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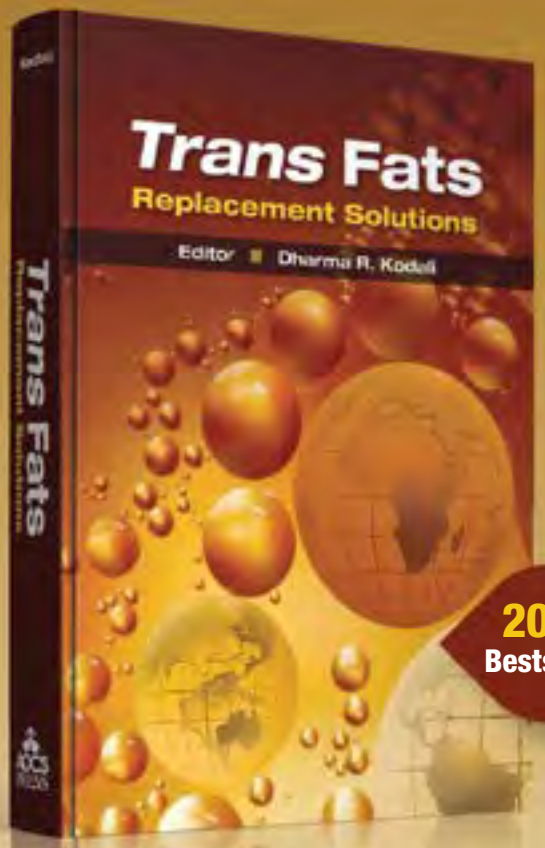

2014 Bestseller

Trans *Fats*

Replacement Solutions

Edited by Dharma R. Kodali

2014. Hardback. 468 pages. ISBN 978-0-9830791-5-6. Product code 271
List: $195 • AOCS Member: $145

Increased awareness regarding the adverse effects of *trans* fats on human health has led countries around the world to adopt regulations to control the content of *trans* fats in foods. The fats and oils industry and food product manufacturers have researched and implemented a number of novel, practical, and cost-effective solutions for replacing *trans* fats with alternate products. This title provides readers with a comprehensive explanation of *trans* fat chemistry, nutrition, methodology, and processing, and covers *trans* fat regulations and replacement solutions by country and region worldwide. Edited by Dharma Kodali, an AOCS member and global authority on *trans* fatty acid research, this book serves as a standalone resource for researchers, food formulators, and regulators alike.

Also available as an eBook on iTunes and Amazon.

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World-renowned Dr. Kodali is an expert in lipids and has given numerous invited lectures in a number of international conferences. He has been an active member of the American Oil Chemists' Society (AOCS) and the American Chemical Society for more than 30 years. His accomplishments include Cargill's Chairman's Innovation Award in 2001, the ACS's Industrial Innovation Award in 2002, and the AOCS T.L. Mounts award in 2003. He is an elected Fellow, founding member and past chair for the Industrial Oil Products Division, and member of the Books and Special Publications Committee at AOCS.

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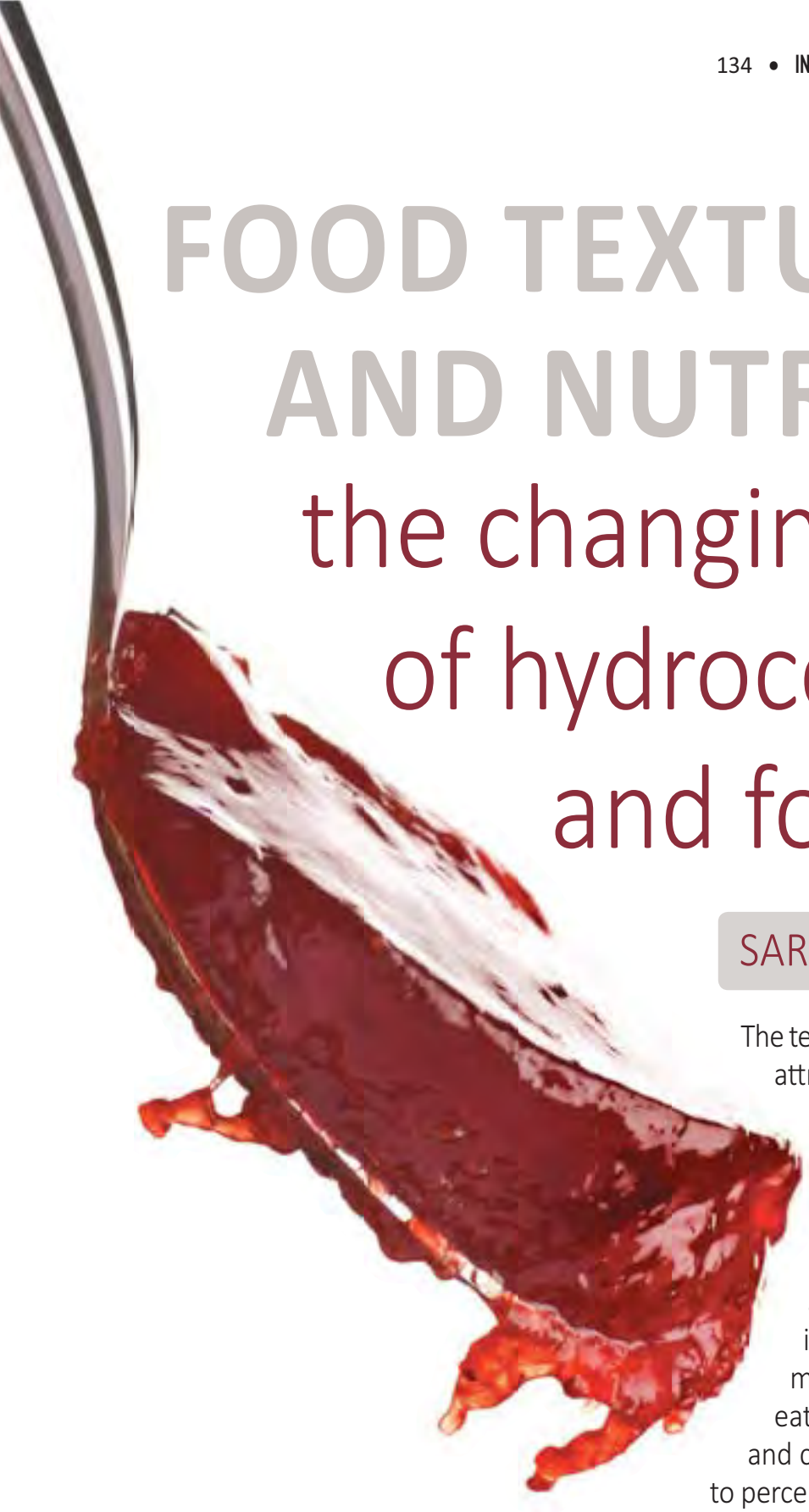

FOOD TEXTURE AND NUTRITION: the changing roles of hydrocolloids and food fibers

SARAH HOTCHKISS

The texture of food is one of the primary attributes affecting its quality. Along with taste and smell, texture defines a food and how we perceive that food's flavor and mouthfeel. Having a texture that we perceive as appropriate for the foodstuff concerned is vitally important to our enjoyment of food. For example, if we eat a low-fat yogurt that has a rich and creamy texture, we are less likely to perceive it as low-fat and we will enjoy it more. With the current drive toward more healthful eating, food texture and the development of creative texture solutions are becoming increasingly important.

Creating healthful food formulations is one of the key challenges facing the food industry. In the past, the production of food ingredients has led to the purposeful extraction, removal, substitution, and even disposal of many nutritional components. With the drive toward "naturalness" and the use of "less processed" food ingredients, the food texture industry is responding and changing. We are seeing:

- **hydrocolloids that have traditionally been used to provide texture only, being used for their nutritional functionality;**
- **intelligent processing of food fibers that allows for their use as food ingredients with a nutrition and texture function; and**
- **the emergence of new clean label functional food fibers with texture and nutritional functionality.**

Hydrocolloids have traditionally been used to provide textural functionality in foods such as gelling in jams, fruit fillings, and confectionery; thickening in dairy-based drinks and desserts; and water binding in meat products (Fig. 1, page 136).

By definition, hydrocolloids are substances that form colloidal systems when dispersed in water. Also known as gums, they are typically polymers of carbohydrates (also proteins) and are derived from a wide range of natural sources or are produced synthetically (Table 1, page 137). Hydrocolloids are widely exploited in industry, not just in the food sector, for their ability to control important functional properties including thickening and gelling, stabilization, dispersion, and emulsification.

As gelling and thickening agents, hydrocolloids are classed as food additives and their use is subject to EC Regulation 1333/2008. They are generally added at very low dosages (<2%, Table 1). This is because they typically have high molecular weight, and technological functionality can therefore be achieved using such low levels of inclusion. They are a versatile group of food additives that can be used to create a spectrum of different gel types and viscosities as appropriate for their intended application. The intrinsic properties, functional behavior, gelling mechanism, and nature of the colloidal systems that are formed vary. Each hydrocolloid behaves differently under different processing and formulation conditions such as pH and temperature—both of which can affect key parameters like solubility and gel stability. All of these factors can be manipulated to produce exactly the right texture solution. Furthermore, blends of hydrocolloids can be used synergistically (Fig. 2, page 138).

The demand for food hydrocolloids has risen significantly in recent years, partly in response to the rapid expansion in the convenience foods and ready meals sector but most importantly as a response to the rise in consumer awareness and growing demand for more healthful foods. Recent projections by Marketsandmarkets.com in October 2014 [1] estimate the market for hydrocolloids to exceed €7.9 million (~$9.63 million) by 2019. Hydrocolloids are finding ever-increasing application on the basis of functional properties that allow for the formulation of more healthful foods. Formulating for no/low fat, sugar, and salt (sodium) is a key driver. However, removing such ingredients from foods has significant implications on their functional, textural, and organoleptic attributes. Hydrocolloids can be used to provide functional solutions that allow for the reduction and replacement of these ingredients.

REDUCING AND REPLACING INGREDIENTS WITH HYDROCOLLOIDS

Reducing sugar: Pectin is a natural polysaccharide found in the cell walls of higher plants. It is widely used to gel, thicken, and stabilize foods, particularly, fruit-based applications. It is possible, through processing, to modify the basic galacturonic acid backbone of pectin to produce LM (low methoxy) and amidated LM pectins (LMA) which have specific gelling properties. These pectins will gel in low-sugar concentrations (<60%) and thus have wide application in low-sugar jams, marmalades and jellies, and specialist fruit-based dietary products such as those marketed to diabetics.

Reducing fat: By using hydrocolloids, calorie-dense fats and oils can be replaced with what is essentially structured water. Initially, starch gels were used, being characteristically soft, fat-like, and spreadable. Improved formulations now exist that make use of hydrocolloids as "*fat mimetics*." Cellulose derivatives like MCC (microcrystalline cellulose) are used in low-fat/no-fat ice creams and dressings. When activated in water with high shear, MCC forms a 3D network with unique fat mimetic properties with shear thinning, thixotropic behavior, and plastic texture.

Reducing salt: The relationship between viscosity and flavor perception is well-established; changes in viscosity are known to affect the release of both aroma compounds and of tastants like salt and sugar. Viscosity itself also contributes to the overall mouthfeel of a foodstuff. Innovative advances are being made in the use of hydrocolloids to control the microstructure of foods.

CONTINUED ON NEXT PAGE

What's an E-number?

Since 1986, food additives—colors, preservatives, antioxidants, stabilizers, gelling agents, thickeners, etc.—have been identified in food labels, either by name or by E-number. An E-number says that an additive has been approved for its intended use across the European Union. Approval depends on scientific testing and monitoring and is reviewed in the light of new scientific information.

HEALTH BENEFITS OF HYDROCOLLOIDS

Although not widely commercialized outside of Asia, there is substantial scientific support for the potential health benefits to humans of low-molecular-weight (LMW) hydrocolloids. This is not surprising given that many hydrocolloids including agar, konjac, and gum arabic are used as traditional medicines in different cultures. Some LMW agars have demonstrated prebiotic potential *in vivo,* also antioxidant and hepatoprotective effects; similarly, LMW alginates have demonstrated prebiotic effects and there is also evidence for their cytotoxic activity; LMW pectins are known for their immunomodulatory properties (Table 1).

Hydrocolloids can also be exploited for their inherent nutritional value as they can contain a large proportion of dietary fiber, between 60–90% (Viebke, *et al.*, 2014). [2] In general terms, dietary fiber is primarily derived from the cell wall material of plants (cereal foods, fruits, pulses, nuts, and vegetables) and is composed of complex, non-starch carbohydrates (cellulose, hemicellulose, pectins, gums, and mucilages) of 10 or more monomeric units and lignin—none of which are hydrolyzed in the small intestine of humans. From a regulatory perspective, a precise definition of dietary fiber was determined by Codex in 2009, this is discussed in detail by Viebke, *et al.,* 2014.

Dietary fiber can be further classified on the basis of its solubility. Fibers are classified as either soluble (pectins, gums, and mucilages) or insoluble (cellulose, hemicellulose, and lignin). Both types of fiber are important to human health, as they have different physiological effects and different implications for texture; hydrocolloids are potential sources of both. The majority of commercial fibers in the United States are insoluble while in Europe both soluble and insoluble fibers have similar market share. Insoluble fibers are typically derived from cellulose, oat, wheat, and pea, among others, and provide textural functionality such as water binding, thickening, anticaking, and dough improvement. The soluble fibers market is dominated by inulin along with polydextrose and resistant starches. These fibers are used primarily for fiber fortification and some for sugar replacement. According to a *Markets and Markets* report (March 2014) [3], the global market value for fibers in 2013 was $2.272 million with a forecasted value

CONTINUED ON PAGE 138

Fig. 1. Some typical food applications that make use of the textural functionality of food hydrocolloids: bake-stable fillings and glazes in bakery products; gelling function in jams, marmalades, and jellies; thickening and stabilization function in yogurts and dairy based desserts; confectionary; water binding in cooked meats; crispy coatings and oil barrier formation in breaded/deep-fried products.

Table 1. Polysaccharide food hydrocolloids, typical dose rates and functional application.

Hydrocolloids and sources	Typical dose (%)	Texture functionality and typical application	Documented health benefits
Trees (exudates)			
Gum Arabic/ acacia gum	0.01-55	Thickening in confectionery; stabilising agent in beverages; carrier for flavours	Source of soluble fibre for fortification, traditional medicine for digestive disorders, prebiotic potential, ability to lower blood triglyceride, cholesterol and glucose levels.
Seeds (flours)			
Carob/locust bean gum	0.1-1	Stabiliser in ice cream and dairy products, texturiser in cultured dairy products; water binder in meat	Increased satiety, modulation of glucose and cholesterol, reduction in gastric emptying time (reflux and diarrhoea) in infants.
Guar gum	0.05-0.5	Stabilising and thickening agent in dressings, soups and sauces; water binder in bakery dough; thickening and water binding in dairy products	PHGG is a source of dietary fibre, both guar and PHGG show hypoglycaemic, hypolipidemic & hypo-cholesterolemic effects, EFSA approved claim for guar and reduction of blood cholesterol, both modulate gut microflora and have positive effects on gut health.
Tara gum	0.05-0.5		
Plants (fragments)			
Pectin	0.15-6.3	Gelling agent in jams and marmalades; gelling and thickening agent in fruit preps and bake stable fillings; gelling and thickening in acidic dairy beverages	Immunomodulatory effects, potential anti-cancer activity.
Cellulose derivatives	0.2-3.5	CMC – thickener and water binder in bakery, ice cream and fruit juice beverage HPMC – thermo-gel properties exploited in restructured foods and bake stable fillings	MCC used as a fat replacer in low fat and slimming products.
Konjac	0.1-1.1	Gelling agent in jellies; thickening, gelling and texturizing agent in dairy products, gelling and water binding in meat	Used in low carbohydrate formulations, traditional medicine for use in digestive disorders; EFSA approved claim for control of normal blood cholesterol levels.
Seaweeds (cell walls)			
Agar	0.1-1	Gelling and stabilising agent in bakery products; texturizing agent in dairy products,; gelling agent in Asian desserts; gelling agent in fish and meat products	Fibre source, in particular SE Asia, LMW agars show prebiotic and antioxidant potential.
Alginate	0.3-1.5	Stabilising agent in ice cream; gelling, thickening and stabilising in bakery fillings; stabilisation and emulsification in dressings; gelling, thickening and stabilisation in fruit preparations and restructured foods	Used to create full fat mouth feel, beneficial to overall gut function, reduced intestinal absorption, increased satiety, modulation of colonic microflora, and elevation of colonic barrier function, hypocholesterolemic and hypolipidemic respons, LMW alginates prebiotic and cytotoxic potential
Carrageenan	0.02-1.5	Water binding and texturizing in meat products; stabilising agent in ice cream; thickening, stabilisation and suspension in milk drinks; thickening, texturizing in dairy products, gelling in desserts	
Microorganisms (fermentations)			
Gellan gum	0.05-2	Stabilising agent in confectionery, bake stable fillings; soya products and dairy *e.g.* sour cream	
Xanthan	0.1-1.5	Thickening and stabilising in dressings and sauces (incl. retorted), bakery fillings and non-dairy beverages	

INFORMATION

1. Hydrocolloids Market by Type (Gelatin, Xanthan, Carrageenan, Alginate, Agar, Pectin, Guar, Locust Bean, Arabic, CMC), Source, F&B Application, Function (Thickener, Stabilizer, Gelling, Fat Replacer, Coating) & Geography - Global Trend & Forecast to 2019. http://www.marketsandmarkets.com/Market-Reports/hydrocolloid-market-1231.html
2. Viebke, C., Al-Assafa, S. & Phillips, G.O. (2014).Food hydrocolloids and health claims. Bioactive Carbohydrates and Dietary Fibre 4: 101-114.
3. Dietary Fiber Market by Product Type (Conventional/ Novel & Soluble/ Insoluble) and Application (Food & Pharmaceutical) – Global Trends & Forecasts up to 2019. http://www.marketsandmarkets.com/Market-Reports/novel-dietary-fibers-market-858.html

in 2019 of $4.210 million—a compound annual growth rate (CAGR) of 13.1%.

In the past, hydrocolloids have not been widely used for fiber fortification, primarily on account of cost and formulation issues. The use of hydrocolloids is relatively expensive at $5–$15/kg versus the cost of traditional dietary fiber ingredients such as those derived from pea, wheat, and oat (typically $1–$2/kg). The superior gelling and thickening properties of hydrocolloids also makes it difficult to include them at physiologically beneficial levels or at a sufficient level to make a fiber claim.

An exception is partially hydrolyzed guar gum (PHGG) which is a variation of standard guar gum that is sold in the marketplace. As the name suggests, it is a hydrolyzed version of guar gum. It is a clear and colorless material unlike traditional guar which is cloudy and has a viscosity in the range of 7–12cps at 5%, whereas standard guar typically has a viscosity of 3000–5000cps at 1%. Commercially available PHGG comprises approximately 80% dietary fiber and low viscosity allows it to be used at concentrations sufficiently high to have a dietary fiber effect.

With the rapidly accelerating growth of the soluble fibers market, the challenge for hydrocolloids manufacturers must be to push the development of innovative and cheaper processing methodology that will allow for the production of lower-molecular-weight products with nutritional potential.

Traditionally, the hydrocolloids and fibers sectors have been viewed as distinct entities, albeit with some overlap in functionality (technical or nutritional), but with advances in processing technology and the drive toward "naturalness" and "less processed" food ingredients, we are seeing the

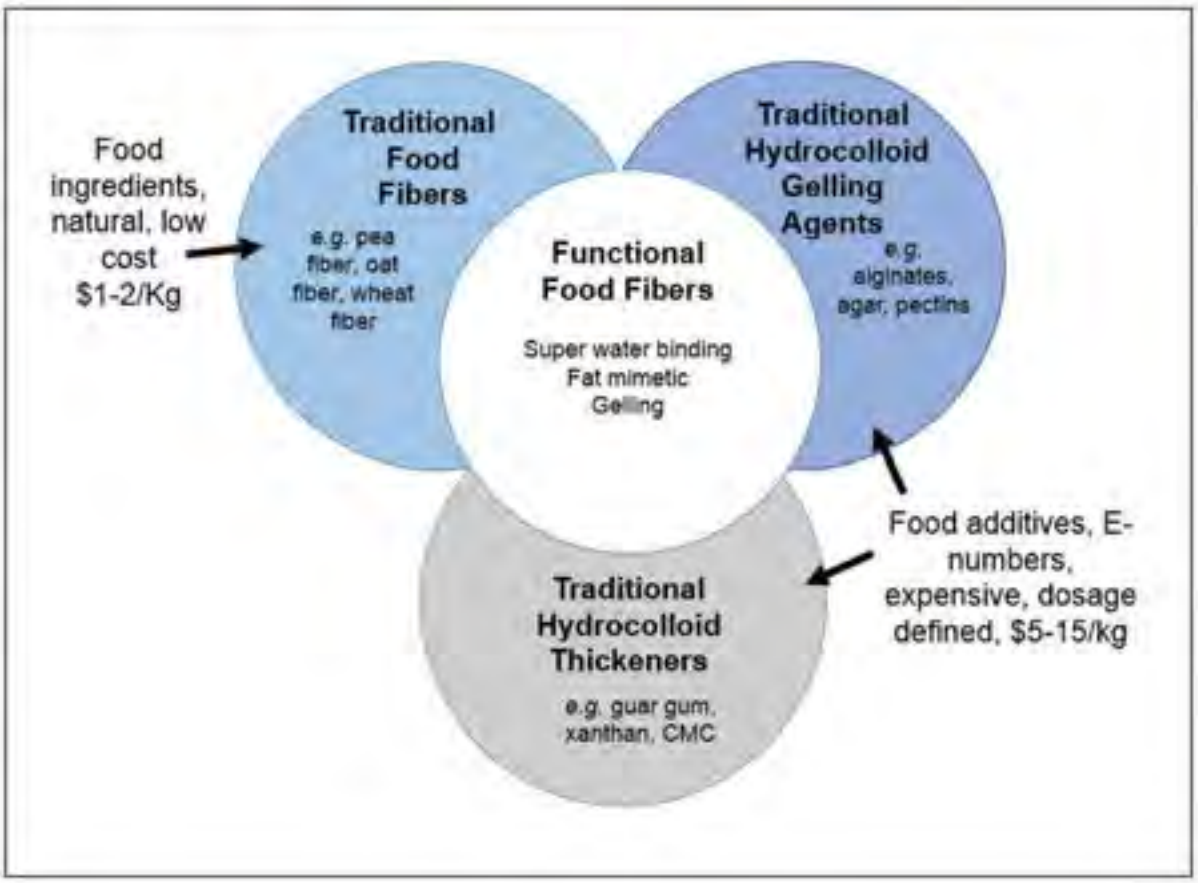

Fig. 2. The emergence of functional food fibers showing the overlap in functionality between hydrocolloid gelling agents and thickeners and traditional food fibers.

overlap expanding and the emergence of a new entity of "functional fibers" (Fig. 2). These are generally minimally processed vegetable, fruit, and cereal materials that contain both soluble and insoluble fractions with different functionalities. Successful products currently in the market place are derived from citrus and oat.

From the legal point of view, in Europe, the manufacturing process determines whether a functional fiber is an additive (with an E-number) or a food ingredient. As previously mentioned, hydrocolloids fit into the first category, being extracts of the original source material and generally modified physically and chemically so that they can no longer be considered food ingredients. Traditional fibers (*e.g.* fruit fibre, pea fibre, oat fiber, inulin, FOS, and resistant starch) are food ingredients; however, the distinction is somewhat blurred with regard to functional fibers.

More sophisticated processing techniques are being employed to produce functional fibers, including chemical, enzymatic, mechanical (shearing and microfibrillation), thermal, or thermos–mechanical (extrusion) treatments. The resulting products have more controllable particle size and superior water binding ability that can also provide viscosity and gelling behavior that is on a par with some hydrocolloids. Consequently, functional fibers are now being used to provide textural functionality that has, until recently, been fulfilled by hydrocolloids. Functional fibers are mainly used in bakery and meat applications where water binding is key but also as stabilizers in beverages, to prevent the formation of ice crystals in frozen foods, and as a barrier to oils and fats in breaded/fried foods.

With the general global push toward achieving food security, resource efficiency, and minimization of waste, the future of functional fibers looks interesting. Smart usage of agricultural waste and processing by products is at the forefront of many research agendas. Many biomass streams have already been successfully converted to functional ingredients for the food industry and fiber producers are continuously looking for promising new candidates.

Sarah Hotchkiss is projects manager at CyberColloids. CyberColloids are experts in hydrocolloid and polysaccharide chemistry. The company is engaged in research activities aimed at developing novel processing methodologies, new ingredients, and innovative applications for new raw materials and downstream products that are derived from plants and seaweed—thus providing creative research solutions and adding value to existing processing practices. She can be contacted at sarah@cybercolloids.net.

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—MICHAEL F. COX

"AOCS has provided me international exposure in lipid research, and without the Society, I would never have achieved my goals no matter how hard I worked. AOCS is like an extended family to me. I can connect up and rely on my fellow members, be they the young or the famous; together we move the boundary of lipid research further."

—MARCEL LIE KEN JIE

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No more boring posters: **how to raise the bar on your next poster presentation**

Crystal Snyder

"Congratulations, your abstract has been accepted for a poster presentation."

Whether it's your first conference or your 50th, posters are an important part of any researcher's presentation repertoire. A well-designed research poster can be a convenient way to disseminate your results and generate discussion about your work. Unfortunately, posters can also be one of the most challenging forms of scholarly communication to master. With so much for conference attendees to see in so little time, the onus is on presenters to stand out from the crowd. It takes good design and good data to make a lasting impression.

With the 106th AOCS Annual Meeting & Industry Showcases just around the corner, these tips will help you avoid the most common poster pitfalls and create a poster that attracts the attention your research deserves.

POSTER PITFALL #1: THE "WALL OF DATA" POSTER

We've all seen this poster. Perhaps we've even been guilty of it once or twice, but we'll never admit it, because we know better.

- **In creating effective research posters, design can be just as important as data.**
- **Building your poster around clear "take home" messages will keep it focused and guide your design decisions.**
- **Effective visual design and presentation should help you start a conversation with your audience about your research.**

It's so crammed with data that by the time we get to the references, we're using font size 8 and skillfully nudging text boxes as though we're putting the finishing touches on a house of cards. Just. One. More. Figure.

The problem with this kind of poster is that it overwhelms your audience before they even have a chance to take interest. With only a few minutes to absorb and comprehend new information, and other posters vying for their attention, few people will spend enough time with your poster to truly make sense of it—which means all of that extra detail is actually working against you.

Fortunately, this most common of poster problems is also straightforward to avoid. The key is to think of your poster, not as a mini-paper, but as a visual abstract. An effective poster conveys your research in broad strokes, opening the door to conversation rather than burying the audience in details. The difficulty from a presenter's standpoint is knowing not just what to put on the poster, but more often, what to leave off.

So how do you decide? Here are some strategies to try:

- Distill your poster into 2–3 main take home messages. Ask yourself, "If someone visits your poster and remembers nothing else, what are the most important things they need to know about your research?"
- As a rule of thumb, consider that each of these take-home messages needs to be conveyed clearly in under 2 minutes. You should be able to present all of the key points to a casual poster browser in 3–5 minutes without rushing.
- Anchor your poster with dominant visuals that support your key messages, then build the rest of your poster around them.
- Remember that most people scan posters rather than reading from beginning to end. Select, arrange, and caption your images so that your audience can draw the intended conclusion at a glance, without reading the whole poster. (Try testing your poster drafts on your colleagues to see if you're on the right track.)
- When editing your poster, ask yourself how each element (text or visual) contributes to your key

messages. If you cannot directly link content to one or more of your key messages, consider leaving it out.

- If you feel it's necessary to provide supplemental information, consider creating a handout that includes a copy of your poster with the additional information on the back.

POSTER PITFALL #2: THE "CRIMES AGAINST POWERPOINT" POSTER

Once you've determined the central messages of your poster, you can focus on the design. There is no shortage of free templates available online to help you get started, and many research institutions will have a selection of templates that conform with the institutional visual identity. But beware the copy-and-paste approach. Not all templates are good examples of effective poster design. Your design should always be driven by your data, not by the layout of the template.

Whatever template you choose to start with, here are some things you might need to tweak to make it work for you:

- Your poster should have a clear visual hierarchy; that is, the size and space allocated to each element should reflect its relative importance. Just as you would expect titles to be larger than subtitles or captions, you should expect that your data will most often take up more space than your methods or introduction.
- Rather than simply adhering to a generic three- or four-column template, let your dominant visuals (i.e. your most important data) be a natural focal point for your poster.
- When it comes to color, more is not better. Stick to 2–3 colors that complement one another, and use them consistently throughout your poster. Avoid overlapping primary colors (e.g. red on blue) or poorly contrasting colors (e.g. black on dark green), as these can be hard to read at a distance.
- As a rule of thumb, text should be legible at a distance of 3 feet, and sans-serif fonts (e.g. Arial, Helvetica) are easiest to read in large print.
- When choosing graphics (including logos), use the highest possible resolution to ensure the image quality is sufficient for large-format printing.
- White space is not wasted space. Use white space strategically to break up the visual elements and combat the dreaded "wall of data" effect.

For more information

1. URI Poster Design Tip Sheet (quick poster tips, plus links to templates and free design tools): http://bit.ly/1ApGfDz
2. Designing Conference Posters (an excellent poster design resource maintained by Colin Purington): http://colinpurrington.com/tips/academic/posterdesign
3. Pimp My Poster Flickr Group (large collection of poster examples with feedback; users can also upload their own posters to get feedback from the group): https://www.flickr.com/groups/pimpmyposter/pool/

POSTER PITFALL #3: THE "ABSENTEE PRESENTER" POSTER

One of the most overlooked aspects of poster design is the role of the presenter. Poster sessions offer a valuable opportunity to interact one-on-one with your audience, and customize your presentation to highlight different aspects according to your audience's interests. As a presenter, you can bring the

CONTINUED ON NEXT PAGE

research alive in a way that a poster alone cannot. Without an effective presentation, even well-designed posters can fall short of making an impact.

Here are some tips for making the most of your poster presentation time:

- Be approachable. When standing with your poster, keep an open body posture and make eye contact.
- Use the informal atmosphere of a poster session to your benefit. Ask your audience questions to assess their understanding and encourage a two-sided conversation. It will make the session more enjoyable for both of you, and your presentation more memorable for the right reasons.
- Even if a conversation is going well, keep it brief. Many people will be reluctant to interrupt a presentation in progress. Invite newcomers to join in the discussion, or if it seems to be running long or off-topic, respectfully offer to continue at another time.
- If you cannot attend your poster during one of the conference's scheduled poster viewing times, post your alternate availability or contact information with your poster. This gives your potential audience another opportunity to connect with you.
- Get creative. In the age of ubiquitous smart phones and tablets, it's easier than ever to complement your poster with videos or other multimedia resources. Include a QR code on your poster to quickly connect your audience to your website or publications.

A FINAL WORD OF ADVICE

The paradox of effective design is that it's often invisible. It's easier to see what's wrong with a poster than to notice what's working well. While this is helpful for avoiding the common mistakes, it's just as important to cultivate a conscious awareness of good design.

So the next time you're at a poster session, pay attention to what works, and take note. And don't forget to compliment the presenter, because great posters don't just happen.

Crystal Snyder is the coordinator of the University of Alberta's Undergraduate Research Initiative and a former laboratory manager in Agricultural Lipid Biotechnology. She can be reached at crystal.snyder@ualberta.ca

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The US Pharmacopeial Convention has pre-released a guidance document, prior to its publication in the September 2015 *Food Chemicals Codex*, that offers a framework for the food industry and regulators for developing and implementing preventive management systems to deal specifically with economically motivated fraudulent adulteration (EMA) of food ingredients. The guidance provides a comprehensive step-wise approach for preventing EMA at the ingredient level. It allows individual assessment of all the indicators and factors known to contribute to fraud vulnerabilities and impacts, as well as qualitative tools to make sense of the results. See http://tinyurl.com/USP-EMA for the complete document.

■■■

Evolva, a Swiss biotech company, has acquired California-based Allylix, which focuses on fermentation-based flavor and fragrance ingredients. Cargill, Evolva's partner on its stevia program, will invest $4 million in Evolva shares in support of the transaction. The transaction was expected to close by mid-December 2014. According to Evolva, Allylix is developing a brewed version of sandalwood oil, a highly sought-after fragrance that is now in short supply because its natural source—the tropical sandalwood tree—has largely disappeared owing to overharvesting and illegal logging.

NEWSMAKERS

Andrew Proctor of the University of Arkansas, after many years of service, has stepped down as senior associate editor for analytical and physical chemistry for the *Journal of the American Oil Chemists' Society*. Rick Ashby of the US Department of Agriculture–Agricultural Research Service's Eastern Regional Research Center, who has been serving as an associate editor, has taken over the position.

■■■

AOCS' *Journal of Surfactants and Detergents* (*JSD*) has a new editor-in-chief (EiC): George Smith, a research fellow at Huntsman Corp. and head

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NEWS & NOTEWORTHY

Rabobank agri commodity market outlook for 2015

Rabobank, the global agricultural banking cooperative, has published its outlook for the global agri commodity markets in 2015, looking at issues of demand, supply, and pricing across international agri commodities, and forecasting a 12-month price outlook for 12 major agri commodities.

In the report, the bank's Agri Commodities Markets Research analysts say that fundamentals in the agri commodity markets appear more balanced through 2015, but they expect narrower trading ranges for many commodities versus 2014. On the demand side, growth has slowed in recent years. However, lower price levels should now encourage consumption growth, which will support prices. Rabobank says key variables to watch in 2015 are US dollar strength, uncertain Chinese demand growth, slowing biofuel demand, and oil price weakness.

Stefan Vogel, global head of Rabobank Agri Commodities Markets Research, said, "2015 will be another interesting year for agri commodities. Macro drivers remain very much in play and price swings from supply and demand shocks are still likely, given that the stocks for most commodities are not yet at levels necessary to provide an adequate buffer."

The pace of world economic growth has been disappointing during 2014, particularly in the Eurozone where counter sanctions from Russia have hindered economic recovery. Rabobank says that the United Kingdom and the United States are the bright spots for 2015, but their pace of expansion will be tempered by slow growth elsewhere. Significantly, in 2015 Rabobank expects a downward revision of China's 7.5% annual growth rate.

Rabobank says farmer selling and planting decisions, global demand, and weather-related production risks remain key drivers through 2015. Assuming normal growing conditions, moderate increases in demand will allow stocks to build for most commodities through 2015.

However, the projected lower price levels through 2015 also provide a great

CONTINUED ON NEXT PAGE

incentive for consumption to exceed the forecast levels. In particular, China's import demand will continue to be one of the most important variables for many agri commodity markets.

On the supply side, weather-related production abnormalities will impact agri commodity prices. The weather in 2014 was somewhat of an anomaly for agri commodity production, with favorable-to-ideal growing-season conditions experienced across most regions driving bumper crops across commodities. The only exception was persistent drought conditions across central and southeast Brazil and the east coast of Australia. Despite the higher beginning stocks in 2015, weather threats, including risk of a weak-to-moderate El Niño, could cause prices to diverge from Rabobank's base case.

Some of Rabobank's specific commodity-related forecasts include the following:

- The International Commodities Exchange No. 2 cotton is expected to remain subdued through 2015, as China's import demand is projected to slow by the most since 2008/2009.
- Palm oil prices are expected to improve in 2015, although strong soybean supplies will limit the upside.
- Soymeal prices in 2015 will be below the high levels of the last two years but will be supported by strong global demand.
- Soy oil futures are expected to move lower to sideways over the course of 2015, with a stronger bearish move later in the year.
- Soybean prices in 2015 are expected to trade in a tighter range than in previous years, as global soybean availability has significantly improved following the record US crop.
- Cocoa futures are expected to remain under pressure through 2015, easing from an average of $2,800/metric ton (MT) in the first quarter to $2,700/MT in the fourth quarter of 2015.

Why plants do not get sunburn

Plants rely on sunlight to make their food, but they also need protection from its harmful rays, just as humans do. Recently, scientists discovered a group of molecules in plants that shields them from sun damage. Now, one team reports on the mechanics of how these natural plant sunscreens work.

Timothy Zwier and colleagues at Purdue University in West Lafayette, Indiana, USA, note that the harsh ultraviolet radiation plants are exposed to daily can cause serious damage to plant DNA and, as a result, hinder plant growth. Biochemical tests have shown that plants produce special molecules and send them to the outer layer of their leaves to protect themselves. These molecules, called sinapate esters, appear to block ultraviolet-B radiation from penetrating deeper into leaves where it might otherwise disrupt a plant's normal development. Although researchers have been amassing evidence that points to sinapate esters as the protective molecules, no one had investigated in detail what happens to them under UV exposure. Zwier's team wanted to understand this process.

AOCS MEETING WATCH

May 3–6, 2015. 106th AOCS Annual Meeting and Industry Showcases, Rosen Shingle Creek, Orlando, Florida, USA. http://annualmeeting.aocs.org

October 27–30, 2015. SODEOPEC2015, Hyatt Regency Miami, Miami, Florida, USA. http://sodeopec.aocs.org

May 1–4, 2016. 107th AOCS Annual Meeting & Expo, Calvin L. Rampton Salt Palace Convention Center, Salt Lake City, Utah, USA.

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

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

The researchers coaxed these molecules into the gas phase and zapped them with UVB radiation from a laser in the laboratory. They found that the particular sinapate ester that plants use as a screen against UVB was inherently capable of soaking up radiation at every wavelength across the UVB spectrum. Thus, it is remarkably efficient at absorbing harsh radiation that could otherwise damage the plant. Their findings further shore up the idea that this class of molecules does indeed comprise plant-made sunblock, the researchers say.

The authors acknowledge funding from the Department of Energy Basic Energy Sciences. The article appeared in the *Journal of the American Chemical Society* (http://dx.doi.org/10.1021/ja5059026, 2014).

Cargill introduces nutrient formulating platform

Cargill Animal Nutrition has introduced a proprietary nutrient formulating platform, Cargill Nutrition System (CNS), which combines real-time global nutrient analysis of feed ingredients with the latest research into nutrient application and ingredient sourcing. The CNS database is comprised of more than 2 million nutrient samples, covering more than 200 ingredients, and 10 million annual nutrient predictions, Cargill said in a statement.

"CNS allows [us] to deliver precise feed formulations to producers based on a host of variables often unique to each individual customer: species, climate, location, business goals, nutrient-content requirements, and cost considerations of available ingredients," according to the news release.

EFSA updates advice on allergens

The European Food Safety Authority (EFSA) has updated its scientific advice on food allergens. The Authority's scientific opinion looks in detail at all the allergenic products and substances whose presence in food must be indicated on labeling, according to EU law. These include cereals containing gluten, milk, eggs, nuts, peanuts, soybeans, fish, crustaceans, mollusks, celery, lupin, sesame, mustard, and sulfites.

The opinion is based on a review of all published data on the prevalence of food allergies in Europe. For each food product or substance on the EU list of allergens, information is given on:

- The prevalence of allergies in unselected populations;
- Proteins identified as food allergens;
- Cross-reactivities;
- The effects of food processing on the allergenicity of the food or ingredient;
- Methods for detecting allergens and allergenic foods, including mass spectrometry and DNA methods as well as the more common immunological approach; and
- Doses observed to trigger adverse reactions in sensitive individuals.

of the Home and Personal Care Technology Group. Smith succeeds Jean-Louis Salager, professor emeritus of Venezuela's University of the Andes.

"I am deeply honored to have been selected as the new EiC and have very big shoes to fill, indeed," said Smith. "I'm looking forward to working with AOCS staff and the associate editor team to maintain the high level of scientific integrity and to serve all the *JSD* stakeholders in the coming years."

■■■

In November 2014, five leaders from across the cleaning product supply chain were elected as new members of the American Cleaning Institute (ACI) Board of Directors. They include: Ralf Brinkmann, business president, Dow Consumer Care, The Dow Chemical Co.; Shailesh Jejurikar, president, fabric care, North America, brand building organization, global fabric and home care, global new business creation, The Procter& Gamble Co.; Ole Kirk, vice president for household care R&D, Novozymes A/S; Frank Pacholec, vice president, research & development, corporate sustainability officer, Stepan Co.; and Dawn Willoughby, executive vice president and chief operating officer—cleaning, international, and professional products, The Clorox Co. ACI is a trade association based in Washington, DC, USA.

■■■

Archer Daniels Midland Co. (ADM; Chicago, Illinois, USA) has named Ken Campbell, who was vice president of ADM's North American Oilseeds unit, as president of the company's newly acquired ingredients company, Specialty Commodities Inc. Previously, ADM named Greg Morris, head of North American oilseeds processing, as president of its new Wild Flavors and Specialty Ingredients business unit, which will include Specialty Commodities. ■

EFSA's Panel on Dietetic Products, Nutrition and Allergies points out that the prevalence of food allergies is difficult to establish because of a scarcity of studies available for some geographical areas and the use of different methodologies to gather prevalence data. However, using food challenges as a criterion for diagnosis, the prevalence of food allergies across Europe has been estimated at around 1% for both adults and children.

About 75% of allergic reactions among children are caused by egg, peanut, cows' milk, fish, and nuts. About 50% of allergic reactions among adults are to fruits of the latex group and of the *Rosaceae* family (which includes apples, pears cherries, raspberries, strawberries, and almonds), vegetables of the *Apiaceae* family (which includes celery, carrots, and aromatic herbs), and various nuts and peanuts (ground nuts).

For the complete report (PDF), see http://tinyurl.com/EFSA-Allergens. ■

SUSTAINABILITY WATCH

Sustainable food supply chains

The Long and the Short of It, according to a report by that name out of the United Kingdom, is that "the scale and pace of activity [toward creating sustainable food supply chains] needs to accelerate to be commensurate with the scale of global challenges."

The report was produced by UK's Industry and Parliament Trust, Food Ethics Council, and the University of Warwick. The findings will be presented to the European Commission and the European Parliament's Agriculture and Rural Development Committee, according to FoodNavigator.com.

Price remains the key consideration for consumers when food shopping, the report notes, whereas issues regarding sustainable supply chains are not a concern. This means that companies and governments will have to make investments in "resilient, efficient, fair, long-term, transparent, traceable, and forward-looking food supply chains."

See http://tinyurl.com/Sus-Food-LandS (PDF) for the complete report.

Gut bacteria from a worm can degrade plastic

Plastic is well known for sticking around in the environment for years without breaking down, contributing significantly to litter and landfills. However, scientists have now discovered that bacteria from the guts of a worm known to munch on food packaging can degrade polyethylene, the most common plastic. Reported in *Environmental Science & Technology* (http://dx.doi.org/10.1021/es504038a, 2014), the finding could lead to new ways to help get rid of the otherwise persistent waste, the researchers say.

Jun Yang and colleagues in China and the United States point out that the global plastics industry churns out about 140 million metric tons of polyethylene every year. Much of it goes into the bags, bottles, and boxes that are used and then thrown out. Scientists have been trying to figure out for years how to make this plastic trash go away. Some of the most recent studies have tried using bacteria on plastic to degrade it, but this required first exposing the plastic to light or heat. Yang's team wanted to find bacteria that could degrade polyethylene in one step.

The researchers turned to a plastic-eating moth larva known as a waxworm. They found that at least two strains of the waxworm's gut microbes could degrade polyethylene without a pretreatment step. They say the results point toward a new, more direct way to biodegrade plastic.

The authors acknowledge funding from the National Natural Science Foundation of China, the National Basic Research Program of China, and the Shenzhen Key Laboratory of Bioenergy. ■

BRIEFS

The US Department of Agriculture announced in December 2014 that it is providing $5.6 million in grants to 220 producers to support the production of advanced biofuels, and is awarding more than $4 million in additional grants that will advance the bioeconomy. The National Biodiesel Board and Regents of the University of Idaho were among the grantees, receiving $768,000 and $192,000, respectively, through the Biodiesel Fuel Education Program. The complete list (PDF) is available at http://tinyurl.com/USDA-Bio-Grants.

■■■

If this becomes a trend, it could bode well for the bioeconomy: Three large companies recently upped their commitment to renewable energy. NRG Energy, Inc.—which says it is the second-largest conventional power generation company in the United States—plans to cut CO_2 emissions by 50% by 2030 and 90% by 2050 using 2014 usage as a baseline. Wal-Mart Stores, Inc., which has vowed to get all of its energy from renewables, said in late 2014 that 24.2% of its electricity needs globally are supplied by renewable sources. Lastly, online retailer Amazon's cloud computing division—Amazon Web Services—said in December 2014 that it has a "long-term commitment to achieve 100% renewable energy usage" for its "global infrastructure footprint." No deadline for the reduction was given. For more information, see http://tinyurl.com/NRG-Renewable, http://tinyurl.com/Walmart-Energy, and http://tinyurl.com/Amazon-100-Renewable.

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Biodiesel Digest reports that the US District Court for the Southern District of Indiana has ruled against GS CleanTech in a suit the company had brought against 17 ethanol plants and manufacturers of ethanol production equipment, who CleanTech claimed had violated its corn oil production patents. The company said it would appeal the ruling. See Inform 18:714–717, 2007 for a feature article on the technology. ■

ENERGY

Toward a low-cost 'artificial leaf' that produces clean hydrogen fuel

For years, scientists have been pursuing "artificial leaf" technology, a green approach to making hydrogen fuel that copies plants' ability to convert sunlight into a form of energy they can use. Now, one team reports progress toward a stand-alone system that lends itself to large-scale, low-cost production. They describe their nanowire mesh design in the journal *ACS Nano* (http://dx.doi.org/10.1021/nn5051954, 2014).

Peidong Yang, Bin Liu, and colleagues note that harnessing sunlight to split water and harvest hydrogen is one of the most intriguing ways to achieve clean energy. Automakers have started introducing hydrogen fuel cell vehicles, which only emit water when driven. However, making hydrogen, which mostly comes from natural gas, requires electricity from conventional carbon dioxide-emitting power plants. Producing hydrogen at low cost from water using clean energy from the sun would make this form of energy, which could also power homes and businesses, far more environmentally friendly. Building on a decade of work in this area, Yang's team has taken one more step toward this goal.

The researchers took a page from the paper industry, using one of its processes to make a flat mesh out of light-absorbing semiconductor nanowires that, when immersed in water and exposed to sunlight, produces hydrogen gas. The scientists say that the technique could allow their technology to be scaled up at low cost. Although boosting efficiency remains a challenge, their

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approach—unlike other artificial leaf systems—is freestanding and does not require any additional wires or other external devices that would add to the environmental footprint.

The authors acknowledge funding from the US Department of Energy and the Singapore-Berkeley Research Initiative for Sustainable Energy. The team members are affiliated with the University of California, Berkeley, the Lawrence Berkeley National Laboratory, and the Nanyang Technological University in Singapore.

Meanwhile, Toyota announced that it will introduce, sometime in 2015, the first hydrogen fuel-cell car for personal use that emits only water. An article about this development in *Chemical & Engineering News* (*C&EN*) explains how hydrogen could supplant hybrid and electric car technology—and someday even spur the demise of the gasoline engine.

Melody M. Bomgardner, a senior editor at *C&EN*, notes that the first fuel-cell vehicles will be sold in Japan, then California. Although Toyota is the only company poised to sell fuel-cell vehicles soon, other companies are also investing billions of dollars in the technology. Hyundai, General Motors, Honda, and Daimler have all announced plans to offer their own hydrogen models in the near future. The first cars will set customers back about $70,000, but this marks a 95% cut in system costs in less than 10 years. As they improve the technology further, car manufacturers expect that prices will come down to more affordable levels.

But does that translate into a practical edge for consumers? With a hydrogen vehicle, filling up only takes about three minutes, compared to an overnight charge for an all-electric car. Fuel-cell vehicles can go 400 miles on one fill-up, which is less than a hybrid but with no polluting emissions. Although electrics also boast zero tailpipe emissions, they will have a tough time competing with that kind of range. Given these advantages, some experts suggest hydrogen fuel cells could someday overtake hybrid, electric, and even internal combustion technologies.

Boeing conducts first flight with 'green diesel'

In December 2014, Boeing (Chicago, Illinois, USA) completed the world's first flight using a blend of 15% "green diesel" and 85% petroleum jet fuel in the test jet's left engine.

"Green diesel offers a tremendous opportunity to make sustainable aviation biofuel more available and more affordable for our customers," said Julie Felgar, managing director of Environmental Strategy and Integration, Boeing Commercial Airplanes. "We will provide data from several ecoDemonstrator flights to support efforts to approve this fuel for commercial aviation and help meet our industry's environmental goals."

Sustainable green diesel is made from vegetable oils, waste cooking oil, and waste animal fats. Boeing previously found that this fuel is chemically similar to HEFA (hydro-processed esters and fatty acids) aviation biofuel approved in 2011 by ASTM International. Green diesel is chemically distinct and a different fuel product than biodiesel, which is used in ground transportation.

With a production capacity of 800 million gallons (3 billion liters) in the United States, Europe, and Asia, green diesel could rapidly supply as much as 1% of global jet fuel demand. With a current wholesale cost of about $3 per gallon, inclusive of US government incentives, green diesel approaches price parity with petroleum jet fuel.

"The airplane performed as designed with the green diesel blend, just as it does with conventional jet fuel," said Capt. Mike Carriker, chief pilot. "This is exactly what we want to see in flight tests with a new type of fuel."

Green diesel is among more than 25 new technologies being tested by Boeing's ecoDemonstrator Program aboard 787 Dreamliner ZA004. The program accelerates the testing, refinement, and use of new technologies and methods that can improve aviation's environmental performance.

On a lifecycle basis, sustainably produced green diesel reduces carbon emissions by 50% to 90% compared with fossil fuel, according to Finland-based Neste Oil, which supplied green diesel for the ecoDemonstrator. The flight test was coordinated with the US Federal Aviation Administration, Rolls-Royce, and Pratt & Whitney; EPIC Aviation blended the fuel.

New enzyme technology converts waste oils into biodiesel

Novozymes has introduced Novozymes Eversa®, which it claims is the first commercially available enzymatic solution to make biodiesel from waste oils.

"Growing demand for vegetable oil in the food industry has resulted in increased prices, causing biodiesel producers to search for alternative—and more sustainable—feedstocks," noted the company in a news release. Most of the oils currently used are sourced from soybeans, palm, or rapeseed, and typically contain less than 0.5% free fatty acids (FFAs). Existing biodiesel process designs have difficulty handling oils containing more than 0.5% FFAs, the Novozymes release said, "meaning that waste oils with high FFAs have not been a viable feedstock option until now."

"The idea of enzymatic biodiesel is not new, but the costs involved have been too high for commercial viability," said Frederik Mejlby, marketing director for Novozymes' Grain Processing division. "Eversa changes this and enables biodiesel producers to finally work with waste oils and enjoy feedstock flexibility to avoid the pinch of volatile pricing." Eversa can work with a broad range of fatty materials as feedstock, Novozymes said, but initial focus has been on used cooking oil, DDGS corn oil, and fatty acid distillates.

Making the change from a chemical catalyst to the enzymatic process requires retrofitting in existing plants. Biodiesel producers looking to utilize Eversa will therefore have to invest time and resources to make the switch to the enzymatic process. Novozymes' engineering partners estimate that the resulting

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BRIEFS

A paper that called into question the health benefits of fish oil has been retracted by the *Journal of Lipids* after suspicions were raised about the author's undeclared competing interests. The author, Brian Peskin, a former adjunct professor in the department of pharmacy and health sciences at Texas Southern University (Houston, USA), is associated with Peskin Pharmaceuticals, a firm that is behind several patents for products that could be in direct competition with fish oils. Read more about how a reader of the journal discovered the undisclosed conflict of interest at the blog *Retraction Watch* (http://tinyurl.com/FishOilRetraction).

■■■

The Environmental Working Group (EWG; Washington, DC, USA) has released the first "Dirty Dozen" list for food additives in an effort to highlight "some of the worst failures of the [US] regulatory system," it says. The list includes nitrates and nitrites, potassium bromate, and propylparaben, among others. "There are some additives that are classified generally recognized as safe and we really question that classification because they're not free of health concerns," Johanna Congleton, EWG senior scientist, told *Food Safety News*. Read the full guide at http://tinyurl.com/DirtyDozenFood.

■■■

NattoPharma ASA (Høvick, Norway) has received a Canadian patent (No. 2,657,748: "Pharmaceutical and Nutraceutical Products Comprising Vitamin K2"), which covers orally administered nutraceutical and pharmaceutical products providing vitamin K2 in combination with polyunsaturated fatty acids, such as fish or krill oil. "Canada joins Australia, New Zealand, and other markets recognizing vitamin K2's benefits for bone and cardiovascular health," said CEO Hogne Vik. "In this case, vitamin K2's synergy with fish oil is an added benefit." ■

FOOD, HEALTH & NUTRITION

The debate over whether saturated fat has been unfairly vilified rages on as a study reveals levels of saturated fat in the blood are correlated with carbohydrates, not fat, in the diet.

Doubling dietary saturated fat does not boost levels in blood

High plasma saturated fatty acid levels are associated with a greater risk for developing type-2 diabetes and heart disease. However, recent meta-analyses have found no such association between saturated fat consumption and heart disease. So while lowering saturated fat in the blood is an important goal for good health, replacing dietary saturated fat with carbohydrates is not the way to accomplish it, and in fact, the opposite may be true, according to a study in PLOS ONE led by The Ohio State University (Columbus, USA) researcher Jeff Volek (http://dx.doi.org/10.1371/journal.pone.0113605, 2014).

The finding "challenges the conventional wisdom that has demonized saturated fat and extends our knowledge of why dietary saturated fat doesn't correlate with disease," Volek said in a news release.

The researchers performed controlled feeding studies on a group of 16 adults with an average age of 45, all of whom had metabolic syndrome, or the presence of several factors that increase the risk for diabetes and heart disease. These factors include excess belly fat, elevated blood pressure, low "good" cholesterol, insulin resistance or glucose intolerance, and high triglycerides. Over the course of 18 weeks, the participants were fed six 3-week diets in which total calories

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(2,500) and protein (130 g) were kept the same. The first diet was composed of 47 g/day carbohydrates and 84 g/day saturated fat (which represents a near doubling from baseline saturated fat levels of 46 g/day). Every three weeks, the level of carbohydrates was incrementally increased with an accompanying decrease in dietary saturated fat. The final diet consisted of 346 g/day carbohydrates and 32 g/day saturated fat. On this final diet, carbohydrates represented 55% of daily calories, which roughly matches the estimated daily percentage of energy provided by carbohydrates in the American diet.

At each stage, the team analyzed the level of total saturated fat in the blood and found it did not increase during the introduction of the first high-fat, low-carbohydrate diet. "We had people eat two times more saturated fat than they had been eating before entering the study, yet when we measured saturated fat in their blood in their blood, it went down in the majority of people," Volek said. "Other traditional markers improved, as well," such as blood glucose, insulin, and blood pressure.

Yet as carbohydrates were reintroduced into the diet, plasma levels of palmitoleic acid, which is associated with unhealthful metabolism of carbohydrates that previous research suggests can promote disease, gradually increased as well. When that marker increases, Volek said, it's a signal that an increasing proportion of carbohydrates are being converted to fat instead of being burned as fuel. The key to losing weight is to reduce carbohydrates and add fat to the diet in a well-controlled way, Volek noted, which ensures that the body will promptly burn the fat as fuel instead of storing it.

"There is widespread misunderstanding about saturated fat," Volek said. "In population studies, there's clearly no association of dietary saturated fat and heart disease, and yet dietary guidelines continue to advocate restriction of saturated fat."

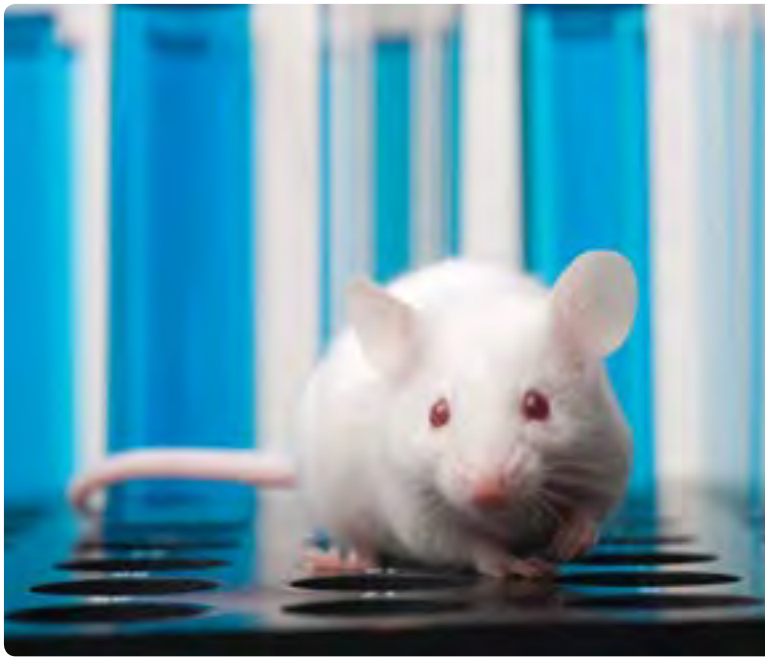
The major finding from the study, Volek added, is that "you don't necessarily save the saturated fat that you eat. And the primary regulator of what you save in terms of fat is the carbohydrate in your diet." However, Volek points out that when it comes to diet, there is no cookie-cutter approach that works for everyone. "There's a lot of interest in personalized nutrition, and using a dynamically changing biomarker [such as palmitoleic acid] could provide some index as to how the body is processing carbohydrates."

This study is one of only a "few controlled feeding studies have specifically examined how varying saturated fat intake across a broad range affects circulating [saturated fatty acid] levels," the authors write. "These findings contradict the perspective that dietary saturated fat *per se* is harmful, and underscore the importance of considering the level of dietary carbohydrate that accompanies saturated fat consumption."

The work was supported by the Dairy Research Institute, the National Cattlemen's Beef Association, and the Egg Nutrition center.

New class of lipids fights diabetes in mice

A newly identified class of lipid molecules has been found to enhance insulin sensitivity and blood sugar control in mice, according to a report published in the journal *Cell* (http://dx.doi.org/10.1016/j.cell.2014.09.035, 2014). In the study, performed by researchers at the Salk Institute (La Jolla, California, USA) and Beth Israel Deaconess Medical Center (BIDMC; Boston, Massachusetts, USA), mice with the equivalent of type 2 diabetes that consumed fatty acid hydroxyl fatty acids (FAHFAs) were found to have lower elevated blood sugar compared to a control group. The team also found FAHFA levels in humans with a high risk of diabetes are low, which suggests the lipids hold potential for use as a therapy for metabolic disorders. FAHFAs exist in low levels in vegetables, fruits, and other foods, and are also produced and broken down inside the body.



FAHFAs were identified in mice when the team used mass spectrometry to analyze the fat of a diabetes-resistant mouse model, which had been engineered to express elevated levels of the sugar transporter Glut-4 in their fat. Previous studies had shown that people with low Glut4 levels are prone to developing diabetes, so the team reasoned that elevated levels would help protect against the disease. They found FAHFA lipids were elevated 16-fold in the diabetes-resistant mice compared to normal mice. To determine whether FAHFAs are also relevant in humans, the researchers measured FAHFA levels in insulin-resistant patients, who are known to be at high risk for developing diabetes. FAHFA levels in both fat and blood were found to be lower than normal in this group, suggesting the link between FAHFA and diabetes may be relevant in humans, although additional studies are needed to test this hypothesis.

"We show that the lipids work through multiple mechanisms," said BIDMC researcher Barbara Kahn, one of the lead authors, in a news release. "When blood sugar is rising, such as after a meal, the lipids rapidly stimulate secretion of a hormone that signals the pancreas to secrete insulin. . . . [These] novel lipids also directly stimulate sugar uptake into cells and reduce inflammatory responses in fat tissue and throughout the body." Because FAHFA levels in blood can be detected before a person

develop diabetes, Kahn believes they may serve as an early marker for diabetes risk.

The team also identified the cellular receptor to which FAHFAs bind, known as GPR120. Since FAHFA-GPR120 binding events help control how much glucose is absorbed into fat cells, the researchers speculate that targeting the pathways that make or break down lipids to control FAHFA levels could lead to the development of new drugs for treating diabetes.

According to a news report in the journal *Nature* (http://dx.doi.org/10.1038/nature14070, 2014), FAHFAs are not the only class of lipids that have been found to have a therapeutic role in metabolic disorders. "For example, administration of a monomeric fatty acid, palmitoleate, which is also produced in adipose tissue during periods of increased fat synthesis, decreases the liver fat content of mice and enhances insulin sensitivity in their skeletal muscles," the authors write. However, the researchers who performed the study on palmitoleate did not demonstrate a strong association between that particular fatty acid and human insulin resistance. Omega-3 fatty acids have also been suggested as being protective against metabolic diseases by stimulating GPR120, which reduces inflammation and improves insulin sensitivity. "Thus, it seems that FAHFAs and omega-3 fatty acids may converge, at least in part, on the same receptor system to regulate glucose uptake and inflammation. It will be interesting for future studies to compare which is the more potent and efficacious lipid in this regard."

A link between fish intake and response to antidepressants

For certain patients suffering from depression, increasing consumption of fatty coldwater fish may be the key to increasing their response to treatment. A study presented in 2014 at the European College of Neuropsychopharmacology congress in Berlin, Germany, found that among the roughly 50% of patients with Major Depressive Disorder (MDD) who do not respond to treatment with selective serotonin reuptake inhibitors (SSRIs), the worst responders were those with the lowest levels of fatty fish intake.

"We were looking for biological alterations that could explain depression and antidepressant nonresponse, so we combined two apparently unrelated measures: metabolism of fatty acids and stress hormone regulation," said University of Amsterdam (Netherlands) researcher Roel Mocking, the study's lead author, in a news release. "Interestingly, we saw that depressed patients had an altered metabolism of fatty acids, and that this changed metabolism was regulated in a different way by stress hormones."

The researchers looked at the relationship between depression, fatty acids, and various hormones, including the stress hormone cortisol. They compared 70 patients with depression to 51 healthy controls, and administered 20 mg/day of an SSRI to the depressed patients for six weeks. To those who did not respond to the drug, the researchers increased the dose up to 50 mg/day. They also assessed the dietary habits of all research participants and classified the patients into four groups, according to their fatty fish intake. They found patients with the lowest fatty fish intake tended to have the poorest responses to SSRIs, with a 23% response rate, while those with the highest consumption had a 75% response rate.

"These findings suggest that measures of fatty acid metabolism, and their association with stress hormone regulation, might be of use in the clinic as an early indicator of future antidepressant response," Mocking said. "[But] it's not necessarily a causal effect. Our next step is to look at whether these alterations in fatty acid metabolism and hormonal activity are specific for depression, so we are currently repeating these measurements in patients with post-traumatic stress disorder and schizophrenia." ■

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BRIEFS

China has launched a media campaign in support of genetically modified crops. According to a report from the Reuters news service, the Chinese government hopes the efforts to educate the public via TV, newspapers, and the Internet, will help counter negative publicity and promote the use of a technology that holds promise for boosting its food security. China consumes roughly one third of the world's soybeans and has imported millions of tons of genetically modified soybeans over the past 10 years.

■■■

DuPont Pioneer (Johnston, Iowa, USA) and Cargill (Wayzata, Minnesota, USA) have announced plans to work with farmers in Ohio to grow Pioneer®-brand soybeans with the Plenish® high-oleic trait in 2015. Growers will be eligible for a processor-paid incentive for producing and delivering the high-oleic soybeans. The oil provides a soy-based trans fat alternative for food companies and foodservice operators, providing enhanced stability for use in frying applications and packaged foods.

■■■

More than 20 European plant scientists have signed a joint letter urging action to defend plant science research. The letter warns that Europe may lose its research lead in the field unless European policymakers take a more "pro-science" stance, which includes adequate funding for plant science research and allowing field trials for genetically modified crops that have been found safe. "In most European countries permits to perform field experiments are blocked, not on scientific but on political grounds," and huge scientific and financial losses often result from vandalism of field trials, write the scientists from Germany, Switzerland, the United Kingdom, Austria, Netherlands, Belgium, and Sweden. ■

BIOTECHNOLOGY

GMO update: meta-analysis touts benefits, EU deal allows bans

Genetic modification of crops is a "promising technology" that is good for both the economy and the environment, according to a meta-analysis published in PLOS ONE (http://dx.doi.org/10.1371/journal.pone.0111629, 2014).

Researchers Willhelm Klumper and Matim Qaim, from Germany's Gottingen University, reviewed studies published from 1995 through March 2014 and found that genetically modified (GM) crops have decreased farmers' use of chemical pesticides by 37% while increasing both crop yields and profits, by 22% and 68%, respectively. The studies in the analysis included those that built on primary data from farm surveys or field trials around the globe, and those that reported impacts of GM soybean, maize, or cotton on farmer profits, pesticide use, and crop yields. The analysis was funded by the German Federal Ministry of Economic Cooperation and Development and the European Union's Seventh Framework Program FOODSECURE.

Notably, both yield gains and pesticide reductions were larger for insect-resistant crops than herbicide-tolerant crops. However, herbicide-tolerant crops had lower production costs compared to their non-GM counterparts, while insect-resistant ones did not.

"Despite the rapid adoption of [GM] crops by farmers in many countries, controversies about this technology continue," the authors write. "Uncertainty about GM crop impacts is one reason for widespread public suspicion. . . . The meta-analysis reveals robust evidence of GM crop benefits for farmers in developed and developing countries. Such evidence may help to gradually increase public trust in this technology."

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The study came out a few months after a new book questioning the safety of GM foods was published. The book, titled "The GMO Deception: What You Need to Know about the Food, Corporations, and Government Agencies Putting Our Families and Our Environment at Risk," is co-edited by Tufts University (Medford, Massachusetts, USA) Professor Sheldon Krimsky and Jeremy Gruber, president of the nonprofit Council for Responsible Genetics (Cambridge, Massachusetts, USA). "The scientific debate is not resolved, even though many people are claiming it is," Krimsky said in a news release. "If there is honest science that warns us of possible dangers, this should be addressed."

In his review of the scientific literature since the 1990s, Krimsky said he found 22 studies, most of which were funded from public sources, that demonstrated adverse consequences from GM food consumption. "Although there may be more feeding studies that found no adverse effects, when you are looking at the safety of a product, the negative effects that you see in a study are more important than the positive—they have more weight and they have to be examined and replicated to see if there was a mistake or if you can get consistent results," he said. The book contains more than 60 essays by scientists and science writers that explore what is known and unknown about the science of genetic modification and its impact on human health, the environment, and agriculture, according to the news release.

Concerns over the safety of GM crops have prompted at least 26 nations, including China, Austria, Switzerland, Australia, India, Germany, Poland, Mexico, and Russia, to implement total or partial bans on GM crops.

In late 2014, the European Parliament and member states agreed to allow individual states to ban or restrict GM crops even if they are approved by the European Union (EU). Under this new agreement, member states would be allowed to ban GM crops in their territory on the basis of environmental policy objectives.

"The agreement . . . will ensure more flexibility for member states who wish to restrict the cultivation of the GMOs in their country. It will, moreover, signpost a debate which is far from over between pro- and anti-GMO positions," Belgian Member of the European Parliament Frédérique Ries told *FoodNavigator*.

Biotech groups, such as EuropaBio, an industry association based in Belgium, do not support the agreement. "Rejecting modern technologies on non-scientific grounds sets a dangerous precedent for the internal market and sends a negative signal for innovative industries worldwide considering whether or not to invest and operate in Europe," said Beat Späth, director for agricultural biotechnology at EuropaBio, in a statement.

The vote that would determine whether the rules would become law had not been completed at the time *Inform* went to press.

Progress toward boosting photosynthesis

Sunlight in, chemical energy out. It sounds simple enough, yet there is much that remains in the dark about photosynthesis. A better understanding of the mechanisms underlying this important process can help pave the way for crop science researchers to use the tools of biotechnology to engineer more efficient, higher-yielding crops, which will be vital for feeding the world's growing population. Four recent studies represent a significant step in this direction.

NEW INSIGHTS INTO THE PHOTOSYNTHETIC PROCESS

Plants are exposed to varying degrees of sunlight throughout the day, ranging from bright light to shade. Often, these fluctuations can happen rapidly, requiring that plants adjust their photosynthetic machinery quickly in order to maximize energy capture. Researchers are interested in understanding the mechanism underlying this biochemical process, which has practical implications for improving agricultural productivity.

Now, a team led by Carnegie Institution researchers Ute Armbruster and Martin Jonika reports the discovery of a protein in *Arabidopsis thaliana* known as KEA3, that helps plants make immediate adjustments during fluctuating light conditions. The results are reported in *Nature Communications* (http://dx.doi.org/10.1038/ncomms6439, 2014). During phases of intense light exposure, plants dissipate the energy from excess absorbed photons as heat. But when the sun is not shining so brightly, it is important that plants switch into a different mode that allows them to harvest as many photons as possible. The researchers found that plants that were mutated to lack KEA3 dissipated absorbed light energy as heat for a longer period of time after shifting from high to low light compared to control plants, revealing the importance of the protein in keeping photosynthesis operating at its best when environmental conditions are rapidly fluctuating.

Light intensity obviously has great impact on a plant's photosynthetic efficiency, but two other important factors are drought and heat. Another study, also reported in *Nature Communications,* reveals another piece of the photosynthetic puzzle pertaining to a plant's ability to regulate photosynthesis under varying conditions. A team led by University of Arkansas (Fayetteville, USA) researcher Andy Pereira found that a protein known as higher yield rice (HYR) acts as a "switch" to activate genes that enhance the photosynthetic activity of rice under multiple environmental stresses, including drought and high temperatures (http://dx.doi.org/10.1038/ncomms6302, 2014). Most plants, when subject to stressful conditions, shut down photosynthesis in order to prevent the production of reactive oxygen, which can cause damage. "That might be a good survival mechanism," Pereira said in a news release. "But we don't want crops to just survive. We want them to keep producing."

BACTERIAL GENES MAKE PLANT PHOTOSYNTHESIS MORE EFFICIENT

Earlier in 2014, a team led by Rothamsted Research (Harpenden, UK) researchers Alessandro Occhialini and Myat Lin created an engineered strain of tobacco (*Nicotiana tabacum*) that exhibited greater photosynthetic efficiency than its unmodified counterparts. The study, published in the journal *Nature,* shows that replacing the tobacco plant's gene for the carbon-fixing enzyme Rubisco with two genes for a cyanobacterial version

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Lubrizol Corp. (Wickliffe, Ohio, USA) is purchasing Warwick Chemicals (Mostyn, UK), a maker of tetraacetylethylenediamine (TAED), a bleach activator used primarily in laundry detergents. The transaction also includes Warwick Equest, a manufacturer of test swatches for fabric cleaning. Upon completion of the deal, Warwick Chemicals will retain its company name and will become part of Lubrizol's advanced materials business, according to *Chemical Week* magazine.

Lubrizol also recently agreed to buy Weatherford International's oilfield chemicals business, known as Engineered Chemistry, and its drilling fluids business, known as Integrity Industries. Terms were not disclosed. The two businesses will give Lubrizol "a more significant footprint in the $20 billion oilfield chemicals business and more importantly, extensive applications experience and end-user relationships," according to a news release.

■■■

Chemical Watch reports that China produced more than 30% of the products notified to the European rapid alert system for dangerous products (RAPEX), according to an analysis by the German Institute for Occupational Safety and Health. Consumer products for the home and for leisure received the most notifications, followed by cosmetics, which included tattoo inks, skin creams, and hair dyes.

■■■

The sunscreen market in the United States may soon see new products, thanks to the Sunscreen Innovation Act (S. 2141). Signed into law by President Obama in November 2014, the Act modifies how some drugs, particularly sunscreen ingredients, are regulated by the US Food and Drug Administration (FDA). It has been 25 years since the last FDA approval for widespread use of a sunscreen ingredient; eight ingredients submitted for approval during that time have been awaiting action for more than a decade. Many of them have been widely used in Europe and Asia. ■

HOME & PERSONAL CARE

Scientists rank thousands of substances according to potential exposure level

An overwhelming number of chemicals from household and industrial products are in the environment—and hundreds are in our bodies. However, scientists have yet to determine whether most of them cause health problems. Now, a team of researchers has taken the first step toward doing that by estimating which substances people are exposed to the most. The researchers' new method is published in *Environmental Science & Technology* (http://dx.doi.org/10.1021/es503583j, 2014).

John F. Wambaugh of the US Environmental Protection Agency (EPA) and colleagues note that the risks to human health of any given substance depend primarily on two factors: the potential hazards a chemical presents and how much exposure persons have to the chemical. Yet, public data on these variables are lacking for many substances already in widespread use.

About 80,000 chemicals are registered in the United States alone, under the Toxic Substances Control Act, and industry adds 700 to 1,000 new chemicals every year. Directly measuring how much of these substances people are getting exposed to would be a Herculean task requiring the time-consuming

CONTINUED ON NEXT PAGE

analysis of thousands of blood or urine samples. Wambaugh's team sought a more practical approach.

The researchers developed a mathematical model to predict which household and industrial chemicals have the highest exposure levels. They based their method on answering five simple questions about the substances, such as whether they are used in consumer products or whether they are pesticides. They used this approach to rank nearly 8,000 chemicals, from highest potential exposure level to lowest. While a few of the top 10 were familiar compounds such as DEHP (di-2-ethylhexyl phthalate), a common phthalate that has been shown to cause reproductive problems in rodents, most were substances that scientists know very little about. The researchers say the ranking could help prioritize future efforts that aim to understand potential health risks of thousands of chemicals.

The authors acknowledge funding from the EPA.

In related news, a nonprofit known as Clean Production Action has developed a new tool to establish common benchmarks intended to hasten market movement toward safer chemicals.

The tool, called the Chemical Footprint Project (CFP), will enable retailers and other purchasers to evaluate how their suppliers are addressing chemicals in their supply chains. "The CFP results will enable brands to market their progress and success in using safer chemicals," the group said in a news release.

Mike Schade, campaign director for the Mind the Store campaign of Safer Chemicals, Healthy Families, added, "Like carbon footprinting, the CFP will help enable big retailers to measure their success in moving toward safer chemicals and products for their customers. We feel confident this new tool will empower big retailers to more comprehensively assess and address toxic chemicals in their supply chain. This will help retailers sell products that are safer for their customers and avoid the use of hazardous chemicals linked to chronic diseases."

The Chemical Footprint Project was founded by the environmental nonprofit Clean Production Action, The Lowell Center for Sustainable Production at the University of Massachusetts Lowell, and the sustainability consultancy Pure Strategies.

For more information about the Chemical Footprint Project, visit www.chemicalfootprint.org.

EPA grants reward start-ups

The US Environmental Protection Agency (EPA) recently announced nine awards totaling almost $3 million for small businesses to help them bring innovative green technologies to the marketplace.

Among the grants was one to Instrumental Polymer Technologies, Inc., a small business based in Westlake Village, California, USA, which uses a unique process to mix low-cost, no-emission polymers from sustainable materials into water-based wood coatings, reducing their environmental impact. Also receiving a grant was EP Purification, Inc., a small business based in Champaign, Illinois, USA, which received a grant to continue developing and commercializing a system for using ozone to treat water, thereby reducing the use of hot water and detergents in commercial laundry settings.

Study: soap washes down the drain but germs do not

To track down where germs linger, The Clorox Co. (Oakland, California, USA) and global public health organization NSF International conducted a study in homes of families with young children. Researchers analyzed 100 samples from five commonly touched surfaces and found bacteria or viruses on all five of the surfaces tested, from the kitchen to the common area to the bathroom, with the bathroom sink being one of the surfaces with the most germs. In fact, the study found that four times as many households had bathroom sinks that had more germs than the kitchen countertop.

A survey of parents also revealed that they had misconceptions about which surfaces tested were the "germiest." Key findings include:

- Soap washes down the drain, but germs do not: The bathroom sinks harbored the most germs of all surfaces tested.
- When asked which surface they felt they needed to clean most often, more than half of parents surveyed said the kitchen countertop. Yet study results showed more households actually had germier bathroom sinks than kitchen countertops. Moreover, 90% of parents ranked the kitchen drawer knob as the germiest surface, but results revealed it held less bacteria than all other surfaces tested.
- Germs stick when you're sick: Influenza A was found on a surface in the home of a person who had the flu.

NSF International performed the study from August to September 2014 to evaluate the microbiological contamination on various surfaces within households in the Detroit, Michigan, USA, metropolitan area. Five surface locations within the household were sampled: kitchen countertop, kitchen drawer knob, common area doorknob, bathroom sink, and bathroom sink faucet handle. Twenty households with at least one child under six years old residing in the house were included in the study. Each surface was evaluated for the presence of *E. coli*, total coliforms, *Staphylococcus aureus*, and influenza A. Additionally, the household residents were asked to complete a survey regarding their expectations of the study findings.

New report on consumer perceptions of organic beauty products

A new Consumer Insights report from the London-based Organic Monitor consultancy gives a detailed account of buyer perceptions of natural and organic beauty products in the United Kingdom.

Among the findings:

- Health concerns are the primary reason for consumers to buy natural and organic beauty products.
- Eighty-four percent of male shoppers said avoiding synthetic chemicals in personal care products was important or very important to them; the share is higher for female shoppers.
- Certification is becoming more important. Forty-three percent of consumers look for symbols and logos when buying these products, up from 33% in 2007. Most look for the Soil Association logo.
- Parabens are the synthetic chemicals most consumers look to avoid, as stated by 63% of buyers. Awareness of all synthetic chemicals has increased significantly since 2007.
- The Internet is now the prime source of information on natural and organic products, overtaking friends and family (the No. 1 source in 2007). General media sources remain important for buyers over the age of 55.

CSPA retools program

At its annual meeting in December 2014, the Consumer Specialty Products Association (CSPA), a trade group based in Washington, DC, USA, announced the expansion of a service that helps companies form and manage groups to meet data requests from government agencies and to support industry scientific ventures. The newly reintroduced program will be known as the Research & Regulatory Management Council.

"The Research & Regulatory Management Council provides unparalleled expertise in rapidly uniting diverse industry representatives into well organized, and highly effective coalitions and working groups," said Susan Little, executive director of the Research & Regulatory Management Council. "Our affiliation with the CSPA ensures immediate, cost-effective access to expertise, from issue-specific technical knowledge, through legal counsel, administrative support, and budget administration."

The Research & Regulatory Management Council was formerly known as the Product Ingredient Review Program. For more information, contact Susan Little at slittle@cspa.org. ■

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Chia seed: omega-3 fatty acids and beyond

Latin America Update is a regular Inform *column that features information about fats, oils, and related materials in that region.*

Leslie Kleiner

With increasing consumer demand for healthier foods that improve nutrition, interest in exploring and developing functional foods with beneficial ingredients that originate from all parts of the world is growing. Chia seeds come from the chia plant (*Salvia hispanica* L.). This plant was part of the traditional diet of the Aztecs and Native Americans from the Southwest, and is currently grown in Latin America (Argentina, Bolivia, Colombia, Guatemala, Mexico, and Peru), as well as in Southeast Asia and Australia. Given the fatty acid profile of the seeds, which are rich in the omega-3 fatty acid α-linolenic acid (ALA , 18:3 ω-3), chia seeds have been studied in animal feed to increase the omega-3 fatty acid content in chicken eggs (1) and the level of polyunsaturated fatty acids in hogs (2). In US markets, chia seeds are also found in various products, such as beverages, granola bars, snacks, and candy.

To learn more about chia's potential, I recently interviewed chia expert Mabel C. Tomás, professor in the Center for Research and Development in Food Cryotechnology (abbreviated in Spanish as CIDCA) at the Universidad Nacional de La Plata, La Plata, Argentina. Tomás's research group explores key aspects of the Chia seed, ranging from the growth of the seed in different Latin-American regions, to oil extraction and fatty acid profile, as well as emerging applications of mucilage exudate in gelling. Following is the discussion we had about novel developments in chia seed research and applications.

Q: WHAT ARE THE MAIN DIFFERENCES BETWEEN CHIA SEEDS GROWN IN DIFFERENT REGIONS OF LATIN AMERICA?

A: In a study comparing seeds grown in the Argentine province of Salta, with those grown in Quetzaltenango, Guatemala, it was seen that physically, the Argentine seeds were larger and heavier than their counterparts in Guatemala.

This is of importance because the morphology and gravimetrical properties of the seed dictate the type of equipment needed for processing, storing, and transporting. From a compositional perspective, the lipid content of the chia seed oil is rich in triacylglycerols containing ALA, with variations in content and speciation depending on region, climatological, and harvest-related factors.

Q: CHIA SEED OIL IS RICH IN OMEGA-3 FATTY ACIDS, WHICH HAVE MANY HEALTH BENEFITS BUT MAKE THE OIL SUSCEPTIBLE TO LIPID OXIDATION. IS THERE A PARTICULAR ANTIOXIDANT OR SYSTEM OF ANTIOXIDANTS THAT CAN AMELIORATE LIPID OXIDATION?

A: We have studied the oxidative stability of chia seed oil under various natural antioxidants (rosemary and green tea extracts, tocopherol mixture, ascorbyl palmitate, and their respective blends), as well as various storage conditions (3). In our work, depending on the type of antioxidant and its concentration, it was possible to increase the induction time and shelf life of chia seed oil. For example, ascorbyl palmitate (5000 ppm) was the most effective single antioxidant tested, while the most effective blend was comprised of a combination of rosemary extract (2500 ppm) and green tea extract (5000 ppm).

Q: BESIDES THE OIL, CHIA SEED IS OF INTEREST FOR ITS MUCILAGE EXUDATE. COULD YOU EXPAND ON MUCILAGE EXUDATION, AND THE APPLICATIONS OF THIS MUCILAGE?

A: The chia plant fruit forms four fruitlets (nutlets), although the true seed is contained within each nutlet, commercially speaking, the nutlets are referred as "seeds." When the nutlets are soaked in water, exudation of a clear mucilaginous gel occurs. We have studied the mucilage exudation of chia nutlets from Argentina, and compared its proximal composition to that of guar gum and locust bean gum. We determined that in the temperatures studied (25–80 °C), the solubility of chia mucilage (10 g/ L, wt/v) was higher than that of guar and xanthic gums (4). This property along with other ones makes chia mucilage of interest as a food-grade thickener for various food applications.

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Q: WOULD EXTRACTION OF THE EXUDATE INTERFERE WITH OILSEED EXTRACTION?

A: No, both oil and exudate can be extracted from the same source. Initially, the mucilage exudate would have to be extracted. Then, it would be possible to perform an oil extraction.

Q: WHAT ARE YOUR PERSPECTIVES ON THE ROLE OF CHIA SEED IN LATIN AMERICA, AND WORLDWIDE?

A: Chia seed production is quickly growing, and there are many applications in the food industry that reflect the interest of consumers on incorporating this seed to their diet. As our understanding on the multiple functionalities of chia seed also grows, we will continue to see more applications in the food industry, as well as novel uses for specific functionalities. However, regulatory aspects are needed in order to improve commercialization in other countries.

Latin America Update is produced by Leslie Kleiner, R&D Project Coordinator in Confectionery Applications at Roquette America, Geneva, Illinois, USA, and a contributing editor of *Inform*. She can be reached at LESLIE.KLEINER@roquette.com.

Functionalization of unsaturated fatty compounds across the C,C double bond

Lipid Snippets is a regular Inform *column that features select content from The AOCS Lipid Library (http://lipidlibrary.aocs.org/).*

Ursula Biermann and Jürgen O. Metzger

Oils and fats of vegetable and animal origin are historically as well as currently the most important renewable feedstock of the chemical industry. Classic and well-established oleochemical transformations occur preferentially at the ester functionality of triglycerides [1] such as hydrolysis to free fatty acids and glycerol [2] and transesterification to fatty acid methyl esters. Fatty acids are transformed by reactions at the carboxy group to soaps, esters, amides or amines. However, most oils contain unsaturated fatty acids, such as oleic acid **1a**, which is a cis alkene, in principle allowing the application of well-

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known reactions of petrochemical alkenes. Remarkably, only very few reactions utilizing the double bond of unsaturated fatty compounds are currently applied in the chemical industry, i.e. hydrogenation, ozone cleavage, or epoxidation.

Predominantly, saturated fatty acids with an even number of carbon atoms (C8–C18) and unsaturated C18-fatty acids such as oleic acid **1a**, linoleic acid **2a**, and in addition relatively small amounts of linolenic acid **3a**, erucic acid **4a**, and ricinoleic acid **5a** (**Figure 1**) are utilized industrially. The most important oleochemical reactions performed with **5a** are the thermal cleavage to undecenoic acid **13a** [3] and basic cleavage to sebacic acid (decanedioic acid) [4]. Interestingly, the enantiomeric purity of **5a**, making it an interesting substrate for organic synthesis, has not been exploited appropriately.

It should be of interest to promote the cultivation of new oil plants containing fatty acids with new and interesting properties for chemical utilization such as petroselinic acid **6a** from the seed oil of *Coriandrum sativum*, (5*Z*)-eicosenoic acid **7a** from meadowfoam (*Limnanthes alba*) seed oil, calendic acid **8a** from *Calendula officinalis*, α-eleostearic acid **9a**, and punicic acid **10a** from chinese wood (tung) oil and pomegranate, respectively. Santalbic acid **11a** is the main fatty acid of the seed oil of the sandalwood tree, and offers as well as vernolic acid **12a** from *Vernonia galamensis* interesting synthetic applications.

In the last twenty years modern synthetic methods have been applied extensively to fatty compounds for the selective functionalization of the alkyl chain. Radical, electrophilic, nucleophilic, and pericyclic as well as transition metal-catalysed additions to the C-C double bond of, for example, oleic acid **1a** as the prototype of a readily accessible, unsaturated fatty acid have led to a large number of novel fatty compounds [5-10]. Great interest has been focused on C-C bond-forming addition reactions which afford new branched chain or elongated fatty compounds with possibly interesting properties.

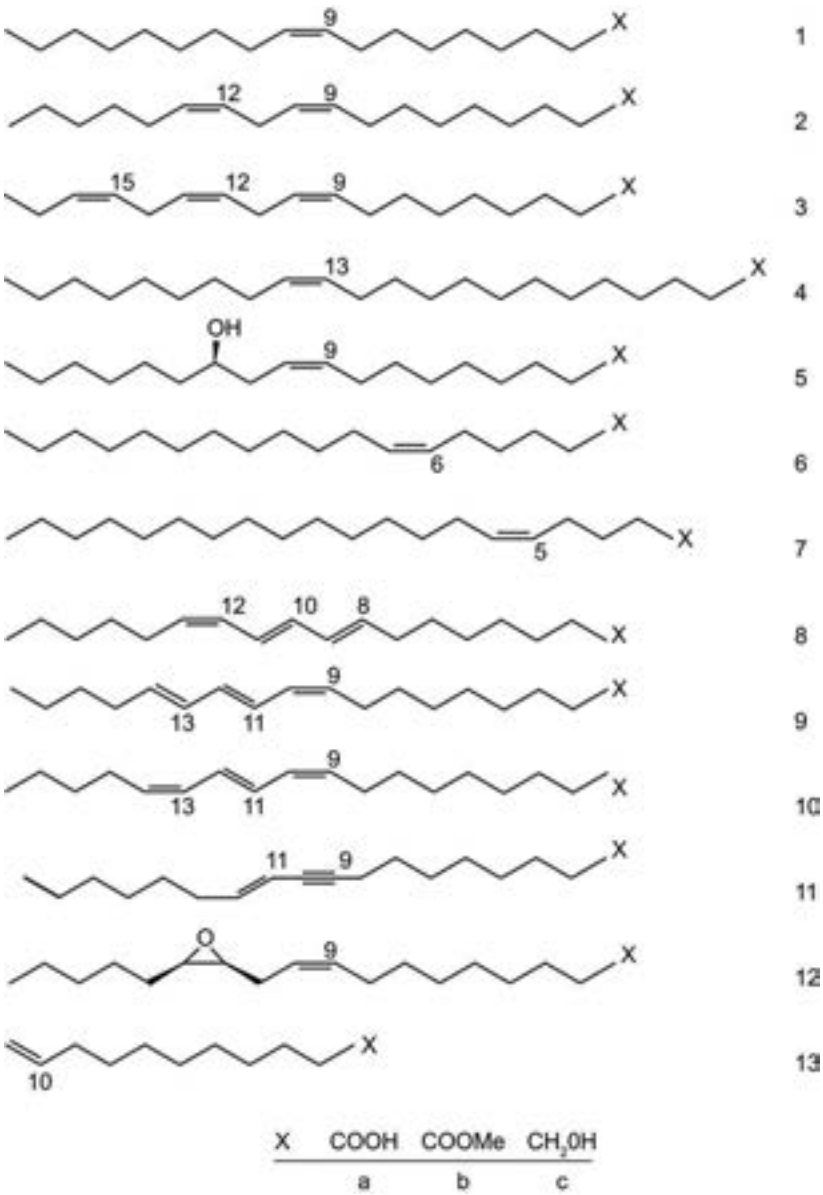

*FIG. 1. Unsaturated fatty compounds as starting materials for synthesis: oleic acid (**1a**), linoleic acid (**2a**), linolenic acid (**3a**), erucic acid (**4a**), ricinoleic acid (**5a**), petroselinic acid (**6a**), 5-eicosenoic acid (**7a**), calendic acid (**8a**), α-eleostearic acid (**9a**), punicic acid (**10a**), santalbic acid (**11a**), vernolic acid (**12a**), 10-undecenoic acid (**13a**), and the respective methyl esters (**1b-13b**) and alcohols (**1c-13c**).*

Ursula Biermann is a senior researcher and Jürgen O. Metzger is a professor in the Institute of Pure and Applied Chemistry at the University of Oldenburg (Germany).

Professional Pathways

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

William Craig Byrdwell is a Research Chemist at the US Department of Agriculture, Agricultural Research Service (USDA-ARS) Food Composition and Methods Development Lab in Beltsville, Maryland, USA. He specializes in developing and validating new methods for analyzing lipids and fat-soluble vitamins in foods using mass spectrometry (MS) with atmospheric ionization techniques (atmospheric pressure chemical ionization, electrospray ionization, and others).

Why did you join AOCS?

I was working for Dr. Ed Emken on new mass spectrometry techniques for lipid analysis in the USDA-ARS Food Quality and Safety Research group under Dr. Timothy Mounts. Both Ed and Tim were active in AOCS, so they encouraged me to go to meetings and get involved in the Society, which helped introduce me to people in the field. Many of my close colleagues were AOCS members: Bill Neff, Gary List, Rich Adlof, and many others.

Describe your career path.

I graduated from the University of Louisville, in Louisville, Kentucky, USA, where I conducted research on fluorophores and sphingolipids in the human eye lens and developed a new chromatographic method that allowed

me to identify "the unknown phospholipid" in the human lens as dihydrosphingomyelin. At the Pittsburgh Conference, I interviewed and obtained a post-doc working for Dr. Ed Emken at the USDA-ARS National Center for Agricultural Utilization Research in Peoria, Illinois, USA. After initial success applying the then new mass spectrometry technique of atmospheric pressure chemical ionization (APCI), an opening became available, and I was hired for a permanent position. After a few years, I started getting restless, and started looking for an academic position at a university close to beaches, sun, and sand. I enjoyed teaching, but it wasn't too long before I learned what a small part it was of being a professor. I really didn't enjoy having to rely on fickle grant funding agencies, even though I was successful at obtaining some NIH funds. So, having gotten the beach life out of my system, I sought and found a position back with the Agricultural Research Service, which I view as the perfect compromise between academia and industry. I was lucky enough to find the perfect position at the Food Composition and Methods Development Lab, and have been happy there ever since.

What do you love about your job?

I really enjoy the opportunity to be creative and do things that no one has ever done before. I love "pushing the envelope" or even making a new envelope!

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

Regarding analytical aspects of the fats and oils industry, I think that the greatest advancements in instrument hardware have mostly already occurred, and that further gains in sensitivity and other measurement capabilities will be mostly incremental. The greatest advancements need to be made in software for data analysis. Despite manufacturers' claims, I have still not found an instrument control and processing package that can integrate and interpret peaks as well as an experienced human. Of course, apps should probably be available to monitor or control most instruments via mobile devices in the near future.

Describe memorable job experiences.

Dr. Harrell Hurst at the University of Louisville School of Medicine gave me my first job learning mass spectrometry in the Pharmacology and Toxicology Lab. Not only did we use gas chromatography-mass spectrometry to analyze (GC-MS) drugs for the University Hospital, but also Dr. Hurst turned me loose on an old broken-down magnetic sector instrument, told me to get it working, and I did. I learned a lot in that lab that led directly to getting my post-doc. What I learned there also allowed me to use high-performance liquid chromatography (HPLC) instrumentation that led me to the discovery of the identity of "the unknown phospholipid." That identification required creativity and a lot of hard work, but was very rewarding. Nothing compares, though, to discovery of the new principles that formed the foundation of "The bottom-up solution to the triacylglycerol lipidome using atmospheric pressure chemical ionization mass spectrometry (*Lipids 40*: 383–417, 2015)." Project changes held that up for a while, but I am finally starting to report on the incredible things that came from that discovery. When I hope and think that people will be amazed at the far-reaching implications of what began as simple APCI-MS of triacylglycerols.

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

AOCS has played a large role in shaping my career. I remember when Dr. Magdi Mossoba and Dr. Rich McDonald invited me to author my first book chapter in their book, *New techniques and applications in lipid analysis*.And I'll always be grateful for and proud of my own first AOCS Press book, *Modern methods for lipid analysis by liquid chromatography/mass spectrometry and related techniques,* which still stands as an excellent compendium of methods from world-renowned experts in the field of lipid analysis. AOCS members Drs. Ken Lin and Tom McKeon (*HPLC of acyl lipids*) and Rich Adlof (*Advances in lipid methodology–five*) have given me precious opportunities to share my work with a wider audience.

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

Join and get involved in AOCS! Pick a Division and be active in it. Volunteer for committees and help to organize sessions (go the Division roundtable at the annual meeting). AOCS needs young people to keep the Society vibrant, and young career professionals will find, like I have, that volunteering offers many more rewards than the time it requires. Most importantly, I have made many dear lifelong friends for whom I have the greatest affection and respect through AOCS.

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

I wouldn't change much about my career path. I feel very fortunate to have walked the path I am on. Each position I have taken has been a conscious choice, with some luck mixed in. The only thing I would do differently is get serious about school earlier: I had to work hard to get a good

CONTINUED ON NEXT PAGE

GPA after playing around too much my first year of undergraduate school.

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

I have always had the philosophy, and have told my kids: No matter where you are or what job you are doing, do your very best and give more effort than you are asked for, and you will rise to the top. If you work harder than the average person and give above and beyond what duty requires, you will advance in whatever endeavors you undertake. I am sure that I could advance further into management, but I enjoy being in the lab and working with my own hands to do things that no one has ever done before, so I have chosen to advance to my own level of maximum happiness.

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

The culture in the field of analytical chemistry reflects society at large. It used to be dominated by white males, but has really changed for the better, to be far more inclusive and egalitarian as time has progressed. I think that anyone who chooses to work exceptionally hard to be a highly capable person can succeed in today's environment.

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

A person needs to be both. To be successful in any job, you need a variety of expertise, such as familiarity with a wide range of instrumental techniques, as well as mechanical aptitude. But it's also important to specialize, since science is so specialized and compartmentalized these days. The best strategyis to be a well-rounded specialist by forming collaborations with people with complementary specialties and participating in teams that bring a variety of specialties together into a well-rounded whole.

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

I have always felt that getting a graduate degree should be motivated bya burning passion to pursue knowledge, rather than the drive for monetary gain. Most successful people attain success as a by-product of their love and passion for their work. That being said, without a graduate degree, there will usually be limits above which one cannot rise. Some positions require an advanced degree, and an advanced degree often leads to positions that offer the greatest degree of intellectual freedom.

Energy (cont. from 152)

improved process economy indicates a return-on-investment time of three years or less, depending on the plant setup and feedstock savings potential in that region.

"The enzymatic process uses less energy, and the cost of waste oil as a feedstock is significantly lower than refined oils," said Mejlby. "A small number of plants have been producing biodiesel from waste oils using existing technologies. However, this has not been cost-efficient until now, broadly speaking, as the waste oils have had to be refined before being processed using chemicals. We hope that our technology can unleash more of the potential in these lower-grade feedstocks."

AkzoNobel in waste-to-chemicals partnership

AkzoNobel is part of a Dutch consortium working with Canada's Enerkem to explore the use of waste streams as a feedstock for chemical production and the development of waste-to-chemicals facilities.

The collaboration includes a number of industry and quasi-governmental partners hoping to benefit from Enerkem's proprietary technology that converts waste into synthesis gas—a common starting material for products such as methanol and ammonia.

The initial partners are AkzoNobel, Enerkem, the investment and development agency for the Northern Netherlands, Groningen Seaports, Rotterdam Partners, and InnovationQuarter. The partners plan to test various local waste streams, including residual municipal and agricultural waste.

Waste remains a problem in many regions and is generally regarded as being under-utilized for the production of chemicals. The advantage of Enerkem's proven conversion process is that it is complementary to existing technologies, such as recycling and anaerobic digestion.

The partners aim to become the first in Europe to use the new technology and to build a plant in Delfzijl or Rotterdam—or both—within the next two to three years. ■

PATENTS

Biodiesel lighter fluid

Marlin, J., US8722591, May 13, 2014

Disclosed is an environmentally conscious, odor-free lighter fluid mixture comprising a 50–70% ethanol and 30–50% biodiesel combination. Combined with an ethanol accelerant, the mixture provides a lighter fluid that is easily ignitable without risk of detonation or explosion, and one that brings charcoal briquettes up to temperature quicker than traditional methods. The mixture is petroleum free, which eliminates the associated unpleasant odors and potential health risks of traditional lighter fluid, including a reduction in the emission of volatile organic compounds into the environment. The mixture offers a renewable, sustainable, and efficient ignition source for charcoal that does not sacrifice utility compared to traditional lighter fluid and that does not impart undesirable flavors onto grilled food.

Method of making polyglycerol esters

Bevinakatti, H.S., *et al.*, Croda International PLC, US8722814, May 13, 2014

Polyglycerol carboxylic acid esters are made by reaction of a, typically, C_2 to C_{30}, particularly C_6 to C_{22}, carboxylic acid with glycerol carbonate, particularly with base catalyst, and desirably at temperatures from 170°C to 250°C. Other carbonates, for example cyclic diol carbonates such as ethylene or propylene carbonates, may be used in combination with the glycerol carbonate to make novel mixed polymeric esters. The molar ratio of carboxylic acid group to glycerol carbonate is typically from 2 to 30, but can be up to 100. The base catalyst is desirably alkali metal hydroxide, carbonate, or alkoxide. The reaction is desirably carried out in an inert atmosphere, and reducing agent such as phosphorous acid, hypophosphorous acid, or borohydride and/or activated carbon, may be included to improve product color.

Lighter fluid compositions with *n*-butanol and biodiesel

Moe, D.E., and R.E. Oshel, Greenflame Products, LLC, US8728178, May 20, 2014

An improved, environmentally friendly lighter fluid composition made from renewable resources is described that includes *n*-butanol and biodiesel. This lighter fluid has reduced volatile organic compounds (VOCs) compared to a petroleum-based lighter fluid. The fuel sources such as charcoal ignited with the lighter fluid composition maintain desirable temperature profiles. Foods cooked using the lighter fluid composition as the ignition source have improved taste characteristics due to reduced VOCs. Methods of using the lighter fluid compositions are also described.

Polyricinoleate composition and process for producing the same

Ebata, H., and S. Matsumura, Keio University, US8729176, May 20, 2014

A process is disclosed wherein ricinoleic acid from petroleum alternative vegetable castor oil that has a hydroxyl group at the 12-position or a derivative thereof (an ester or a hydrogenated compound thereof) is polymerized in the presence of a synthetic zeolite and an immobilized lipase at around normal temperature without using any harmful polymerization catalysts or organic solvents which can cause environmental pollution whereby a polyester useful in the industry that has a weight average molecular weight of 20,000 or more is obtained. This high-molecular weight polyester is crosslinked to give a crosslinked elastomer that is comparable to synthetic rubbers.

Diesel fuel formulation

Felix-Moore, A., *et al.,* Shell Oil Co., US8734541, May 27, 2014

A diesel fuel formulation containing a triethoxypropane and a palm oil methyl ester (POME), and a diesel fuel supplement containing a premix of a triethoxypropane and a POME is disclosed. The triethoxypropane may be 1,2,3-triethoxypropane or 1,1,3-triethoxypropane.

Compositions based on polyester in an oily phase and uses thereof

Barba, C., and A. Ricard, L'Oreal, US8734765, May 27, 2014

The present invention relates to a cosmetic make-up or care composition comprising an oily phase comprising at least one liquid polyester obtained by condensation of unsaturated fatty acid dimer and/or trimer and diol, said composition being free from lipophilic gelling agent or comprising at the most 10 wt% thereof, relative to the weight of the composition. The present invention also relates to a method of make-up of the face and body comprising the use of said composition.

Pseudomonas aeruginosa strain developed for improving fatty acid content, and method of manufacturing the same

Lee, J.-W., *et al.*, Industry–University Cooperation Foundation Sogang University, US8735110, May 27, 2014

Disclosed are novel *Pseudomonas aeruginosa* strains capable of producing in high yield and preparation methods thereof. The strains anchor an expression vector carrying either or both of a nucleotide sequence coding for acetyl-CoA carboxylase carboxytransferase subunit alpha of *P. aeruginosa* and a nucleotide

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sequence coding for malonyl-CoA-[acyl-carrier-protein] transacylase of *P. aeruginosa*, and/or a nucleotide sequence coding for acyl-acyl carrier protein thioesterase of *Streptococcus pyogenes*. The recombinant *P. aeruginosa* strains are genetically stable and have high lipid or fatty acid contents, thus being applicable to the mass production of fatty acids.

Cocoa bean processing methods and techniques

Huhn, T., and R. Laux, Unico-First AG and Zürcher Hochschule für Angewandte Wissenschaten Grüental, US8734888, May 27, 2014

Improved methods and/or techniques for processing and/or extracting materials from cocoa beans. In certain embodiments, cocoa bean processing methods (e.g., using unfermented or fermented or roasted or nonroasted beans) which result in cocoa products with improved taste characteristics and/or increased levels of anti-oxidants and/or vitamins.

Eco-friendly cleaners for oilfield equipment

Perusalsamy, J., and C. Tate, Halliburton Energy Services, Inc., US8735336, May 27, 2014

Methods for removing an organic material from a portion of oilfield equipment are described. The methods include forming a composition that includes a hybrid polymer and introducing the composition to the portion of the oilfield equipment from which the organic material is to be removed. The hybrid polymer includes a synthetic component formed from at least one or more olefinically unsaturated carboxylic acid monomers or salts thereof, and a natural component formed from a hydroxyl-containing natural moiety.

Method for extracting unsaponifiables from renewable raw materials

Piccirilli, A., Valagro Carbone Renouvelable Poitou-Charentes, US8735615, May 27, 2014

A method for extracting an unsaponifiable fraction from a renewable raw material selected among oilfruits, oleaginous seeds, oleoproteaginous seeds, seed husks, oil-yielding almonds, sprouts, stones and cuticles of fruits, high-fat raw materials from animals, algae, fungus or yeast, includes the following steps: (i) dehydrating and packaging the renewable raw material, not resulting in any extraction of the fat; (ii) reactive crushing of the fatty packaged raw material in the presence of a light alcohol and a catalyst; (iii) evaporating the light alcohol; (iv) concentrating the liquid phase such as to obtain a concentrate including the unsaponifiable fraction diluted in fatty acid alkyl esters; (v) saponifying the unsaponifiable concentrate; (vi) extracting the unsaponifiable fraction from the saponified mixture. The use of an unsaponifiable fraction or co-products obtained by implementing the method for preparing a composition such as a cosmetic, drug, food, or food additive or supplement is also described.

Conversion of crude tall oil to renewable feedstock for diesel range fuel compositions

Stigsson, L., and V. Naydenov, Sunpine AB, US8735637, May 27, 2014

A method for converting crude tall oil into high-quality diesel fuels include the steps of (i) removal of non-oil contaminants present in the crude tall oil and recovery of valuable organic, (ii) heating and removing the volatile fractions of the refined tall oil stream from step (i) and forming a volatiles-free oil stream comprising organic components with boiling points of 170°C and higher, (iii) vacuum distilling the volatiles-free oil stream of from step (ii) to produce a first and second stream the first stream including components with boiling points between 170 and 400°C and the second stream comprising components having boiling points greater than 400°C and (iv) passing the first stream into a catalytic reactor wherein hydrogenation and deoxygenation take place to produce a diesel range fuel depleted in oxygen.

Vegetable oil of high dielectric purity, method for obtaining same and use in an electrical device

Pulido Sanchez, A.J., *et al.,* Ragasa Industrias, S.A. de C.V. and Prolec-GE Internacional, S. de R.L. de C.V., US8741186, June 3, 2014

A dielectric high-vegetable oil—free from antioxidants and/or external additives to be used in electric equipment such as transformers, as isolating element and as cooling means and a method for obtaining the same in which the dielectric high-purity vegetable oil—is obtained by means of the optimization of the bleaching steps—and deodorizing—from the refining process—known as modified caustic refining long-mix (RBD).

Water-repellent admixtures for cementitious materials

Walloch, C.G., *et al.*, ACM Chemistries, Inc., US8747550, June 10, 2014

The present disclosure provides improved water-repellent admixtures for cementitious materials. The water-repellent admixtures are incorporated during masonry processing to improve the water resistance of the final product. Solid water-repellent admixtures may be conveniently incorporated into pre-blended dry mortar mixes. In some variations, a pre-blended dry mortar mix comprises a cementitious material, an aggregate, and a dry water-repellent admixture, wherein the water-repellent admixture contains one or more materials selected from the group consisting of silanes, siloxanes, free fatty acids, fatty

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EXTRACTS & DISTILLATES

Mango butter emulsion gels as cocoa butter equivalents: physical, thermal, and mechanical analyses

Sagiri, S.S., *et al.*, *J. Agric. Food Chem. 62*: 11357–11368, 2014, http://dx.doi.org/10.1021/jf502658y.

The search for cocoa butter equivalents in food and pharmaceutical industries has been gaining importance. In the present study, mango butter was explored as cocoa butter equivalent. Aqueous gelatin solution (20% w/w) containing cocoa butter and mango butter water-in-oil (fat) type emulsion gels were prepared by hot emulsification method. XRD and DSC melting profiles suggested the presence of unstable polymorphic forms (α and β′) of fats in the emulsion gels. The crystal size and solid fat content analyses suggested that the presence of aqueous phase might have hindered the transformation of unstable polymorphic forms to stable polymorphic form (β) in the emulsion gels. Fat crystals in the emulsion gels were formed by instantaneous nucleation via either uni- or bidimensional growth (Avrami analysis). The viscoelastic nature of the emulsion gels was evaluated by modified Peleg's analysis (stress relaxation study). Results inferred that the physical, thermal, and mechanical properties of mango butter emulsion gels are comparable to those of cocoa butter emulsion gels. On the basis of preliminary studies, it was suggested that the mango butter emulsion gels may have potential to be used as cocoa butter equivalents.

Enhancing the stability of lipid nanoparticle systems by sonication during the cooling step and controlling the liquid oil content

Ban, C., *et al.*, *J. Agric. Food Chem. 62*: 11557–1567, 2014, http://dx.doi.org/10.1021/jf503489v.

Aggregation of unstable particles in water limits the application of lipid nanoparticle (LNP) systems to foods despite the capability to encapsulate lipophilic bioactive components. This study exploits a preparation process that can reduce the aggregation of LNPs. Sonication during the cooling step (postsonication) for 4, 5, or 6 min was applied to increase the covering effect of Tween 20 on the particle. Additionally, LNPs were prepared using fully hydrogenated canola oil (FHCO) blended with 0–30 wt % liquid canola oil (LCO) of the lipid phase. Surfactant surface load data indicate that the postsonication might make nonemulsifying Tween 20 diffuse from the aqueous phase to droplet surfaces, which could decrease the crystallinity index (CI) of LNPs due to the inhibition of lipid crystallization. Moreover, the LCO content in lipid matrix could decrease the CI, which could reduce the formation of hydrophobic patches on the particle surface. Therefore, the postsonication and the LCO addition in the matrix could effectively prevent aggregation among hydrophobic patches. This improved colloidal stability of LNPs was verified by the particle shape in transmission electron microscopy and the gelation test. Consequently, LNPs fabricated using 6 min postsonication and 30 wt % LCO in the lipid exhibited the greatest stability (size, 202.3 nm; CI, 57.5%; Tween 20 surface load, 10.29 mg m^{-2}). This study may serve as a basis for further research that aims to develop delivery systems for functional foods.

Lipoxygenase-catalyzed transformation of epoxy fatty acids to hydroxy-endoperoxides: a potential P450 and lipoxygenase interaction

Teder, T., *et al.*, J. *Lipid Res.* 55: 2587–2596, 2014, http://dx.doi.org/10.1194/jlr.M054072 .

Herein, we characterize a generally applicable transformation of fatty acid epoxides by lipoxygenase (LOX) enzymes that results in the formation of a five-membered endoperoxide ring in the end product. We demonstrated this transformation using soybean LOX-1 in the metabolism of 15,16-epoxy-α-linolenic acid, and murine platelet-type 12-LOX and human 15-LOX-1 in the metabolism of 14,15-epoxyeicosatrienoic acid (14,15-EET). A detailed examination of the transformation of the two enantiomers of 15,16-epoxy-α-linolenic acid by soybean LOX-1 revealed that the expected primary product, a 13*S*-hydroperoxy-15,16-epoxide, underwent a nonenzymatic transformation in buffer into a new derivative that was purified by HPLC and identified by UV, LC-MS, and ^{1}H-NMR as a 13,15-endoperoxy-16-hydroxy-octadeca-9,11-dienoic acid. The configuration of the endoperoxide (*cis* or *trans* side chains) depended on the steric relationship of the new hydroperoxy moiety to the enantiomeric configuration of the fatty acid epoxide. The reaction mechanism involves intramolecular nucleophilic substitution (S_Ni) between the hydroperoxy (nucleophile) and epoxy group (electrophile). Equivalent transformations were documented in metabolism of the enantiomers of 14,15-EET by the two mammalian LOX enzymes, 15-LOX-1 and platelet-type 12-LOX. We conclude that this type of transformation could occur naturally with the co-occurrence of LOX and cytochrome P450 or peroxygenase enzymes, and it could also contribute to the complexity of products formed in the autoxidation reactions of polyunsaturated fatty acids.

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Liquid chromatography–tandem mass spectrometry (LC-MS/MS) method for the direct detection of 2-monochloropropanediol (2-MCPD) esters in edible oils

MacMahon, S., *et al.*, *J. Agric. Food Chem. 62*: 11647–11656, 2014, http://dx.doi.org/10.1021/jf503994m.

A new analytical method has been developed and validated for the detection and quantification of 2-monochloropropanediol (2-MCPD) esters in edible oils. The target compounds are potentially carcinogenic contaminants formed during the processing of edible oils. As the 2-MCPD esters that occur most frequently in refined edible oils were not commercially available, standards were synthesized with identity and purity (95+%) confirmed by liquid chromatography–tandem mass spectrometry (LC-MS/MS) and ^{1}H NMR. Target analytes are separated from edible oil matrices using a two-step solid-phase extraction (SPE) procedure. The extracts are then analyzed using LC-MS/MS with electrospray ionization (ESI). The method has been validated for 11 2-MCPD diesters and 3 2-MCPD monoesters in soybean oil, olive oil, and palm oil using an external calibration curve. The ranges of average recoveries and relative standard deviations (RSD) across the three oil matrices at three spiking concentrations are 79–106% (3–13% RSD) for the 2-MCPD diesters and 72–108% (4–17% RSD) for the 2-MCPD monoesters, with limits of quantitation at or below 30 ng/g for the diesters and 90 ng/g for the monoesters.

Serum TG-lowering properties of plant sterols and stanols are associated with decreased hepatic VLDL secretion

Schonewille, M., *et al.*, J. *Lipid Res. 55*: 2554–2561, 2014, http://dx.doi.org/10.1194/jlr.M052407.

Plant sterols and stanols are structurally similar to cholesterol and when added to the diet they are able to reduce serum total- and LDL-cholesterol concentrations. They also lower serum triglyceride concentrations in humans, particularly under conditions of hypertriglyceridemia. The aim of this study was to unravel the mechanism by which plant sterols and stanols reduce serum triglyceride concentrations in high-fat diet (HFD) fed mice. Male C57BL/6J mice were fed HFD for 4 weeks. Subsequently, they received HFD, HFD supplemented with 3.1% plant sterol ester (PSE) or HFD supplemented with 3.1% plant stanol ester (PSA) for another three weeks. Both PSE and PSA feeding resulted in decreased plasma triglyceride concentrations compared with HFD, while plasma cholesterol levels were unchanged. Interestingly, hepatic cholesterol levels were decreased in the PSE/PSA groups compared with HFD and no differences were found in hepatic triglyceride levels between groups. To investigate the

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mechanism underlying the hypotriglyceridemic effects from PSE/PSA feeding, we measured chylomicron and VLDL secretion. PSE and PSA feeding resulted in reduced VLDL secretion, while no differences were found between groups in chylomicron secretion. In conclusion, our data indicate that plasma triglyceride-lowering resulting from PSE and PSA feeding is associated with decreased hepatic VLDL secretion.

Limitation of using silver ion solid-phase extraction for animal lipids with a low-trans content

Belaunzaran, X., *et al.*, *Eur. J. Lipid Sci.Technol. 116*: 1621–1625, 2014, http://dx.doi.org/10.1021/jf503994m.

Silver ion solid-phase extraction (Ag^+-SPE) was reported to provide effective separations compared to other Ag^+ techniques but at a fraction of cost and time. Ag^+-SPE cartridges resolved fatty acid methyl esters (FAMEs) with different number and/or geometric configuration of double bonds. Here we attempted to determine the *trans* fatty acids (FA) contained in a low total *trans* FA sample, horse lipids; lamb was used as a control having a markedly higher total *trans* content. Gas chromatographic assessment of the fractions showed a good separation of the *cis* and *trans* monounsaturated FA (MUFA) fractions, but the relative high content of contaminants that coeluted with these FA impaired the identification of the latter in horse lipids. In lamb *trans* MUFA isomers could be identified since their abundance relative to impurities was greater. Several attempts were made to remove the contaminants from the SPE cartridges including an extensive prewash with acetone and hexane, a prewash with solvents that would elute the *cis* MUFA fraction, and a complete prewash of all solvents used in the fractionation, hexane, acetone, and acetonitrile. The prewash using all elution solvents removed most contaminants but subsequently impaired the separation of *trans* and *cis* MUFA fractions. The same samples were subjected to Ag^+-HPLC fractionation that showed no impurities demonstrating that they were derived from the Ag^+-SPE separation. The *trans* MUFA fraction collected from Ag^+-HPLC allowed for the identification of the *trans* 16:1 and 18:1 FA in horse lipids and is recommended for samples with low *trans* levels.

Chemical changes in microwave-heated vegetable oils

Kreps, F., *et al.*, *Eur. J. Lipid Sci.Technol. 116*: 1685–1693, 2014, http://dx.doi.org/10.1002/ejlt.201400047

The aim of this study was to investigate the influence of microwave heating on sunflower and corn oil in two types of microwave oven. The microwave ovens had the same output power and varied mainly in time of dissipation. The oil samples were heated for 90% and 70% of the total heating time by the two types of ovens, named as the first and the second oven, respectively, and the remaining time was dissipation pause. It was observed that greater dissipation pause in second microwave caused degradation of oil almost two times lower than did heating in the first microwave oil. In microwave heated oils the focus was on analysis of primary and secondary oxidation products, the fatty acids content, the tocopherol content and tocopherol degradation kinetics. The rate of tocopherol degradation in oils heated in the first oven was on average 2-times higher than in the second oven. Oils heated for 10 min in the second oven were found to contain twice the tocopherol content, three times lower peroxide value, three times lower conjugated dienes and aldehydes compared with oils heated in the first type of oven. This is the first report about gentle microwave heating of oils and its dependence on time of heating and dissipation time.

Lipid profile of mice fed a high-fat diet supplemented with a wax ester-rich marine oil

Pedersen, A.M., *et al.*, *Eur. J. Lipid Sci.Technol. 116*: 1718–1726, 2014, http://dx.doi.org/10.1002/ejlt.201400052

Oil extracted from the marine copepod *Calanus finmarchicus* contains the long chain omega-3 fatty acids eicosapentaenoic acid and DHA in addition to stearidonic acid (18:4n-3). Unlike other marine lipids, the fatty acids in this oil are esterified with long chain fatty alcohols as wax esters. The aim of this study was to examine the fate of the wax esters in oil from *C. finmarchicus* when given as a 2% supplement in a high fat diet to C57BL/6J mice for 11 weeks. The study confirmed that feeding mice a high fat diet supplemented with a small amount of oil containing wax esters reduced the body weight gain. During digestion, wax esters were hydrolyzed and the fatty acids absorbed since the fatty acid composition of the adipose tissue and liver reflected the enrichment with the Calanus oil. The composition of the liver lipids demonstrated elongation and desaturation of the C18 omega-3 fatty acids from the feed and accumulation of longer chained omega-3 fatty acids. Elevated levels of FFA and FAOH in the feces suggest that the absorption process, not the hydrolysis, could be a rate limiting step in utilization of small amounts of wax esters included in high fat diets in mice.

Impact of dietary *n*-3 polyunsaturated fatty acids on cognition, motor skills and hippocampal neurogenesis in developing C57BL/6J mice

Janssen, C.I.F., *et al.*, *J. Nutr. Biochem. 26*: 24–35, 2015, http://dx.doi.org/10.1016/j.jnutbio.2014.08.002.

Maternal intake of omega-3 polyunsaturated fatty acids (*n*-3 PUFA) is critical during perinatal development of the brain. Docosahexaenoic acid (DHA) is the most abundant *n*-3 PUFA in the brain and influences neuronal membrane function and neuroprotection. The present study aims to assess the effect of dietary *n*-3 PUFA availability during the gestational and postnatal period on cognition, brain metabolism and neurohistology in C57BL/6J mice. Female wild-type C57BL/6J mice at day 0

of gestation were randomly assigned to either an *n*-3 PUFA deficient diet (0.05% of total fatty acids) or an *n*-3 PUFA adequate diet (3.83% of total fatty acids) containing preformed DHA and its precursor α-linolenic acid. Male offspring remained on diet and performed cognitive tests during puberty and adulthood. In adulthood, animals underwent ^{31}P magnetic resonance spectroscopy to assess brain energy metabolites. Thereafter, biochemical and immunohistochemical analyses were performed assessing inflammation, neurogenesis and synaptic plasticity. Compared to the *n*-3 PUFA deficient group, pubertal *n*-3 PUFA adequate fed mice demonstrated increased motor coordination. Adult *n*-3 PUFA adequate fed mice exhibited increased exploratory behavior, sensorimotor integration and spatial memory, while neurogenesis in the hippocampus was decreased. Selected brain regions of *n*-3 PUFA adequate fed mice contained significantly lower levels of arachidonic acid and higher levels of DHA and dihomo-γ-linolenic acid. Our data suggest that dietary *n*-3 PUFA can modify neural maturation and enhance brain functioning in healthy C57BL/6J mice. This indicates that availability of *n*-3 PUFA in infant diet during early development may have a significant impact on brain development.

Improved synthesis of isostearic acid using zeolite catalysts

Ngo, H.L., *Lipid Technol. 26*: 246–248, 2014, http://dx.doi.org/10.1002/lite.201400066.

Isostearic acids (IA) are branched-chain fatty acids that are nontoxic and biodegradable in nature. They are predominantly used in cosmetics because of their superior moisturizing properties as they are odorless, provide smooth spreading and a nontacky feeling when applied onto skin. They can also be used in applications which require excellent thermo-stability and low flow temperature properties. The existing older technology produces IA at low yields, which limits their commercial adoption; thus, new technologies for preparing IA are needed.

Synthesis and characterization of fatty acid oat β-glucan ester and its structure–curcumin loading capacity relationship

Chen, F., *et al., J. Agric. Food Chem. 62*: 12256–12264, 2014, http://dx.doi.org/10.1021/jf504596u.

An amphiphilic fatty acid oat β-glucan ester (FAOGE) was first synthesized, and its structure–curcumin loading capacity (CLC) relationship was investigated. The DS of product increased with the addition of acyl imidazole, decreased with M_w of β-glucan, and did not relate to the acyl chain length. Characterizations by FT-IR and ^{1}H NMR evidenced the presence of ester groups in FAOGE and confirmed its successful synthesis. The aqueous self-aggregation behavior of FAOGE was revealed by transmission electron microcopy and dynamic light scattering. With the aid of response surface methodology, a quadratic polynomial equation was obtained to quantitatively describe the structure–CLC relationship of FAOGE by using M_w of β-glucan, acyl chain length, and DS as variables. The CLC increased with M_w of β-glucan and acyl chain length but maximized at a medium DS. The maximum CLC value was obtained as 4.05 μg/mg. Hence, FAOGE is a potential candidate in solubilizing and delivering hydrophobic food ingredients.

PUFA biosynthesis pathway in marine scallop *Chlamys nobilis* reeve

Liu, H., *et al., J. Agric. Food Chem. 62*: 12384–12391, 2014, http://dx.doi.org/10.1021/jf504648f.

Long-chain polyunsaturated fatty acids (LC-PUFAs) are essential in important physiological processes. However, the

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endogenous PUFA biosynthesis pathway is poorly understood in marine bivalves. Previously, a fatty acyl desaturase (Fad) with Δ5 activity was functionally characterized and an elongase termed Elovl2/5 was reported to efficiently elongate 18:2*n*–6 and 18:3*n*–3 to 20:2*n*–6 and 20:3*n*–3 respectively in *Chlamys nobilis*. In this study, another elongase and another Fad were identified. Functional characterization in recombinant yeast showed that the newly cloned elongase can elongate 20:4*n*–6 and 20:5*n*–3 to C22 and C24, while the newly cloned scallop Fad exhibited a Δ8-desaturation activity, and could desaturate exogenously added PUFA 20:3*n*–3 and 20:2*n*–6 to 20:4*n*–3 and 20:3*n*–6 respectively, providing the first compelling evidence that noble scallop could de novo biosynthesize 20:5*n*–3 and 20:4*n*–6 from PUFA precursors though the "Δ8 pathway". No Δ6 or Δ4 activity was detected for this Fad. Searching against our scallop transcriptome database failed to find any other Fad-like genes, indicating that noble scallop might have limited ability to biosynthesize 22:6*n*–3. Interestingly, like previously characterized Elovl2/5, the two newly cloned genes showed less efficient activity toward *n*–3 PUFA substrates than their homologous *n*–6 substrates, resulting in a relatively low efficiency to biosynthesize *n*–3 PUFA, implying an adaption to marine environment.

Investigation of natural lipid–phenolic interactions on biological properties of virgin olive oil

Alu'datt, M.H., *et al.*, *J. Agric. Food Chem. 62*: 11967–11975, 2014, http://dx.doi.org/10.1021/jf504557k.

There is limited knowledge regarding the impact of naturally occurring lipid–phenolic interactions on the biological properties of phenolics in virgin olive oil. Free and bound phenolics were isolated via sequential methanolic extraction at 30 and 60 °C, and were identified and quantified using reversed phase high performance liquid chromatography, liquid chromatography coupled to tandem mass spectrometry (LC-MS/MS), and gas chromatography. Decreased oleic acid concentrations and increased concentrations of palmitoleic acid, stearic, linoleic, and linolenic acids were observed in virgin olive oil after removal of free and bound lipid phenolic compounds. The presence of *p*-hydroxybenzoic acid and tyrosol bound to glycerides was determined via LC-MS/MS, which indicates natural lipid–phenolic interactions in virgin olive oil. Both free and lipid bound phenolic extracts exerted antiproliferative activities against the CRC1 and CRC5 colorectal cancer cell lines. The present work indicates that naturally occurring lipid–phenolic interactions can affect the biological properties of phenolics in virgin olive oil.

Characterization of byproducts originating from hemp oil processing

Pojić , M., *et al.*, *J. Agric. Food Chem. 62*: 12436–12442, http://dx.doi.org/10.1021/jf5044426.

Valorization of hemp seed meal, a byproduct of hemp oil processing, was performed by measuring the distribution of nutritional and antinutritional compounds in different hemp seed meal fractions. According to chemical composition, two cotyledon-containing fractions (>180 and <180 μm) were significantly richer in protein ($p < 0.05$) (41.2% ± 0.04% and 44.4% ± 0.02%, respectively), lipid (15.1% ± 0.02% and 18.6% ± 0.04%, respectively), and sugar content (4.96% ± 0.11% and 3.46% ± 0.08%, respectively) in comparison to the hull-containing fractions (>350 and >250 μm), which were significantly richer in crude fiber content (29.5% ± 0.04% and 21.3% ± 0.03%, respectively). The free radical scavenging capacity (IC_{50}) of fraction extracts increased ($p < 0.05$) with increasing mean particle size (from 17.18 ± 0.59 to 5.29 ± 0.30 mg/mL). Cannabisin B and *N-trans*-caffeoyltyramine were the most abundant phenolic compounds in the hull fractions (from 267 ± 15.9 to 287 ± 23.1 mg/kg), while cotyledon fractions had higher content of catechin (from 313 ± 12.4 to 744 ± 22.2 mg/kg) and *p*-hydroxybenzoic acid (from 124 ± 6.47 to 129 ± 8.56 mg/kg ($P < 0.05$). Well-balanced ω-6 to ω-3 fatty acid ratio (3:1) was determined in all

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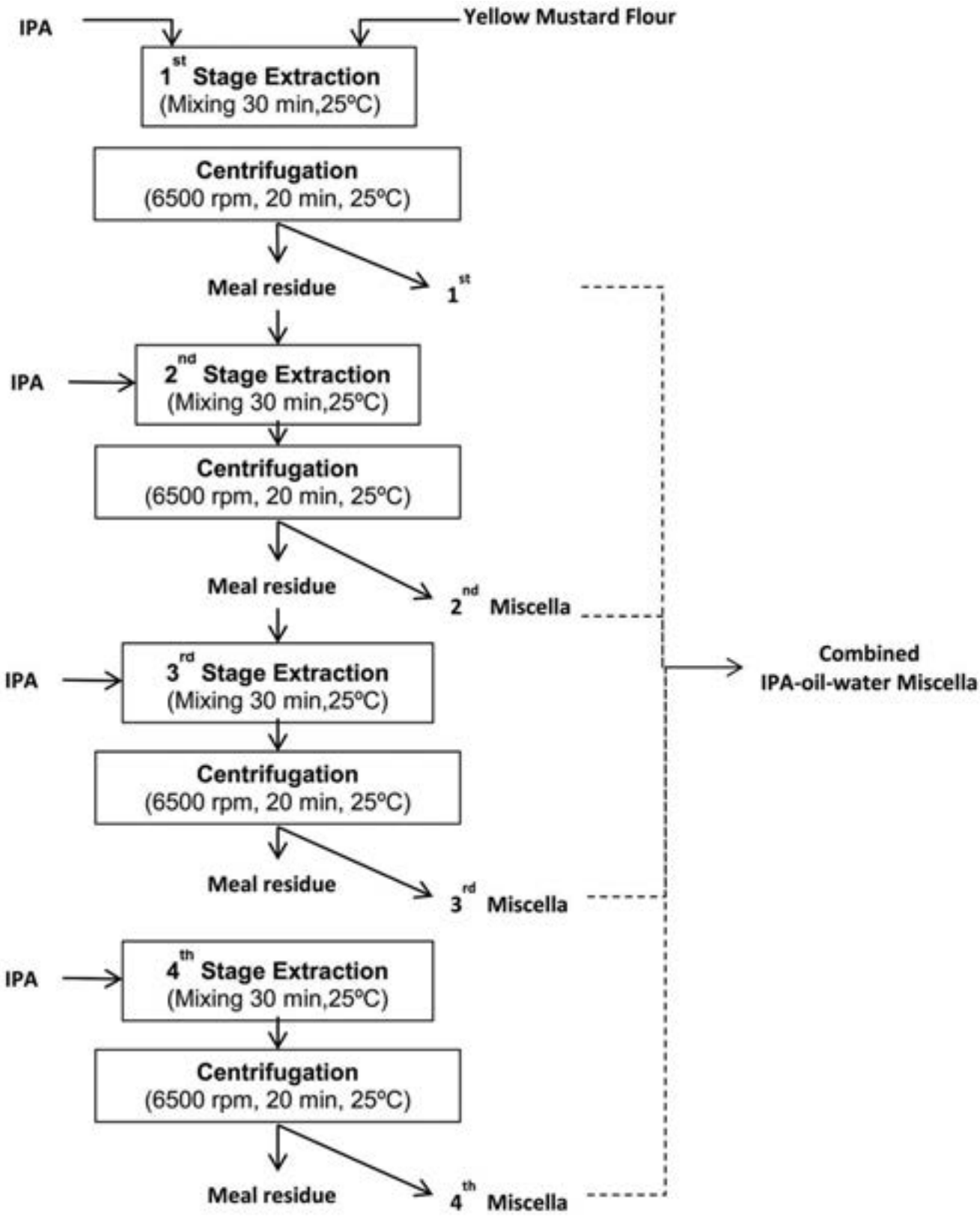

FIG. 1. Oil extraction from yellow mustard flour using IPA

Isopropyl alcohol extraction **of mustard oil**

Sayeh Sinichi and Levente L. Diosady

Mustard is a member of the *Brassica* family of plants. It is related to canola but is more tolerant of drought, heat, and frost than its famous cousin. The seed proteins in yellow mustard have a well-balanced amino acid profile, which makes them an attractive source of food [2]. The oil in yellow mustard seed is low in saturated fatty acids but high in erucic acid; therefore it is not permitted as an edible oil in Europe and North America. The oil has industrial uses as a lubricant and release agent, and its superior lubricating properties, due to erucic acid, make it a potential feedstock for biodiesel production [3]. Vegetable oils are typically extracted with hexane. However, health and environmental concerns over its use have prompted the search for alternative solvents. In this study, mustard oil extraction with IPA to produce an IPA-oil miscella suitable for industrial applications was investigated.

De-hulled yellow mustard flour containing 32.4 ± 0.5 wt% oil (as-is basis), 34.5 ± 0.4 wt% protein (as-is basis), 26.7 ± 0.6 wt% carbohydrates (as-is basis), and 5.5 ± 0.6 wt% moisture was used as feed material. IPA was added to mustard flour at different IPA:flour ratios (volume:weight), and the resulting liquid "miscella" was then separated from the residual solids by centrifugation. The liquid phase "miscella" was made up of IPA, oil components—triglycerides (TAGs), free fatty acids (FFA), phospholipids, and a small amount of water containing protein and sugars. The solid phase was composed of hydrocarbons,

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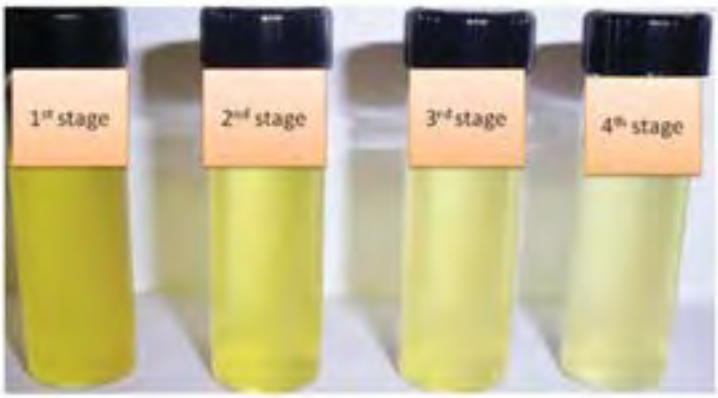

FIG. 2. Miscellae from the four-stage extraction at 2:1 IPA:flour (v:w) ratio

- **Hexane is a common extraction solvent in industrial applications, but concerns over its contribution to air pollution have prompted the search for other extraction solvents.**
- **Isopropyl alcohol (IPA) has high solubility with triglycerides and it is safer than hexane due to its higher flash point, upper explosive limits, and auto-ignition temperature.**
- **This summary of a paper originally published in *JAOCS* describes how IPA was used to develop a rapid method for extracting oil from dehulled yellow mustard flour [1].**

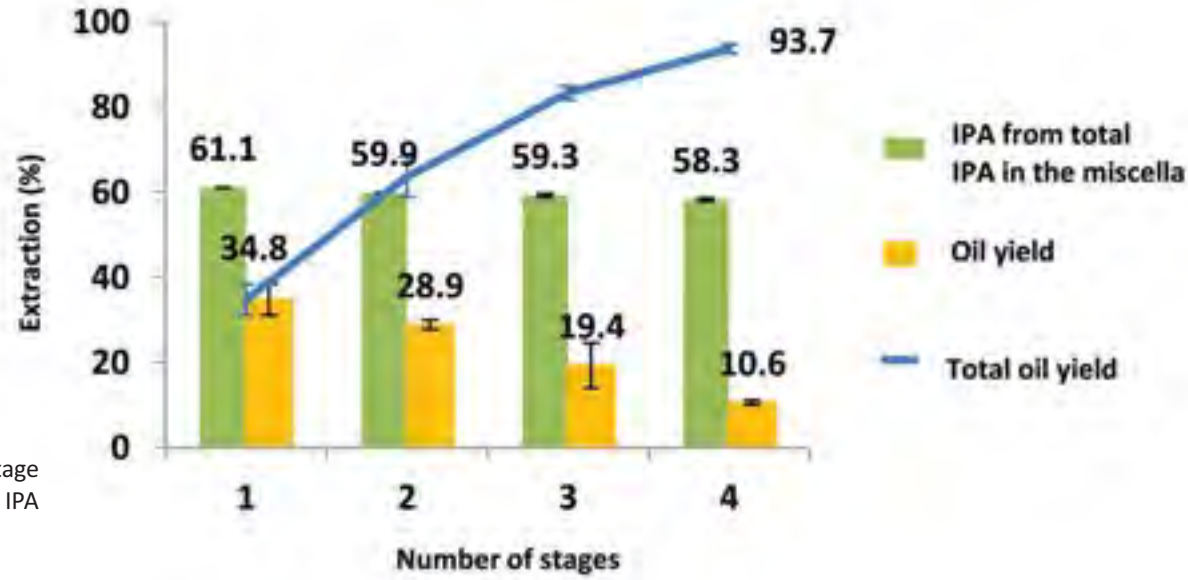

FIG. 3. Four-stage extraction using IPA

protein, residual oil, anti-nutritional components, IPA, and water. An aliquot of miscella and meal residue were dried. The oil yield and extractability and the IPA hold-up in the residual meal were calculated. The oil yield is the oil content of collected miscella and the oil extractability is the oil content of collected miscella plus the oil content of IPA hold-up in the meal. The amount of IPA remaining in the meal residue phase after centrifugation is represented as IPA holdup. For multi-stage oil extraction the single-stage oil extraction process was initially followed. However, following centrifugation, the solids were re-extracted with the same volume to weight ratio of IPA (Fig. 1, page 178).

Single-stage extraction resulted in 87.6 % oil yield at an IPA:flour (v:w) ratio of 10. Four-stage extraction was carried out with 2:1 (v:w) solvent to flour ratio at room temperature and the seed suspension's natural pH of 6.4 (Figs. 2 and 3, pages 179 and 180). The highest oil yield, 34.8±0.52%, was obtained in the first stage. The overall oil yield was 93.7±1.11%. The oil extractability was 99.66 ±0.14%. The combined miscella obtained from the four-stage extraction contained 90.7±0.29% IPA and 8.7±0.30% oil.

The equilibrium line for oil distribution has been determined. Figure 4 shows the oil distribution between miscella and flour residue, the equilibrium line and operating lines

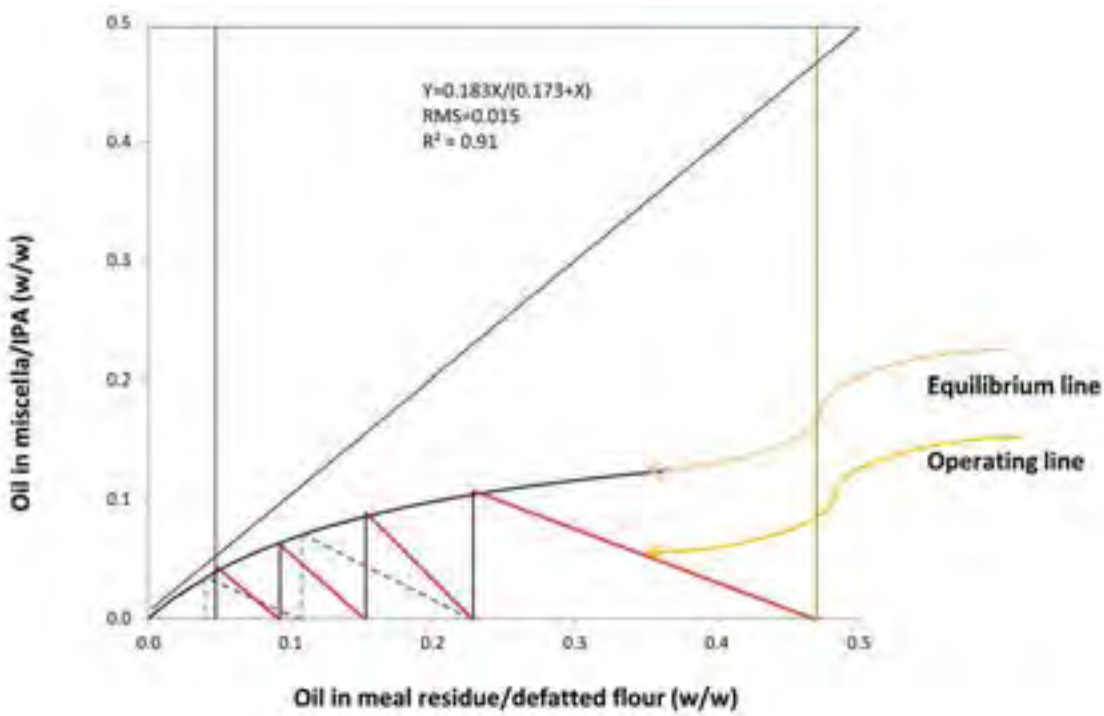

FIG. 4. Oil distribution between miscella and flour residue in four-stage cross-current extraction at 2:1 solvent to solid ratio Four-stage extraction using IPA

representing the four-stage oil cross current extraction at 2:1 IPA:flour (v:w) ratio. The operating lines for each of the four-stages of extraction were plotted using the experimental data. The slope of the operating lines for the experimental data (red lines) showed a slight increase after each stage of extraction, in contrast to the constant slope seen for the operating lines of the theoretical data (dotted lines). This is likely due to the concurrent extraction of non-oil components into the miscella.

The ternary phase diagram was developed to represent the behavior of the IPA-oil-water system. Within the IPA-oil-water system at room temperature, both oil-IPA and oil-water are partially miscible, whereas IPA tends to dissolve in water in any proportion; as a result, two pairs of partially miscible liquids are formed. In this system IPA is considered to be the solvent, water is the solute as it is more soluble in IPA and the oil is considered to be the diluent. The effect of water on oil solubility in IPA was indicated by the solubility curves as well as the corresponding tie lines (Fig. 5). The ternary phase diagram for IPA-oil-water provides an explanation for the decrease in oil yields when water is present in the system. At the azeotropic composition, comprised of 87% IPA and 13% water, miscellae compositions were in the two phase area in which oil solubility was significantly reduced.

Extraction with dry IPA recovered 94% oil, while the azeotrope extracted only 58% of the oil, representing a reduction in oil yield of over 40 %. The sugar extraction by the IPA-water mixture was nearly double the extraction by dry IPA. Somewhat surprisingly, the amount of protein extracted did not change significantly in the presence of water in the solvent

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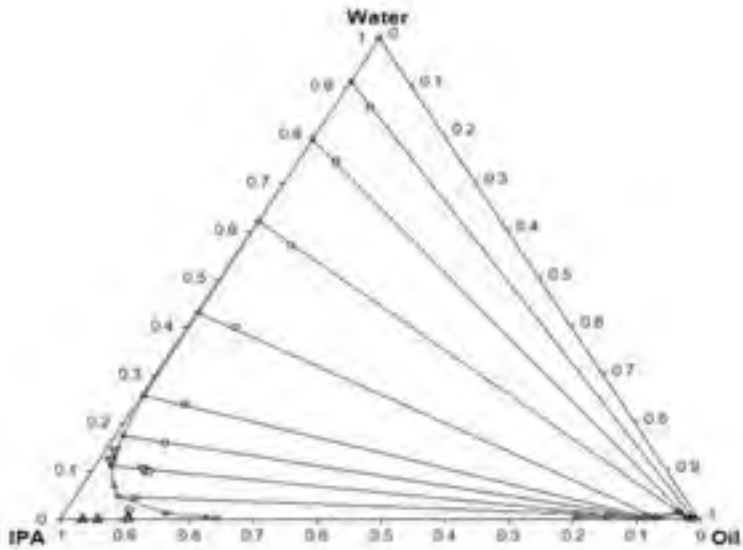

FIG. 5. Ternary Phase diagram of IPA-oil-water

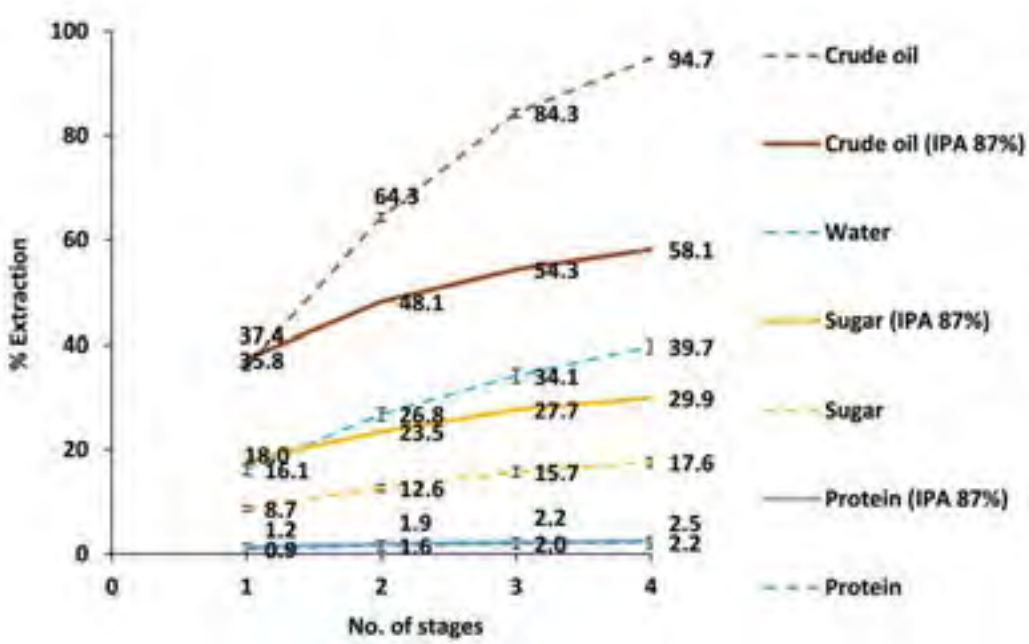

FIG. 6. Different components in the miscella by four-stage extraction, 2:1 IPA: flour (v: w) ratio using IPA and IPA-water

INFORMATION

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(2.2% vs. 2.5), as seen in Fig. 6 (page 181). Clearly, control of water content is critical in achieving efficient oil extraction with minimal co-extraction of non-lipid components. The results are consistent with the report that crude cottonseed oil extracted with 97 % IPA contained 2.3% sugars [4].

WHAT WAS LEARNED

The following three conclusions can be drawn from this work.

- IPA was found to be an effective solvent for recovery of oil from mustard flour without any significant loss or degradation of the unextracted protein.
- Four-stage oil extraction with 2:1 IPA:flour (v:w) ratio at room temperature and native pH resulted in 94 % oil yield.
- Water extracted into the solvent from the seed greatly reduces the oil yield, and therefore a water removal step is required as part of the recovery and reuse of IPA.

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Biotechnology (cont. from 158)

of Rubisco enables the plant to convert CO_2 more efficiently (http://dx.doi.org/nature13776).

The plant is the first genetically engineered crop capable of fixing all of its carbon by a more efficient cyanobacterial enzyme. In an earlier publication, the team reported the creation of tobacco plants that generate structures resembling bacterial carboxysomes, which enclose the Rubisco enzyme inside a beneficial CO_2-rich environment. The next step is to combine the two efforts and create an engineered tobacco strain with carboxysomes that house the turbocharged bacterial Rubisco, which the researchers hope will make the photosynthetic process even more efficient.

In a perspective accompanying the paper, G. Dean Price and Susan M. Howitt from Australian National University (Canberra) comment on the significance of the work: "The advance can be likened to having a new engine block in place in a high-performance car engine—now we just need the turbocharger fitted and tuned."

MATHEMATICAL MODEL AIMS TO BOOST PHOTOSYNTHETIC EFFICIENCY

Some plants are better at photosynthesis than others, and understanding the molecular basis of these differences could lead to the design of higher-yielding crops. A study published in *Nature Biotechnology* presents a mathematical model that will enable researchers to access datasets that compare photosynthetic traits of a class of high-efficiency crops known as C_4 (which includes maize, sorghum, switchgrass, and sugarcane) to less-efficient C_3 crops, such as rice, wheat, barley, and oats (http://dx.doi.org/10.1038/nbt.3019, 2014).

The datasets include information regarding metabolites and gene expression in maize (*Zea mays*, a C_4 crop) and rice (*Orzya sativa*, a C_3 crop), compiled by researchers led by Thomas Brutnell, a researcher at the Donald Danforth Plant Science Center (St. Louis, Missouri, USA). The team used a statistical method known as the unified developmental model to identify differences between the photosynthetic mechanisms of these C_4 and C_3 crops.

"The technologies that our team developed to identify regulatory genes that enhance photosynthesis in C_4 crops can be extended to identify control points for other processes, including nitrogen and phosphate efficiency, as well as a plant's response to environmental stresses like heat and drought," Brutnell said in a news release. The dataset will serve as a resource to researchers interested in using the tools of biotechnology to engineer crops with enhanced photosynthetic efficiency, ultimately resulting in higher yields. ■

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Fig. 1. The discovery of a cellular snooze button has allowed Michigan State University scientists to potentially improve biofuels and offer insight on the early stages of cancer. Photo by G.L. Kohuth.

Discovery of cellular snooze button **advances cancer research and biofuel production**

Layne Cameron

Christoph Benning, MSU professor of biochemistry and molecular biology, and his colleagues unearthed the protein's potential while seeking ways to improve algae's capacity as a biofuel. Its application in cancer research, however, was a surprise finding that is leading Benning's lab in a new direction.

"Algae provide us with model organisms that rival, or possibly exceed, traditional yeast models," Benning said. "It's quite difficult to grow many types of human cells in test tubes. However, we can readily grow, manipulate and study algae, which have the genomic repertoire that make them relevant in their capacity to drive advances in human medicine."

The discovery was made while tackling the conundrum of algae's vexing inverse relationship with growing mass versus producing oil. When algae are awake, they grow; when they're asleep, they produce oil.

"Producing oil is part of the cells' survival strategy when it's under stress," said Chia-Hong Tsai, doctoral candidate with MSU's Department of Energy Plant Research Laboratory and Department of Plant Biology and co-author. "They go into quiescence to conserve energy and nutrients. That's when they

produce the equivalent of vegetable oil. But to convert them into truly viable biofuel producers, we need them to grow and produce oil simultaneously."

The secret for making this happen was CHT7—the gatekeeper that cues cells to wake up or fall asleep. By engineering this protein, Benning's team might one day develop an organism that can't figure out how to doze and is always active. For biofuels, this would remove a major hurdle and gives scientists a way to potentially produce high amounts of oil and biomass.

In terms of human medicine, this discovery gives scientists a promising new model to study tumor suppression and growth. Because quiescent cells are found in many plants and animals, it's a model that can provide important insights into the regulation of cellular behavior in organisms, such as us humans, in ways that traditional yeast models simply can't replicate.

"For cancer research, it's a new paradigm," Benning said. "The switch that tells an organism to grow, or possibly, go rogue and grow uncontrollably – that's exactly what we want to understand. That is the first step of tumor growth."

Additional MSU team members included Jaruswan Warakanont, plant biology doctoral student; Tomomi Takeuchi, biochemistry and molecular biology doctoral student; Barbara Sears, professor emeritus of genetics and plant biology; and Eric Moellering, former doctoral candidate of biochemistry and molecular biology now at Synthetic Genomics Inc.

Layne Cameron is a media communications professional at Michigan State University in East Lansing, Michigan, USA. She can be contacted at Layne.Cameron@cabs.msu.edu.

- **The discovery of a cellular snooze button has allowed a team of scientists at Michigan State University (MSU) in East Lansing, Michigan, USA, to potentially improve biofuel production and offer insight on the early stages of cancer.**
- **The discovery that the protein CHT7 is a likely repressor of cellular quiescence, or resting state, was published in the October 2014 issue of the *Proceedings of the National Academy of Sciences*.**
- **This cellular switch, which influences algae's growth and oil production, also wields control of cellular growth—and tumor growth—in humans.**

Patents (cont. from 170)

acid derivatives, particulated polymers, and particulated copolymers, and wherein the water-repellent admixture is present in the pre-blended dry mortar mix in a dosage from about 0.01% to about 1.00% by weight of the pre-blended dry mortar mix. Water repellency is achieved while maintaining workability as well as the properties of the hardened mortar, including compressive strength and bond strength to other substrates, such as clay or concrete masonry units.

Methods for recovering a solvent from a fluid volume and methods of removing at least one compound from a nonpolar solvent

Ginosar, D.M., *et al.*, Battelle Energy Alliance, LLC, US8747673, June 10, 2014

A method of removing a nonpolar solvent from a fluid volume that includes at least one nonpolar compound, such as a fat, an oil or a triglyceride, is provided. The method comprises contacting a fluid volume with an expanding gas to expand the nonpolar solvent and form a gas-expanded solvent. The gas-expanded solvent may have a substantially reduced density in comparison to the at least one nonpolar compound and/or a substantially reduced capacity to solubilize the nonpolar compound, causing the nonpolar compounds to separate from the gas-expanded nonpolar solvent into a separate liquid phase. The liquid phase including the at least one nonpolar compound may be separated from the gas-expanded solvent using conventional techniques. After separation of the liquid phase, at least one of the temperature and pressure may be reduced to separate the nonpolar solvent from the expanding gas such that the nonpolar solvent may be recovered and reused.

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.

Countdown **to FSMA**

FSMA: What to Expect in 2015

Is your company prepared for the final implementation by the US Food and Drug Administration (FDA) of the Food Safety Modernization Act (FSMA) regulations?

Two experts from The Acheson Group consulting firm in Washington, DC, USA—David Acheson and Melanie Neumann—recently discussed what companies should expect from the FDA in 2015 and how they can adjust to comply with new rules as the final deadlines approach.

Q. WITH THE FSMA COMMENT DEADLINE CLOSED, WHAT CAN WE EXPECT FROM THE FDA IN TERMS OF FINALIZING FSMA?

With the agency still answering questions and conducting FSMA-related activities such as dealing with deadlines and proposals, we can expect to see the agency go silent. We have gone through multiple comment periods already, so we should expect them to stick to their timeline of implementing rules.

- **As industry waits for final regulations from the US Food and Drug Administration under the Food Safety Modernization Act (FSMA) of 2011, many questions remain.**
- **The following answers and tips were presented through a series of free "FSMA Fridays" webinars, usually held the first Friday of the month. Transcripts were summarized by Aaron Biros and previously published on FoodSafetyTech.com. Used with permission. Copyright Innovative Publishing Co. LLC.**
- **To sign up to receive notifications of "FSMA Fridays" webinars, register at http://bit.ly/1xUzQkf.**

Q. WHAT IS FDA ULTIMATELY SEEKING TO ACHIEVE WITH THESE RULES?

When we look at where the FDA is going in 2015, we need to look at what we should be doing in the private sector under FSMA's prevention scheme. The FDA is trying to require companies to think about preventive controls. It is about understanding where your risks are and using the appropriate controls. The main issue surfaces when regulators and suppliers have different senses of what appropriate controls really are. So, thinking about risk-based strategies—whether in the supply chain, internal systems, or whether you are a grower or importer—is going to be key in planning for the future.

Q. WHEN IS IT ANTICIPATED THAT THE FSMA RULES WILL BE FINALIZED?

Going from reactive to proactive and preventive strategies is the essence of FSMA's effect on shifting the regulatory scheme. Therefore, we should expect preventive control rules to come out first. We must put together a monitoring program and corrective actions in our food safety plan proactively. The FDA really wants to get these rules rolled out and enforced before the administration changes in 2016 with the next presidential election, so we can safely assume they will try to stick to their published timelines. (Most proposed rules have a deadline in fall 2015 with the latest in the spring 2016.)

Q. WHAT WILL SOME OF THE BIGGEST CHALLENGES BE FOR FOOD AND BEVERAGE COMPANIES AS THEY BEGIN TO CONSIDER FSMA COMPLIANCE?

The biggest challenges will deal with how to properly manage, store, and retrieve documentation. All the traceability data, information on production, and supplier documentation that are key in a recall should be readily presentable. Having all these data and documentation, being able to produce it quickly and turn it over on demand, is the biggest hurdle. Companies need to leverage technology to manage this risk in documentation and data organization.

Q. WHAT SHOULD COMPANIES BE DOING NOW TO BEGIN TO PREPARE FOR FSMA AS WE WAIT FOR THE FINAL RULES?

Companies should start preparing for FSMA immediately. Between the proposed and final rule, there is some concern about not knowing the future, but companies should conduct FSMA assessments and build a roadmap for compliance on track with FDA timelines.

Supply chain risk control and environmental monitoring are new and challenging ventures. The behavior of the FDA in the past few years has shown that any company that needs to comply with preventive control rules should really pay attention to their environmental monitoring program.

Hazard analysis and critical control points (HAACP) systems are likely to be fairly robust and will translate quickly, but environmental monitoring could be considered the Achilles' heel. The other Achilles' heel is the supply chain. This was in the original statute giving the FDA the authority to require supply-chain risk assessments and controls. This has resurfaced in the re-proposals, which is very reflective of the foreign supplier verification program. Look at what you know about your supply chain. The expectation will be that you control those risks.

The other challenge is FDA is expecting you to look more than one step upstream. If you are buying your ingredients from a distributor, it is your responsibility to institute preventive controls in environmental monitoring. Companies need an organized central repository of all upstream, internal, and downstream documentation and data.

Global Food Safety Initiative (GFSI) standards compare to the preventive control rules. The standards might be highly robust but that does not necessarily mean you comply with food defense and foreign supplier verification programs. Keep all that in mind when looking strategically toward 2016.

FSMA COURT-MANDATED DEADLINES

Following are the court-mandated deadlines for implementation of final rules under the Food Safety Modernization Act of 2011:

- August 30, 2015—Preventive Controls rules—both the human food and the animal food rules
- October 31, 2015—Produce Safety, Foreign Supplier Verification Program, Accreditation of Third-party Auditors rules.
- March 31, 2016—Sanitary Transport rules
- May 31, 2016—Intentional Adulteration/Food Defense rules

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WHAT'S A SUCCESSFUL FOOD SAFETY AUDIT?

SANGITA VISWANATHAN

Being prepared and audit-ready is becoming increasingly important in the food safety world as the industry is moving to compliance with rules proposed under the Food Safety Modernization Act (FSMA). In this Q&A, from a webinar hosted by SafetyChain Software and SCS Global Services, Heena Patel, SCS Global's senior technical director and auditor answers some key questions about audits.

Q. WHAT ARE THE FIVE TOP BEST PRACTICES TO FOLLOW FOR SUCCESSFUL AUDITS?

Heena Patel: As an auditor myself, I have conducted hundreds of audits. Auditors look for specific things and can make keen observations. They look for confidence, if the audit team on the site is well prepared for the audit or not. So be prepared for the audit. Be confident, follow the audit plan, have key staff present for the opening and closing meetings and for the facility walk-through.

Don't make the auditor wait for you to locate reports and records. Follow the audit plan; the plan is sent to the site ahead of time for a reason. It has details about the audit and what it would involve and is a very good guideline that can be used to prepare for the audit by getting ready all the necessary reports and records.

Conduct mock internal audits to prepare for the final audit. Internal audits can help you prepare for any surprises. Use the information from the internal audits to answer questions during the actual audit.

Senior management must be prepared to show commitment and support for the food safety team. This matters a lot to the auditors.

And finally, feed your auditor well. It's not a good idea to have a grumpy auditor.

Q. WHAT ARE THE BIGGEST "NO-NO'S" LEADING TO DEDUCTIONS?

Patel: I would list the following items that lead to deductions:

- Lack of management commitment and lack of teamwork.
- Being unorganized and unprepared.
- Not following and/or not understanding code requirements.
- Not fully answering auditors' questions.

Having an incompetent team and incomplete documentation reveals the company as not having the necessary training or professionally trained personnel in-house. Having prerequisite programs in place is huge in the audit checklist, and this covers aspects such as sanitation practices, mock recalls, allergen management, training, testing, etc. We also look for business continuity plans and management reviews. At SCS Global, we use a matrix with all this information to see what has been addressed well during the audit.

Q. WHAT DO AUDITORS LOOK FOR IN DEMONSTRATING CONTINUOUS IMPROVEMENT?

Patel: As an auditor, I love this aspect of an audit. Auditors don't like to see that the program is not moving forward and is not getting the commitment and resources required from management. They must be focused on investing in employees with training and continuing education programs and focused on upgrading structures and fixtures throughout the building as needed. Key performance indicators must be developed to measure the performance of the food safety and quality programs. These must be based on findings of the internal audit, external audit, recalls, etc. It's also important to trend and evaluate this data during management meetings to see where the program stands and how it can be improved as part of the continuous improvement program.

Q. HOW CAN COMPANIES BEST PREPARE FOR UNANNOUNCED AUDITS?

Patel: Unannounced audits are great from an auditor's viewpoint, as we can use this to see if the site is truly audit-ready at all times. Often, with announced audits, we go in and notice that the floor has been swept well, there are no cobwebs anywhere, everything's nicely arranged on the shelves, etc. But you also realize that the mock recalls have been conducted the day before; the internal audit was conducted two days earlier. And this is not a good sign.

It's important for food facilities to have a schedule in house in which records based on internal audits, sanitation programs, mock recalls, etc., can be updated on a continual basis. The actual audit should just be used to review and sign off on these records.

How can companies be audit-ready at all times? By monitoring all programs continuously, keeping the facility clean at all times and keeping the paperwork up to date at all times.

Q. HOW CAN AUTOMATION/ TECHNOLOGY FACILITATE AUDIT READINESS?

Patel: Many years ago when I used to audit food facilities, there were no automation systems in place. Auditors were using hard

copies and paper checklists. Now, automation has made the entire process more efficient and communication-friendly. Automation can help prepare audit plans; schedule tasks and assign food safety personnel to different parts of the program; have a centralized repository for records and data; work with certified bodies and suppliers who can all see information in one place; report nonconformances; put in place due dates for suppliers and auditors to either confirm or reject actions; have records on who conducted the audit, all nonconformances, all corrective actions; etc. Having automation technology helps save on all the paperwork involved in managing a food safety program and preparing for an audit.

To sum up, automation can:

- Provide greater records efficacy.
- Make it easier to communicate with your auditor when on-site and pre-/post-audit.
- Incorporate automated reminders to help food safety managers and auditors meet required deadlines.
- Save time preparing for your audit by automating record keeping.

Extracts & Distillates (cont. from 176)

fractions. Antinutrients (trypsin inhibitors, phytic acid, glucosinolates, and condensed tannins) were mostly located in the cotyledon fractions. These findings indicate that the separation of hemp seed meal into different fractions could be used to concentrate valuable target compounds and consequently facilitate their recovery.

Validated method for the analysis of goji berry, a rich source of zeaxanthin dipalmitate

Karioti, A., *et al.*, *J. Agric. Food Chem. 62*: 12529–12535, 2014, http://dx.doi.org/10.1021/jf503769s.

In the present study an HPLC-DAD method was developed for the determination of the main carotenoid, zeaxanthin dipalmitate, in the fruits of *Lycium barbarum*. The aim was to develop and optimize an extraction protocol to allow fast, exhaustive, and repeatable extraction, suitable for labile carotenoid content. Use of liquid N_2 allowed the grinding of the fruit. A step of ultrasonication with water removed efficiently the polysaccharides and enabled the exhaustive extraction of carotenoids by hexane/acetone 50:50. The assay was fast and simple and permitted the quality control of a large number of commercial samples including fruits, juices, and a jam. The HPLC method was validated according to ICH guidelines and satisfied the requirements. Finally, the overall method was validated for precision (% RSD ranging between 3.81 and 4.13) and accuracy at three concentration levels. The recovery was between 94 and 107% with RSD values <2%, within the acceptable limits, especially if the difficulty of the matrix is taken into consideration.

Novel approach to evaluate the oxidation state of vegetable oils using characteristic oxidation indicators

Cao, J., *et al.*, *J. Agric. Food Chem. 62*: 12545–12552, 2014, http://dx.doi.org/10.1021/jf5047656.

Four vegetable oils with typical fatty acid compositions were chosen to determine their indicators of lipid oxidation under the conditions of accelerated oxidation. Good linear correlations were observed between the total nonpolar carbonyl amount and the total oxidation value (TOTOX, R^2 = 0.89–0.97) or peroxide value (POV, R^2 = 0.92–0.97) during 35 days of accelerated oxidation. Additionally, nonanal in camellia oil (oleic acid mainly) increased significantly, and correlated linearly with TOTOX (21.6 TOTOX – 595, R^2 = 0.92); propanal increased significantly in perilla oil (linolenic acid mainly) and correlated linearly with TOTOX (8.10 TOTOX + 75.0, R^2 = 0.90). Hexanal (9.56 TOTOX + 913, R^2 = 0.90, and 7.10 TOTOX + 342, R^2 = 0.78, respectively) and nonenal (10.5 TOTOX + 691, R^2 = 0.95, and 6.65 TOTOX + 276, R^2 = 0.84, respectively) in sunflower oil (linoleic acid mainly) and palm oil (palmitic and oleic acids mainly) also had good linear correlations with TOTOX. Considering the change patterns of these four aldehydes, it was found that the oxidation stability was in the order sunflower oil < camellia oil < perilla oil < palm oil, which was same as POV, TOTOX, and total nonpolar carbonyls. It was concluded that the four aldehydes nonanal, propanal, hexanal, and nonenal could be used as oxidation indicators for the four types of oils.

Lipids, tocopherols, and carotenoids in leaves of amaranth and quinoa cultivars and a new approach to overall evaluation of nutritional quality traits

Tang, Y., *et al.*, *J. Agric. Food Chem. 62*: 12610–12619, http://dx.doi.org/10.1021/jf5046377

Composition of lipophilic phytochemicals including fatty acids, tocopherols, and carotenoids in leaves of 6 quinoa and 14 amaranth cultivars was analyzed. The oil yields in quinoa and amaranth leaves were only 2.72–4.18%, which contained mainly essential fatty acids and had a highly favorable ω-3/ω-6 ratio (2.28–3.89). Pro-vitamin A carotenoids, mainly α- and β-carotenes, and xanthophylls, predominantly lutein and violaxanthin, were found in all samples. The primary tocopherol isomers present in both quinoa and amaranth leaves were α- and β-tocopherols. Added to the discussion on the lipophilic nutrients was the normalization of ω-3/ω-6 ratio, α-tocopherol equivalents, and carotenoids, in an attempt to establish a novel system for evaluation of the overall quality attributes of lipophilic nutrients (NQ value). The NQ value, but not the individual components, was highly correlated with all the antioxidant activities, supporting the ranking order of the potential nutritional quality of quinoa and amaranth leaves based on this new method. ■

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How to make LinkedIn work for you

Patrick Ropella

Whether you're a recent college graduate or a veteran of the fats and oils industry, LinkedIn is a great tool to advance your career. The popular online networking tool lets you know about job openings and tells potential employers, friends, and colleagues about your qualifications and career aspirations. It's an excellent way to reach recruiters and employers, who frequently check LinkedIn when they are seeking employees. It can also help you learn more about your field and build professional relationships. The basic service is free (although you can select and pay for an upgraded plan), but whatever plan you choose will take some time and thinking on your part.

MARKET YOURSELF WELL

Start with a professional photo. The photo is the front door of your profile, and you want it to make a good first impression. Choose one that makes you look alert and confident, preferably with a smile on your face. Studies consistently show that a photo convinces more viewers to read your profile and to be more open to you. No photo, no click.

Your LinkedIn profile is a marketing piece that tells your story. Maximize the impact by choosing a professional headline that describes what you do. Keep the headline short and succinct, such as: "Three Years' Experience in Palm Oils," "Personal Care Formulation Expert," or "Specialist in Vegetable Oil Processing." Your professional headline will be displayed each time people search for you, and it should reveal what you do in clear, understandable language.

Make sure to back up the message of your headline with facts by listing relevant documentation in the education and experience categories. Complete the entire profile; the more information you post, the more likely people will find you through searches.

The most effective profile is a well-written marketing piece about you, your talents, your experiences, and skills. Have friends proof-read it to ensure it is easy to read and free of embarrassing typos or misspellings.

The Status Update lets you note accomplishments and highlight recent activities. Perhaps you completed the AOCS Laboratory Proficiency Program, attended a short course on edible fats, or are working on a special project involving soap manufacturing technology. Mention it. If possible, use the Status Update to thank someone who helped you or mention how this activity adds to your expertise.

ENHANCE YOUR LINKEDIN PAGES FOR BEST RESULTS

Use key words to help search engines find you. Don't overuse them, but be sure that you include important keywords related to what you do—or want to do.

CONTINUED ON NEXT PAGE

- **Online networking is becoming increasingly important for professionals in oils- and fats-related industries.**
- **LinkedIn is a popular tool for online networking that can help you reach recruiters and employers, learn more about your field, and build professional relationships.**
- **It's free, but getting the most out of LinkedIn will take some time and effort on your part. Here are some practical tips that will help you take your LinkedIn experience to the next level.**

Make it easier for people to find you by completing the Summary section, which allows up to 2,000 characters. But don't fake it; regular LinkedIn readers can tell when you're over-reaching.

A word about wordiness: Readers have limited time, so be concise. Focus on key points. Explain why you like working with edible oleogels or what you learned about contaminants, chromatography, or lipid oxidation.

MAKE NEW CONTACTS, RENEW OLD CONTACTS

One of LinkedIn's most powerful features is its power to help you make contacts, whether you're searching for a new job or seeking clients for your business.

Keep expanding your list of contacts so searches will turn up your name and qualifications. The more connections you have, the more likely you will draw searches. A significant number of relevant connections shows that you are active in the industry.

Spend some time every week looking for potential contacts—both people in the industry and people you previously worked with or went to school with. (More about this later.)

In addition, your ability to network with people demonstrates that you are someone who can communicate and work well with others. These are skills that employers prize.

Check LinkedIn regularly not only for your own profile but also for information about your industry and your colleagues. If a respected colleague is on LinkedIn, endorse her or offer to write a recommendation. Hopefully, she will reciprocate.

LinkedIn also is a good source of information about companies that are hiring. The open positions may not appeal to you, but perhaps you know someone who would be interested.

Help others. Comment on others' posts when you have something relevant to say. If people comment on your posts, thank them and look for ways to keep the dialogue flowing.

Remember your old contacts, too.

Ian Brodie, a marketing expert in England, got 256 responses when he asked LinkedIn users how they gained new business. The largest number of respondents said that new contacts brought new business, but the second-largest number reported gaining new business by reconnecting with old contacts. Obviously, making connections— both new and old— is the key to using LinkedIn to the best advantage.

BE PROACTIVE REGARDING YOUR EMPLOYMENT

Join LinkedIn Groups relevant to your career and your hobbies. LinkedIn offers many groups for professionals in various specialties to exchange information and career help. There are more than a dozen groups related to soybeans alone; such groups can provide valuable information for your work.

You can build your personal brand by periodically posting valuable or interesting information. Others who see your posts may turn to you for business or advice.

Be proactive. Look up companies by name and develop lists of their employees. This may lead to connections you can develop over time—although, as Lindsey Pollak writes in LinkedIn's blog, you must know a person on LinkedIn, or at least know someone who knows that person before you make contact.

Other ways to build your personal brand include:

- allowing incoming mail;
- obtaining a personalized URL;
- adding Webpage links with good descriptions; and
- asking colleagues to write recommendations to be posted on your page.

Finally, LinkedIn is constantly evolving, as are other social media. Stay current on new ways to use LinkedIn and show potential employers that you are a modern communicator.

Patrick Ropella is Chairman & CEO of the Ropella Group, www.Ropella.com ,an international executive search, leadership transformation, and corporate consulting firm. He authored the book and web-based training program, The Right Hire—Mastering the Art of SMART Talent Management*, and his content has been featured in many trade magazines, business publications, and industry journals. Patrick regularly speaks at webinars, career fairs, and conferences, and can be contacted at +1 850-983-4777.*

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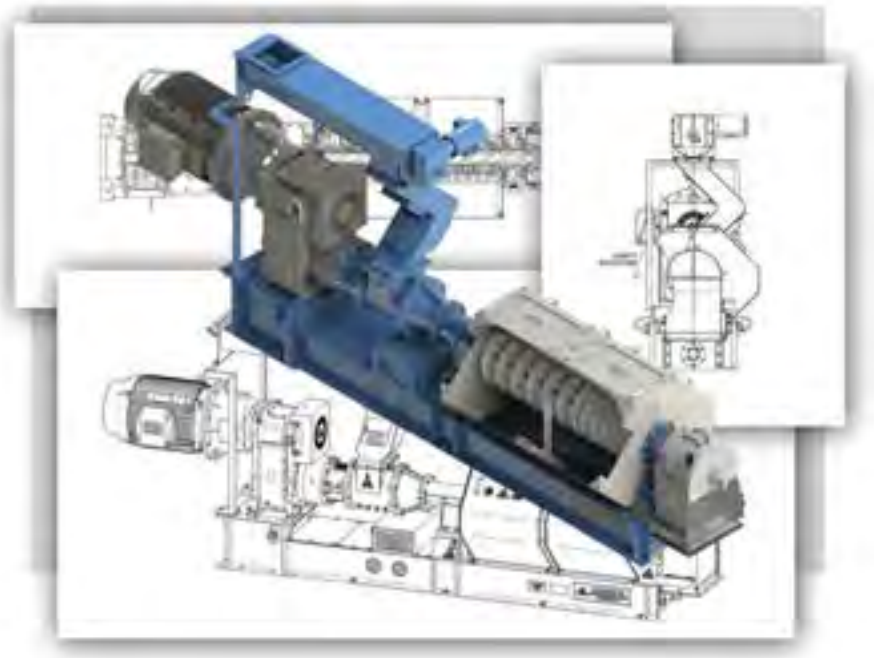

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