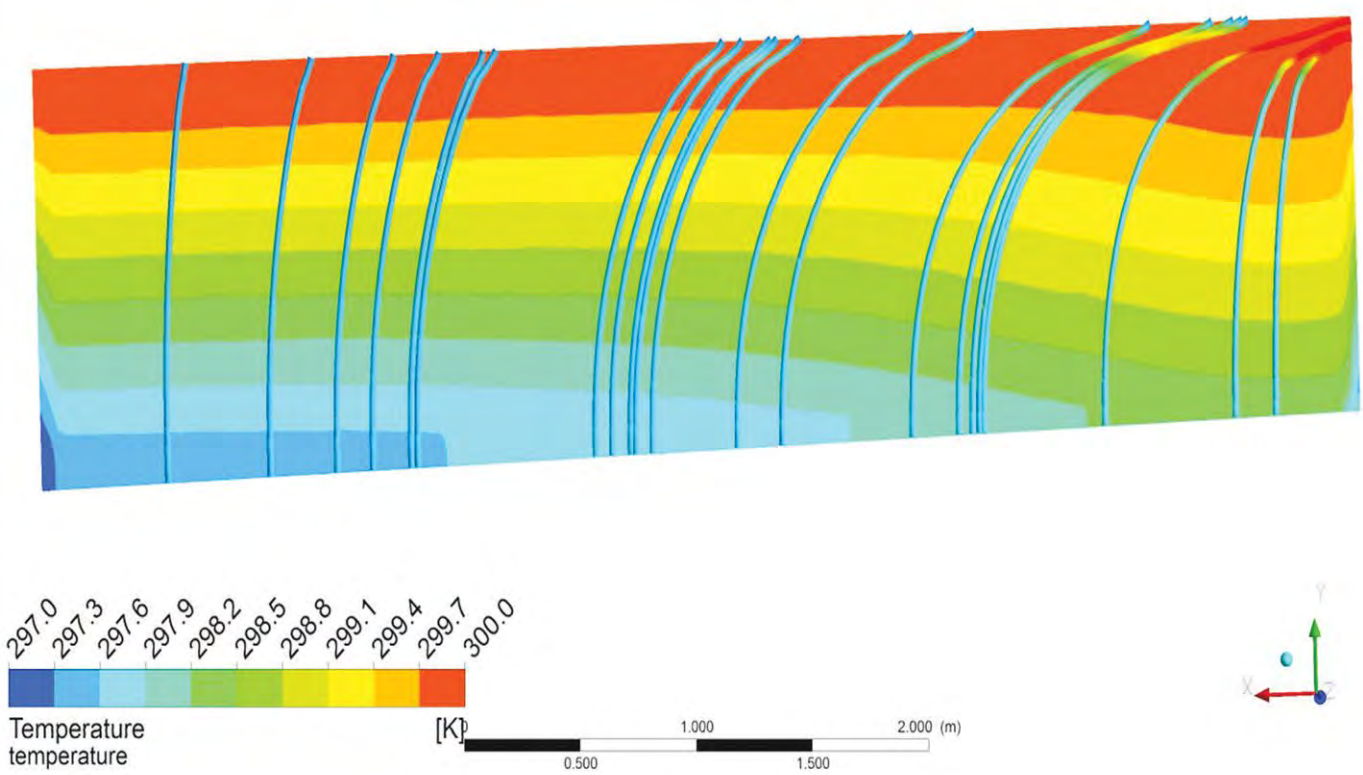

FIG. 2. "Slice" of the crystallizer in which the drop in oil temperature for a given cooling power and oil feed rate is modeled by means of CFD, resulting in a "stratification" of temperature zones. Streamlines indicate the pattern of flow of selected particles from top to bottom (inlet is top right, outlet is bottom left).

rotary drum filters. This loss of performance does not justify the eventual small savings in energy consumption from continuous filtration.

PLUG-FLOW CRYSTALLIZERS

The crucial technological backbone of a proper continuous steady-state process is the successful application of plug-flow crystallizers. Contrary to batch stirred reactors, in which the reaction proceeds by time, plug-flow reactors are continuously fed and drained, and the reaction proceeds as a function of distance from the outlet (Fig. 1).

Plug-flow reactors are not a novelty. In fact, this is the archetypal reactor design in many gas/solid mixing reactors, as well as packed beds. Until recently, continuous plug-flow crystallizers in edible fats were principally only used in high added value applications, such as solvent fractionation for specific confectionery fats, or margarine plants. Typically, such crystallizer designs are scraped surface heat exchangers (SSHE) in which the oil is basically crash cooled, with residence times ranging from a couple of minutes to nearly one hour. The resulting crystals can be scraped off the wall; and their impact on filterability, if it is even relevant, is not crucial for an efficient separation of the phases.

Economically and technically, applying plug-flow crystallization is a lot more challenging in conventional dry fractionation. It is economically challenging, because residence times for palm oil fractionation typically range from 4 to 20 hours—10 to 50 times longer than the reactor residence times in most SSHE processes. So, for the same throughput, plug-flow crystallization calls for 10 to 50 times more crystallizer capacity. The investment in numerous technically advanced continuous crystallizers such as SSHE will not be paid back by the relatively low margins in bulk fractionation. But probably the greatest challenges for continuous crystallization are technical. First of all, the plug flow between the inlet and outlet of the reactor implies maintaining a stable gradient of crystallization degree (from 0 to 15%) over the path length of the oil, while still preserving ideal mixing features in the plane perpendicular to the direction of movement.

This ideal mixing is necessary to bring all the oil, which is a poor heat conductor, in close proximity to the heat exchange surface, so that the crystallization heat can be efficiently removed. In the meantime, the gradient of the crystallization degree has to be preserved to respect the "first in, first out" principle of plug-flow reactors and so guarantee a

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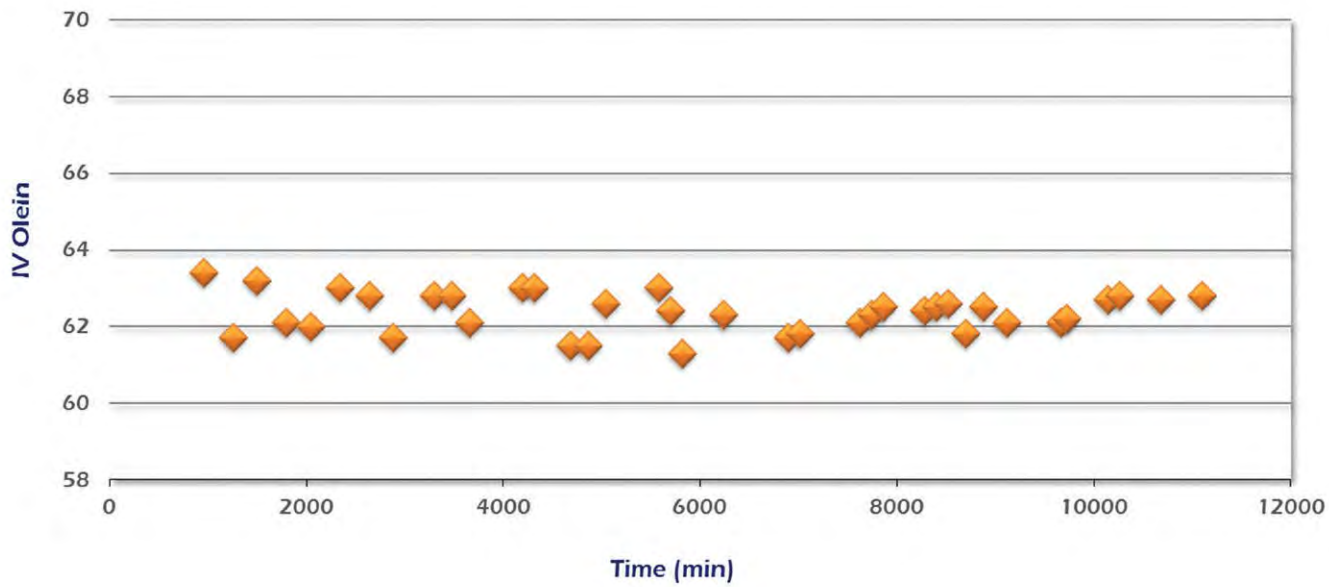

FIG. 3. Iodine values (IV) for olein in (part of) one continuous run of a palm oil fractionation plant.

minimum residence time for the oil. Maintaining such two mixing directions is then complicated by the fact that the rheological behavior of vegetable oil thoroughly changes upon fractional solidification: The apparent viscosity ranges from 50 cP to easily above 1000 cP, and evidently this affects the mixing efficiency in the reactor.

Another technological challenge is to get no or minimal sedimentation of crystallized fat on the heat exchange surface, as this will cause the heat exchange efficiency of the system to drop. The use of scraped surfaces may ultimately solve this problem so long as these surfaces do not affect crystal integrity and/or filtration efficiency. Despite the obvious advantages of continuous operation, the technological intricacy of such a process means that 99% of the dry fractionation plants worldwide are still operating in batch mode.

INDUSTRIAL VALIDATION

Only recently has continuous fractional crystallization gained ground in the realm of commodity oil processing, as the required technology has become affordable only in the last few years. In that sense, rather than a new technical idea, it is the worldwide commercial availability and applicability of the total package of technology that can be regarded as the true novelty and innovation, and one with a history too.

Desmet Ballestra introduced its new continuous fractionation to the market in the late fall of 2011, but the research and development started in 2005. Since then, it has been gradually optimized through pilot-scale tests, various computational fluid dynamics (CFD) simulations of reactor designs, and of course through validation on an

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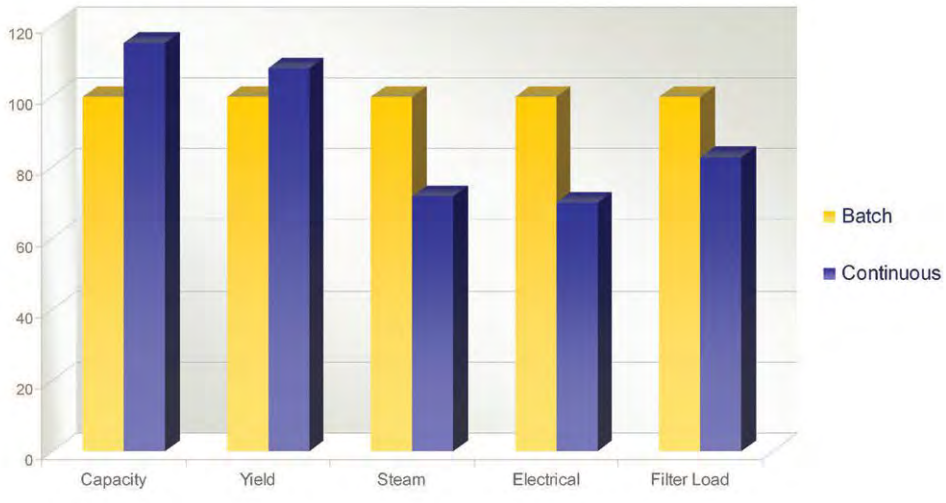

FIG. 4. Performance comparison of Desmet Ballestra's continuous crystallization vs. batch crystallization. The y axis represents the percentage compared to conventional batch performance, which is taken as 100%.

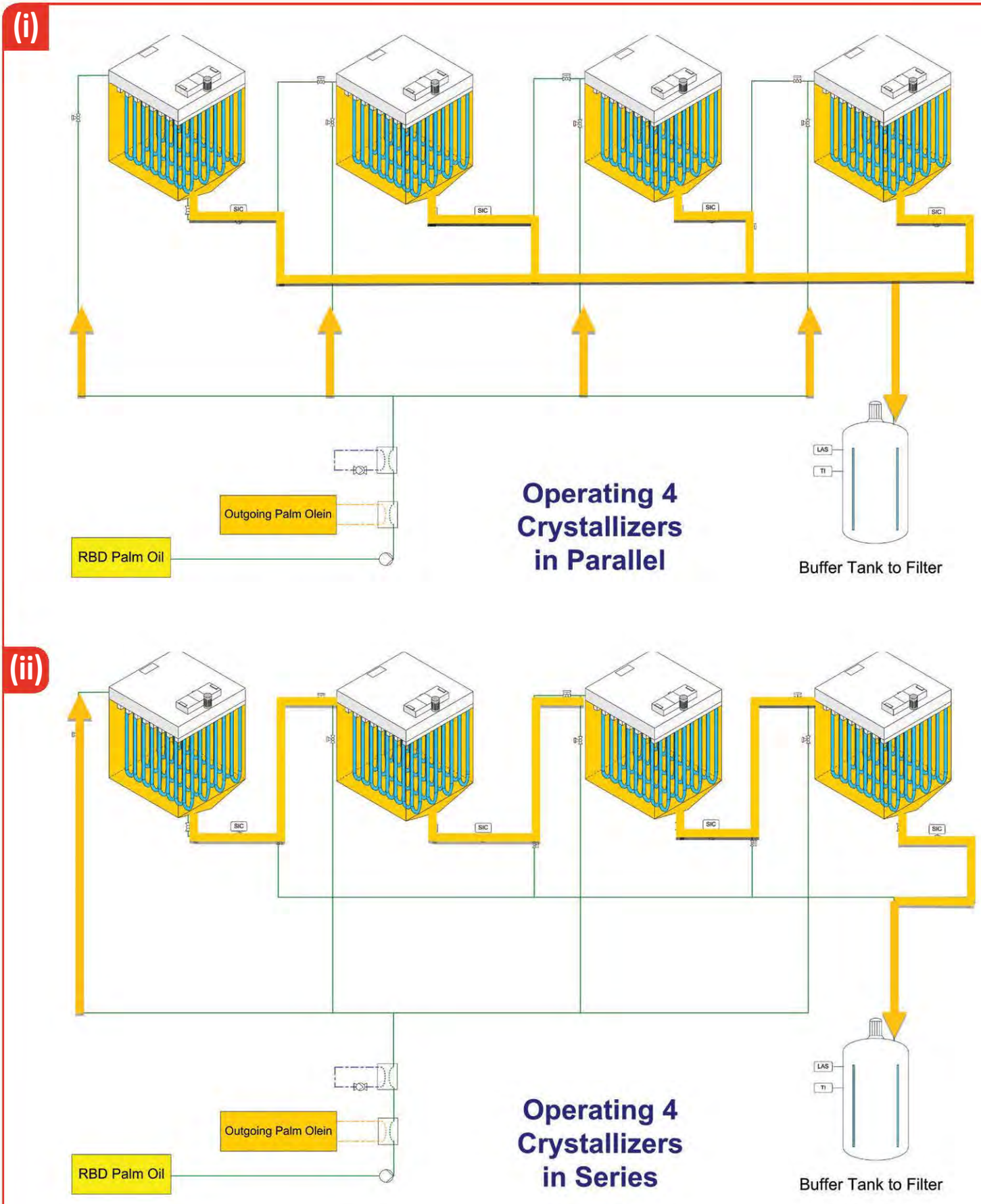

FIG. 5. Schematic operation of (i) all parallel and (ii) all coupled in a continuous crystallization plant equipped with patent pending crystallization technology. RBD, refined bleached deodorized.

TABLE 2. Principal triglyceride distribution (%) of palm olein IV 56 produced from the same RBD oil in batch or continuous crystallizer[a]

	Batch	Continuous
Diglycerides	7.9	7.5
POL	11.1	10.8
PLP	9.9	9.8
OOO	3.9	4.3
POO	23.9	24.8
POP	28.1	28.1
PPP	1	0.3
SOO	2.7	2.8
POS	4.9	5.3

[a]Abbreviations: P, palmitic; O, oleic; L, linoleic; S, stearic; for other abbreviations see Table 1.

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industrial scale. An adequate visualization of the desired plug flow is shown in Figure 2 (page 115), where the vertical temperature gradient of the oil over the height of the crystallizer is demonstrated by means of an advanced CFD simulation. It is the stability in time of this vertical gradient that truly is the key to successful fractional crystallization on an industrial scale.

With some industrial plants already in a 24/7 operation, the technical advantages of conducting the crystallization in a continuous fashion are being mapped and measured. There are many interesting technical aspects to the continuous operation: As a large proportion of the cooling of the oil (say, from 70°C down to 40°C, i.e., not the supercooling and crystallization part) can happen before the oil enters the crystallizer—simply by passing through a heat exchanger—the residence time of the oil in the crystallizer can be notably reduced. In batch processes, hot oil generally is pumped in to ensure that all residual crystals from the previous batch have melted and start with a "clean slate." Since this step does not occur in continuous modes, throughput can be increased 10–20% over that in an equivalent batch process.

Note that a continuous process does not mean a process that runs for infinite times: Regular startups and shutdowns are still needed in a continuous plant, but on average the operation times are sufficient to produce about 10 to 50 batches before shutdown. In practice, the plant can run in a steady-state for days, even weeks, as illustrated in Figure 3 (page 116).

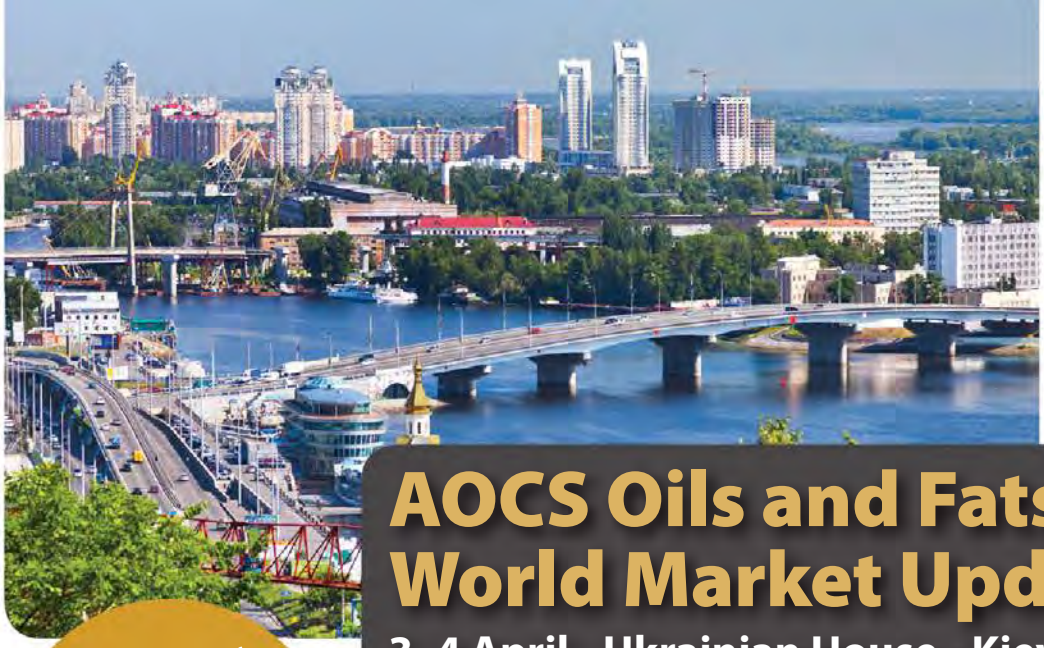
Furthermore, continuous operation reduces the interbatch variability and, as the warm oil is continuously fed to a vast mass of cold crystal suspension, the omnipresence of the existing seed crystals will catalyze the formation of the new crystals in the fresh melt. Another industrial finding is that the solubility of the saturated components such as tripalmitin (PPP) is far lower in oleins produced in the continuous system than in the batch (Table 2). This is obviously a major plus in the effort to achieve lower cloud points and better cold stability of the liquid products.

Continuous operation also gives a more uniform crystal size distribution, which results in an improved filtration performance (lower filter loads), and a higher olein yield (up to 2% more). Hence, especially in processes where the liquid olein fraction is the most valuable, continuous crystallization can offer an increased profitability. Figure 4 (page 116) summarizes the principal quantifiable advantages of continuous operation over batch on an industrial scale.

When it comes to daily operation, continuous fractionation is also a very flexible process. A good plant design will allow operating all available crystallizers in parallel when possible. They can also be coupled in series, and the desired gradient can be spread over different reactor units, as represented in Figure 5 (page 117). Such flexibility is just a matter of piping and smart automation, but it can make a complete difference in enabling a plant to produce IV 56 one day and palm olein with IV 63 the next day.

So, the savings, the higher efficiency, and the ease of operation of these plants will ensure that continuous fractional crystallization of commodity fats finds widespread use in the coming years. In fact, continuous fractionation plants with this patent-pending Desmet Ballestra technology are already running—as well as being installed—in Pacific Asia, Europe, Africa, and South America, where they are being used mainly for palm olein and superolein production. Although the largest market is definitely situated in commodity (palm) oil fractionation, it's probably the ease of use and the unambiguously improved technical features of continuous crystallization that will spur on the application of this technology in developing more intricate fractionation processes, such as production of palm oil superolein IV 70 and hard palm mid-fractions.

Gijs Calliauw is Development Manager Modification for Desmet Ballestra Oils & Fats and is responsible for innovation in the field of modification technology for the group. He can be contacted at Gijs.Calliauw@desmetballestra.com.



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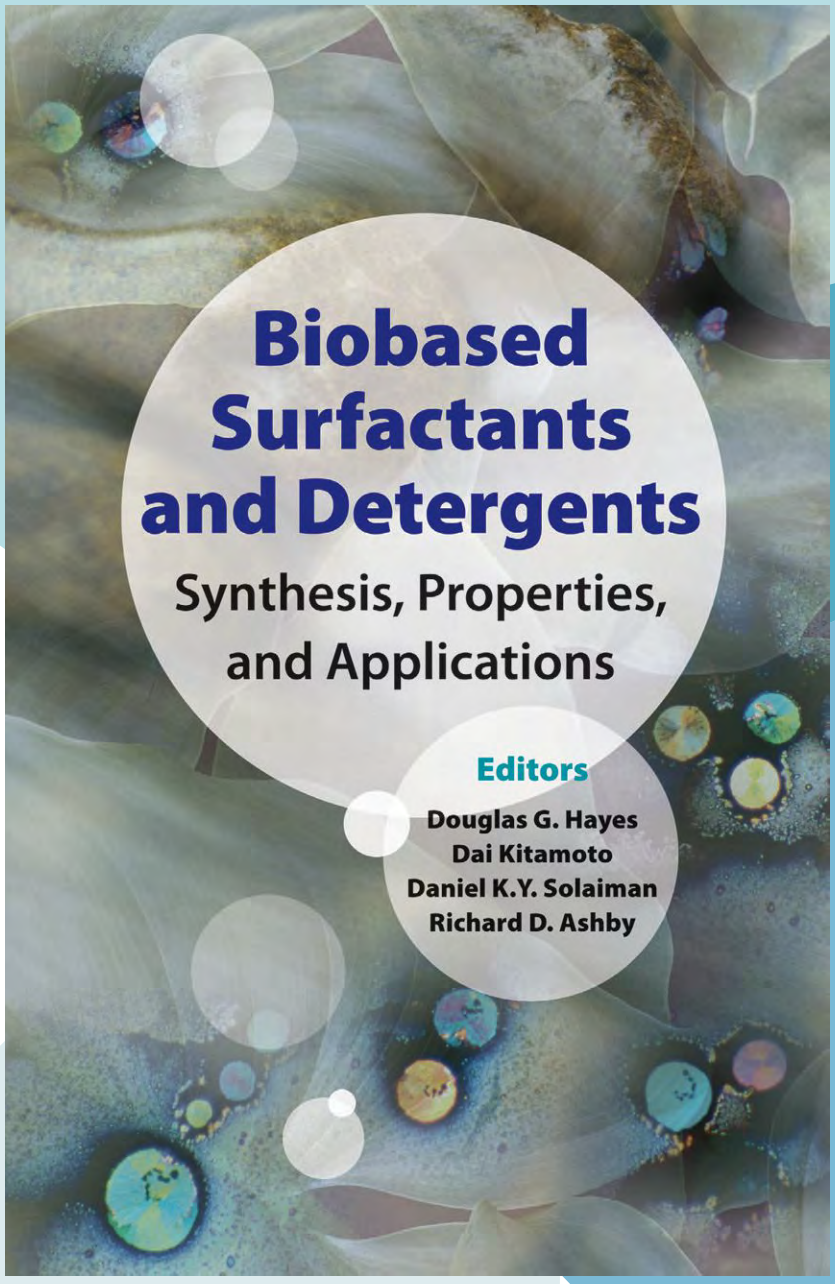

Biobased Surfactants and Detergents

Synthesis, Properties, and Applications

Editors: Douglas G. Hayes, Dai Kitamoto, Daniel K.Y. Solaimon, and Richard D. Ashby

Hardbound. 2009. 504 pages.
ISBN: 978-1-893997-67-7. Product code 235

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

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Sophorolipid biosurfactants: state of the art, applications, and outlook

Sophorolipid biosurfactants are glycolipid biosurfactants that:

- **combine green chemistry and a lower carbon footprint with the absence of undesirable side products or environmental downsides found in many surfactants currently on the market.**
- **offer clear potential in hard-surface cleaning, in automatic dishwashing applications, and in dynamic applications such as spray-on coating and cleaning.**
- **are already being used in some commercial cleaning products and are being developed for a variety of other applications, including cosmetics.**

Dirk W.G. Develter

Surface-active agents, or surfactants, form an integral part of our everyday life, with applications reaching far beyond our hygienic needs, ranging from asphalt and concrete through food to fuel additives. They therefore are typical high-volume products with a worldwide production in excess of 18 million metric tons per year, which places them into widespread contact with our aquatic environment.

The worst environmental problems associated with the discharge of surfactants into the aquatic environment include excessive foaming and lasting toxicity of either the surfactant or its stable metabolites (some of which have endocrine-disrupting properties) due to slow primary or incomplete secondary (ultimate) biodegradation. Such problems have been

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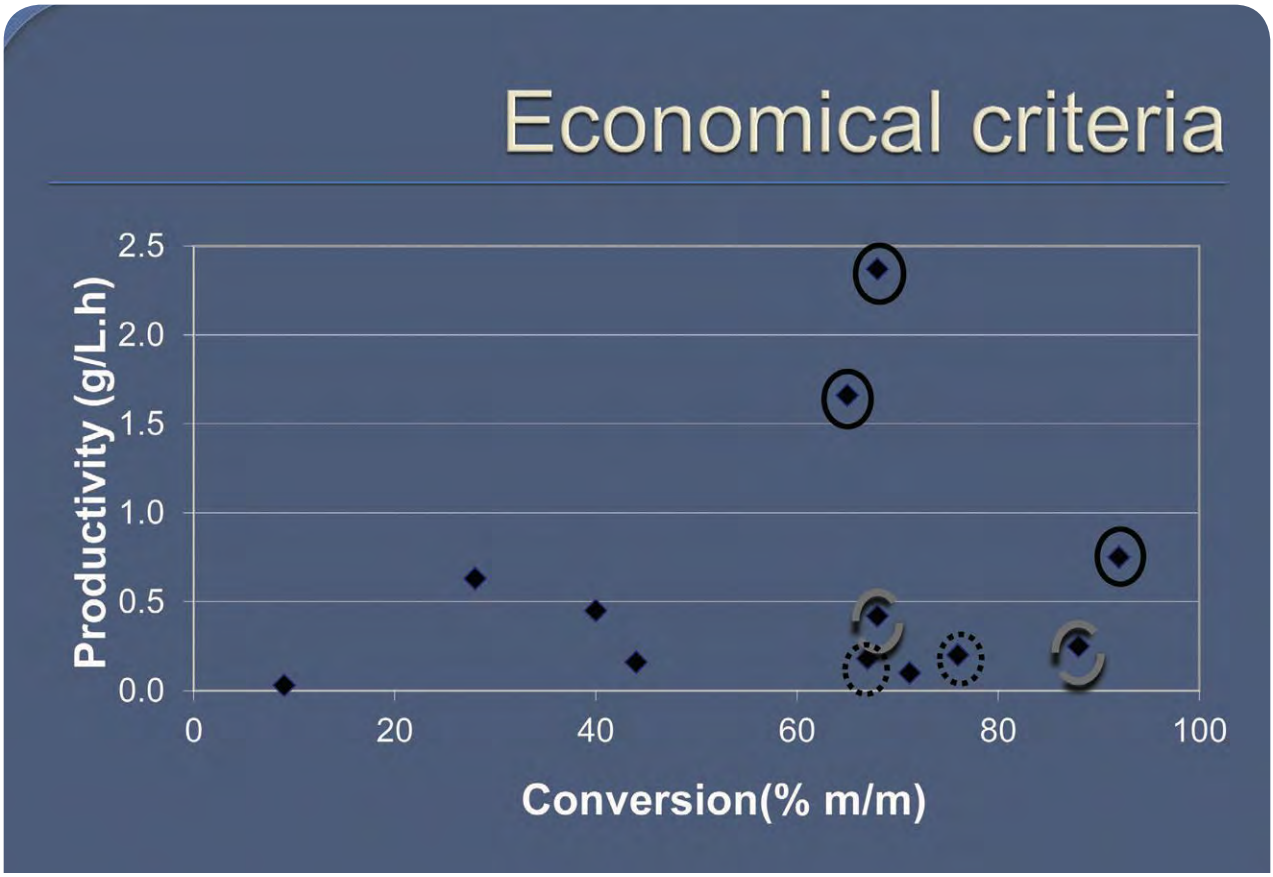

FIG.1. Literature data on substrate conversion and productivity of various species of biosurfactant-producing microorganisms. Solid circles represent literature data for sophorolipid production, dashed circles for rhamnolipid production and dotted circles for mannosyl erythritol lipid production.

and are still further being alleviated with the switch from tetrapropylbenzene sulfonate to linear alkylbenzene sulfonate, and with the gradual disappearance of alkylphenol ethoxylates due to legislative restrictions or voluntary industry commitments, depending on the application and the country. Even so, the inherent toxicity and suboptimal biodegradability profiles of many surfactants make their large-scale use undesirable from an environmental standpoint when they are inadequately treated or left untreated in wastewater treatment plants. Moreover, their synthesis often requires the use of hazardous chemicals, such as ethylene oxide, or results in undesirable residual or side products, such as dioxane, dimethylaminopropylamine, and nitrosamines.

Surfactants are currently manufactured from both petrochemical feedstocks and biobased (renewable) resources. Oleochemical surfactants from renewables offer clear benefits in terms of greenhouse gas emission reduction. Yet only roughly 25% of total surfactant production is currently biobased.

The introduction of glucose-based synthetic glycolipid surfactants in the early 1990s and fatty acid methyl ester ethoxylates at the start of the new millennium is illustrative of continued market-driven research for surfactants with a better environmental profile, many of which start from fully renewable feedstocks that are functionalized using green chemistry. The renewed research and commercial interest into biosurfactants (which were discovered in the 1960s) are intended to further complement the range of green surfactants. Biosurfactants offer the additional advantage of being natural molecules that can be produced through bioconversion rather than chemical derivatization of renewable raw materials.

Sophorolipids are glycolipid biosurfactants that can be produced by fermentation of native and imported renewable feedstocks, such as rapeseed oil, by various *Candida* yeast species. They are generally considered to be the most promising biosurfactants

INFORMATION

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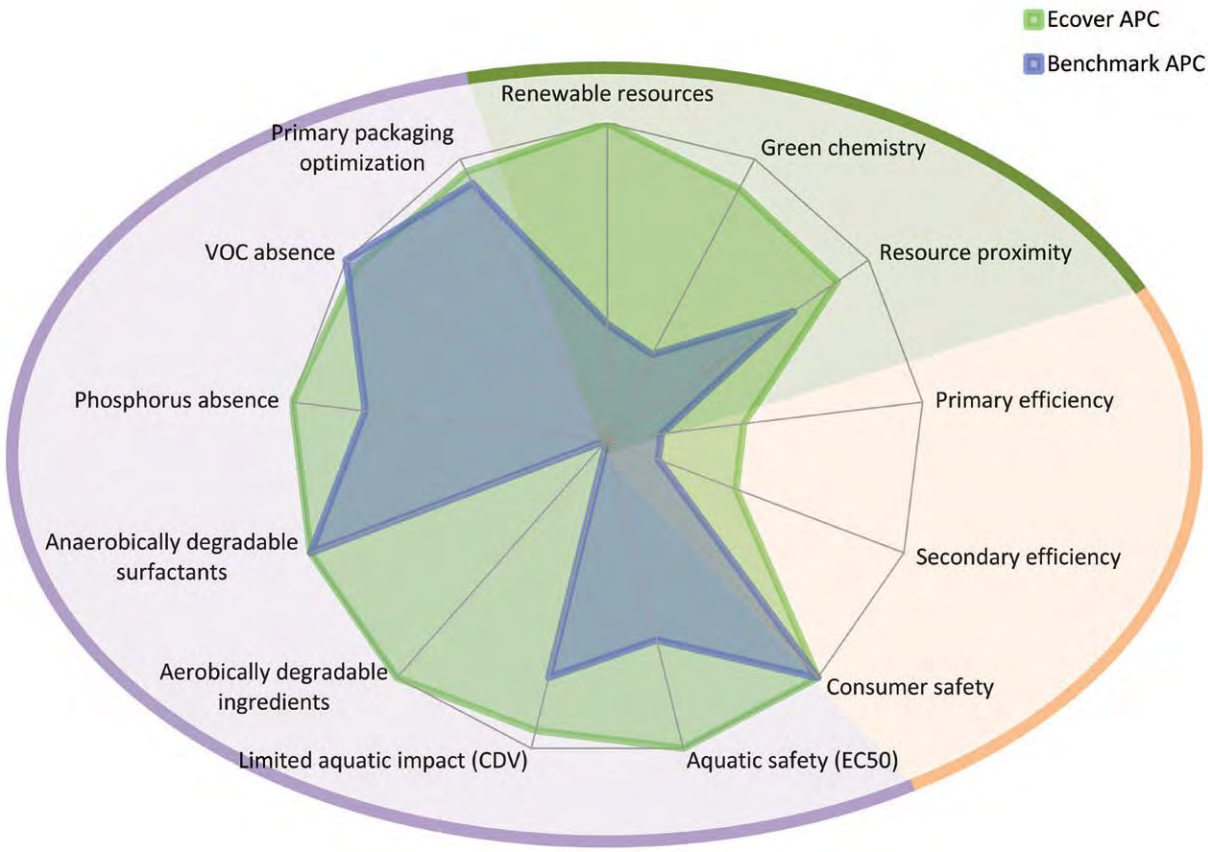

FIG. 2. A spidergram, or diamond model, comparing the ecoprofile of sophorolipids (green) with a fatty alcohol ethoxylate (blue)throughout their complete life cycle. Abbreviations: EC50, half maximal effective concentration; CDV, critical dilution volume; VOC, volatile organic carbon.

because of the nonpathogenic production organism, the ease of product recovery, and their high yield over time (i.e., productivity) and substrate conversion (weight by weight) as illustrated in Figure 1 (see Develter and Lauryssen, 2010, for literature references used for data points). Sophorolipids clearly offer the benefit of a high yield combined with a high substrate conversion, as evidenced by the solid circled data points in Figure 1 which by far exceed the values for any other biosurfactant producing microorganism. This article summarizes a decade of collaborative research on sophorolipids by the Belgian company Ecover (Malle), with particular emphasis on pioneering and novel applications.

These attractive surfactants combine green chemistry and a lower carbon footprint with the absence of undesirable side products or environmental downsides found in many surfactants currently on the market. The author and co-workers describe the additional life cycle advantages of sophorolipids as an oleochemical surfactant obtained from native feedstock (glucose and rapeseed oil-based material as bioconversion substrates) as opposed to imported palm oil (which is sometimes associated with deforestation), or petrochemical feedstocks (Develter and Fleurackers, 2010). Moreover the high-yield fermentation (300–400 g/L, which is three times higher than the next biosurfactant) is operated at near-ambient temperature and pressure (25–30°C, 1–2 bar) as opposed to chemical transformation processes that imply higher energy consuming conditions.

Furthermore, sophorolipids are fully biodegradable. With sophorolipids, no nonbiodegraded stable metabolites linger on in the environment as molecular garbage, as are found with some of the workhorse surfactants. Sophorolipids have a low acute and chronic aquatic toxicity to the extent they are 10 times less toxic than market reference surfactants and do not affect the reproduction of water fleas (*Daphnia*). *In vitro* testing (Episkin and BCOP—Bovine Corneal Opacity & Permeability Assay) proved they have a low skin and eye irritation potential. All these attributes combined with their excellent performance in hard-surface cleaning result in an appealing ecoprofile as illustrated in Figure 2, which compares sophorolipids with another surfactant (a fatty alcohol ethoxylate). This spidergram or "diamond model" as elaborated by Ecover (Develter and Malaise, 2012) incorporates various environmental impact aspects throughout the detergent life cycle and is validated and controlled by Vincotte (Vilvoorde, Belgium), an accredited inspection and certification organization.

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The author and coworkers have optimized a production process, currently applied on a multi-ton commercial scale, to obtain crude sophorolipids in high yield and purity and enriched (up to 90%) in sophorolactone, the most desirable chemical subtype. Furthermore, we developed a process to isolate, dry, and granulate the lactone subtype without making use of solvents. Focus areas of recent as well as ongoing research include applications in products for cleaning, cosmetics, and agriculture and other applications of both the crude sophorolipids or derivatives thereof as well as of the lactone subtype. Another area of research includes shortening the chain length, by using ozonolysis, dedicated substrates, or genetic engineering.

Sophorolipids have been described as not particularly effective emulsifiers, although they can be suitable in formulating microemulsions of limonene with very low interfacial tensions. Their most important property is their superior hard-surface cleaning performance in concentrated applications as compared to market reference surfactants. Develter and Lauryssen (2010) attributed this in part to their rather low foaming profile combined with fast wetting ability in dynamic situations where the water/air interface only exists for some milliseconds.

Their sensitivity to hydrolysis does not necessarily imply a drawback for cleaning applications since at skin pH they outperform conventional surfactants in alkaline conditions, which is an advantage in terms of skin and surface compatibility. The sophorolactone subtype is a water-insoluble solid that, for example, can be used for its microbiological activity or in autodish applications. It is very stable over time when dissolved in a range of solvents (such as ethanol, glycol ethers, or monohydric phenolic compounds). Applying a dispersion of such sophorolactone solution to either biological substrates or synthetic surfaces will form a water-resistant, long-lasting sheeting coating. Water drops on PVC treated with sophorolipids, for example, will sheet because of very low contact angles that remain below 10° even after repeated rinsing. This opens up a vast array of opportunities from antifogging hydrophilization of plastics to applications as a pesticide adjuvant or coating additive. These findings have resulted in a patent portfolio of five patent families.

Sophorolipids thus offer clear potential in hard-surface cleaning and automatic dishwashing applications, as well as in dynamic applications such as spray-on coating and cleaning. Their higher price, well in the range of other specialty surfactants, is inherently due to the loss of a substantial amount of the substrate to CO_2 during bioconversion and is largely compensated by their environmental profile and the reported performance benefits. This is reflected in their commercial use in several cleaning products commercially available from the pioneering company Ecover all over Western-Europe. The Ecover hard-surface cleaning product range, for example, is based on substantial amounts of sophorolipids combined at a ratio of about 50:50 with other sugar-based surfactants. Sophorolipids are also used in a Japanese automatic dishwashing powder and in Korean hand soaps (from the Saraya and MG Intobio companies, respectively). Their application areas will undoubtedly expand and their use will become more widespread.

Dirk W.G. Develter is R&D manager at Ecover Coordination Center. His pioneering sophorolipid work resulted in 2010 in a finalist nomination for the European Business Awards for the Environment in green innovation in the process category. He can be reached at develter.dirk@ecover.com.

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The globalization of oils and fats

Jean-François Mittaine and Thomas Mielke

Globalization generally refers to a complex process of international integration. Vegetable oils and fats have always been naturally "globalized" in both their production and their consumption patterns. It is not new. Already, within the Roman Empire, olive oil trade was thriving.

In a balanced market, global supply must meet global demand. But, over the past 30 years, an expanding disequilibrium has been witnessed in many individual countries between rapidly rising domestic demand and domestic production. The driver has been the widening production deficit in many countries leading to rising import requirements. It occurred when nations started to reduce trade barriers, import tariffs or even non-tariff barriers, enabling an unprecedented increase in trade volumes particularly for palm oil (Fig. 1). This process was fueled by accelerating growth in the two most populous countries in the world (India and China), while African countries and other countries such as Pakistan lagged behind.

The reasons for the production deficit are numerous but they include: lack of arable land (in China and many other countries), lack of productivity, climate change, poor production structures combined with lack of technology, and poor management. There was an enormous expansion of development in only a very few countries: Argentina and Brazil, for soybeans; Indonesia and Malaysia, for palm oil; Ukraine; Russia; Canada; and Australia. Oilseeds acreage rose 50% in 20 years. Oilseeds production more than doubled in 20 years (Fig. 2, page 128). Half of the production gains came from "new lands," half resulted in acreage shifts from other farm productions, particularly grains.

World production of 17 oils and fats (soya oil, palm oil, rapeseed oil, sunflower oil, cottonseed oil, groundnut oil, sesame oil, corn oil, olive oil, palm kernel oil, coconut oil, butter as fat, lard, fish oil, linseed oil, castor oil, tallow and grease) reached about 184.4 million metric tons (Mn T) in 2011/2012 (October/September), an average annual increase of 5.0 Mn T since 1991/1992 and more than double the 83.5 Mn T registered 20 years ago (see Fig. 3, page 128), corresponding to an average annual growth of 4.0%. Palm oil has become the largest vegetable/animal oil produced in the world, more than quadrupling to 51.5 Mn T in 2011/2012, compared with only 11.8 Mn T in 1991/1992, representing an average annual growth of 7.6%. With 42.1 Mn T, soya oil, the second-largest vegetable oil produced in the world, also experienced a noticeable increase from 16.8 Mn T 20 years ago, corresponding to an annual growth of 4.7%. Rape and sunflower oils combined today represent about 21% of world production, about unchanged from 20 years ago in terms of production share but still rising from 17.8 Mn T to 38.9 Mn T, more than a twofold increase. Finally all the other oils including animal fats declined in importance from 39.2% to 23.2% of the total during the period, although this decline in production share still represents a 10 Mn T rise in total production from 32.7 Mn T to 42.8 Mn T. Aside from those 17 oils and fats, which constitute

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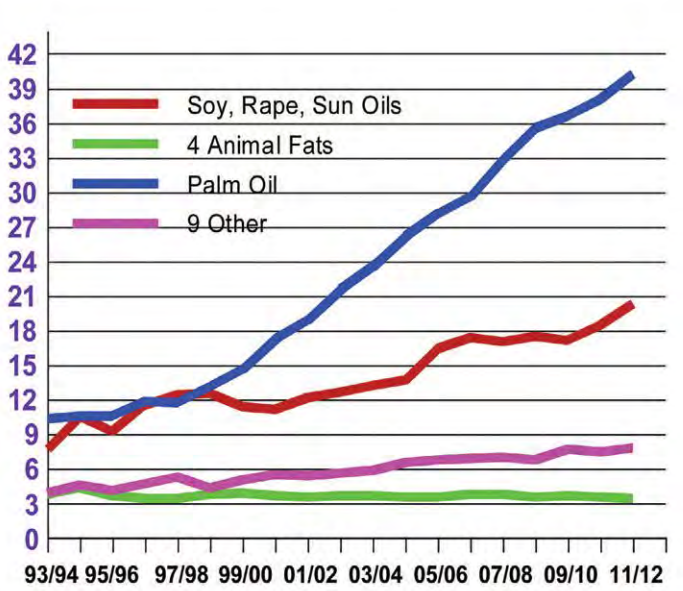

FIG. 1. World exports of 17 oils and fats (in millions of metric tons) from 1993/1994 to 2011/2012.

- **World usage of fats and oils has risen rapidly during the past quarter century.**
- **While globalization has helped meet the growing demand for fats and oils, production deficits in some countries have created supply and demand imbalances that require active balancing through international trade.**
- **Ensuring the long-term adequate supply of this essential food staple will require a new "green revolution" similar to the one that occurred during the 1950s for grains.**

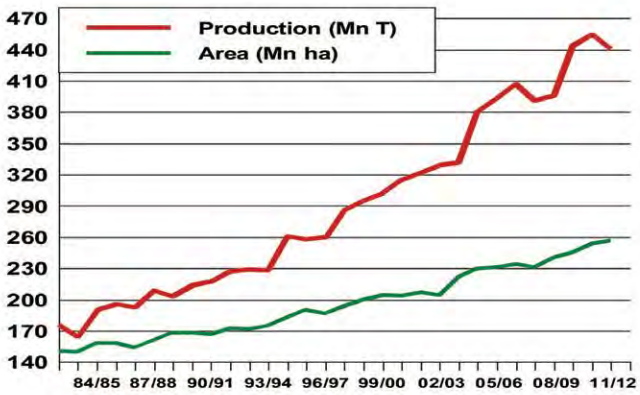

FIG. 2. World area and production of 10 oilseeds from 1984/1985 to 2011/2012. Mn T, million metric tons; Mn ha, million hectares.

the bulk of the world production in tonnage, there are many additional vegetable oils of all types but they are generally found in small volumes, especially from tropical sources that are used by various industries, particularly the cosmetic industry. These "exotic" oils offer many "globalization" opportunities, all the more that they are directly associated with a very high level of technology.

Total world usage of the 17 fats and oils has grown rapidly in the past quarter century, reaching 182 Mn T in 2011/2012 from a starting point below 80 Mn T in 1987/1988. Although the annual growth rate of total usage slowed somewhat on account of smaller rises in biodiesel, this rate still was quite high at an average 4% during the most recent 10 years.

World consumption of oils and fats is well balanced geographically according to population and disposable income, but that balance is rapidly changing due to rising affluence in China.

Since 1996, per capita world consumption of 17 oils and fats has increased from 16.9 kg in 1996 to 25.6 kg in 2011, up 51%, corresponding to an average yearly growth of around 3% per year. Argentina, the 27 members of the European Union, and the USA remain the highest per capita consuming regions in the world, at about twice the world average. But, part of this is due to the large consumption of oils and fats as a feedstock for biodiesel. The two large emerging countries, China and India, still remain below the world average at, respectively, 24.6 kg and 14.6 kg per capita in spite of a huge rise of per capita consumption since 1996 (respectively, +121% and +57%). They will most likely exceed the world average quite rapidly as a result of their quickly rising disposable income.

Thanks to the globalization process, which has widely opened large trade channels, the oils and fats sector was able to meet the supply requirements of a quickly rising demand from both the population and all the industrial usages including alternative "green" energy. These developments were partly made at the expense of other acreage utilization, including grains, as well as at the expense of the wild tropical forest particularly in South America. However, through genetics, biological sciences, and numerous other agricultural improvements, yields have been the main driver in the rising productivity of the major vegetable oils including through the GMO (genetically nmodified organisms) seeds enabling improved protection against diseases. Whether we are experiencing a new "green revolution" as in the 1950s for grains remains to be seen although it will be a necessity in order to ensure the long-term adequate supply of this essential food staple.

The balancing of supply and demand is expected to remain a tight exercise every year. Fortunately, the combination of tropical and temperate origins of vegetable oils allows a convenient "hedge" against the chances of accelerating climate changes. But the wide geographical dispersion of surplus regions and deficit regions will continue to require quite active balancing through international trade.

The future of the entire industry largely lies in technology, not only at production level but also down the value chain for better use of these complex products; and finally also in the recycling technology of all farm products to ensure the best usage of these high-value foods. The final challengeis to ensure the proper supply of this important food staple to the nine billion people who will inhabit this planet in the not-too-distant future.

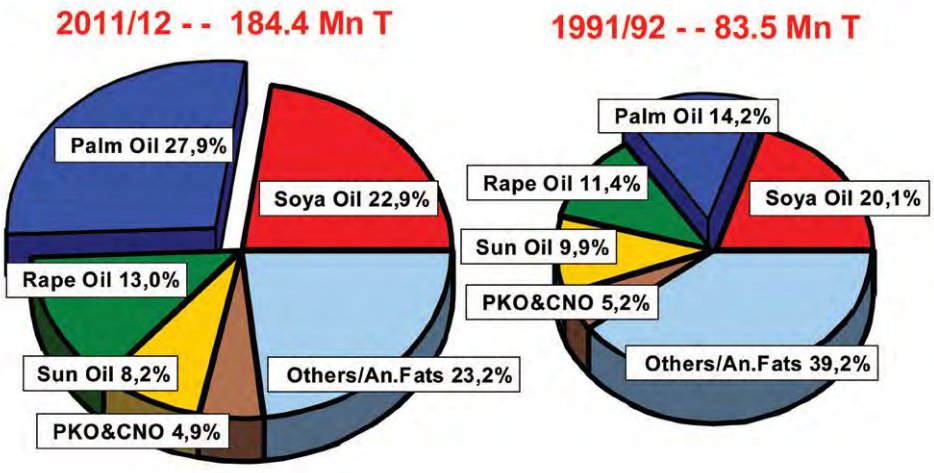

FIG. 3. World production of 17 oils and fats. Mn T, million metric tons ; An., animal ; PKO, palm kernel oil ; CNO, coconut oil.

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