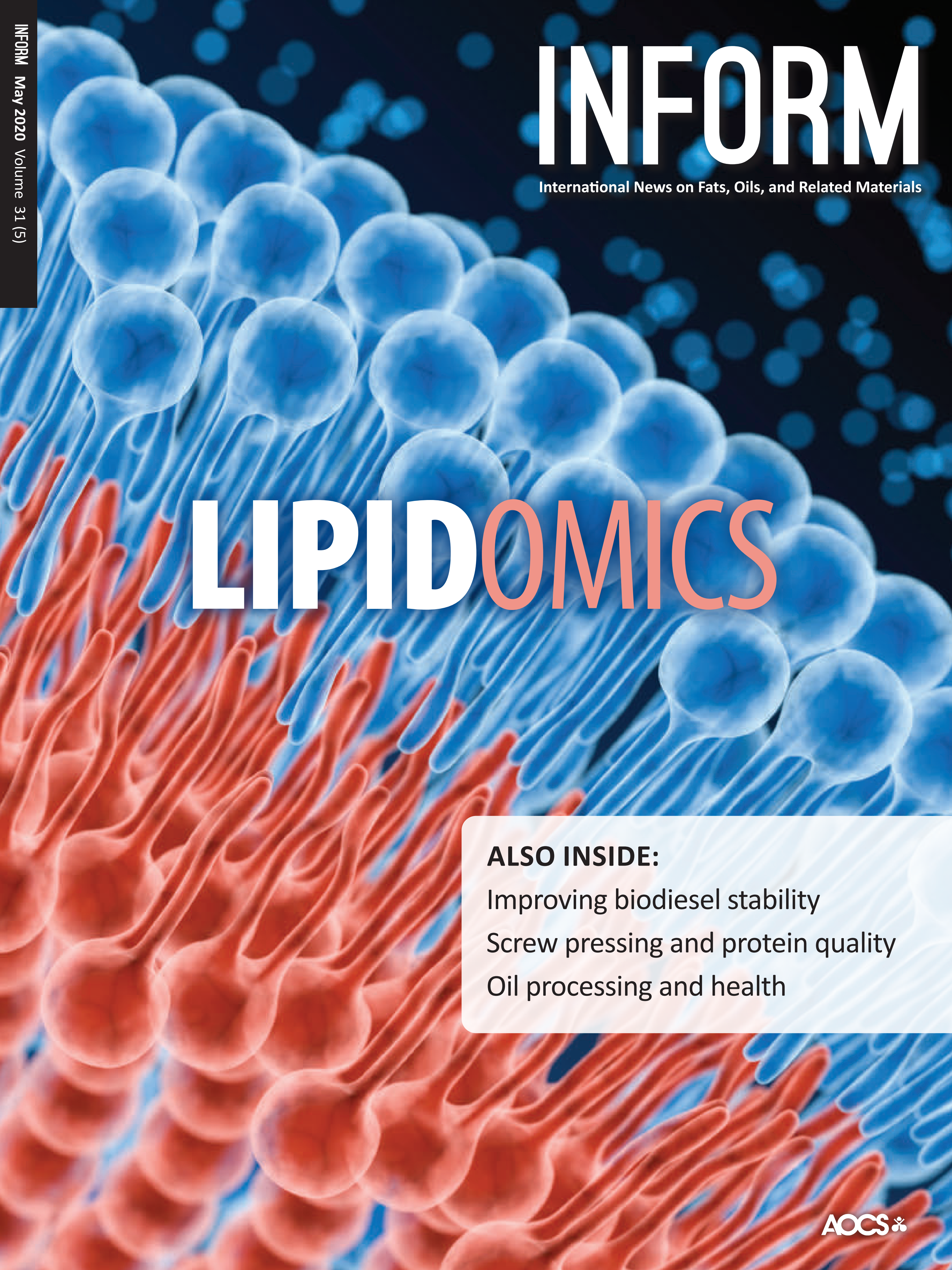

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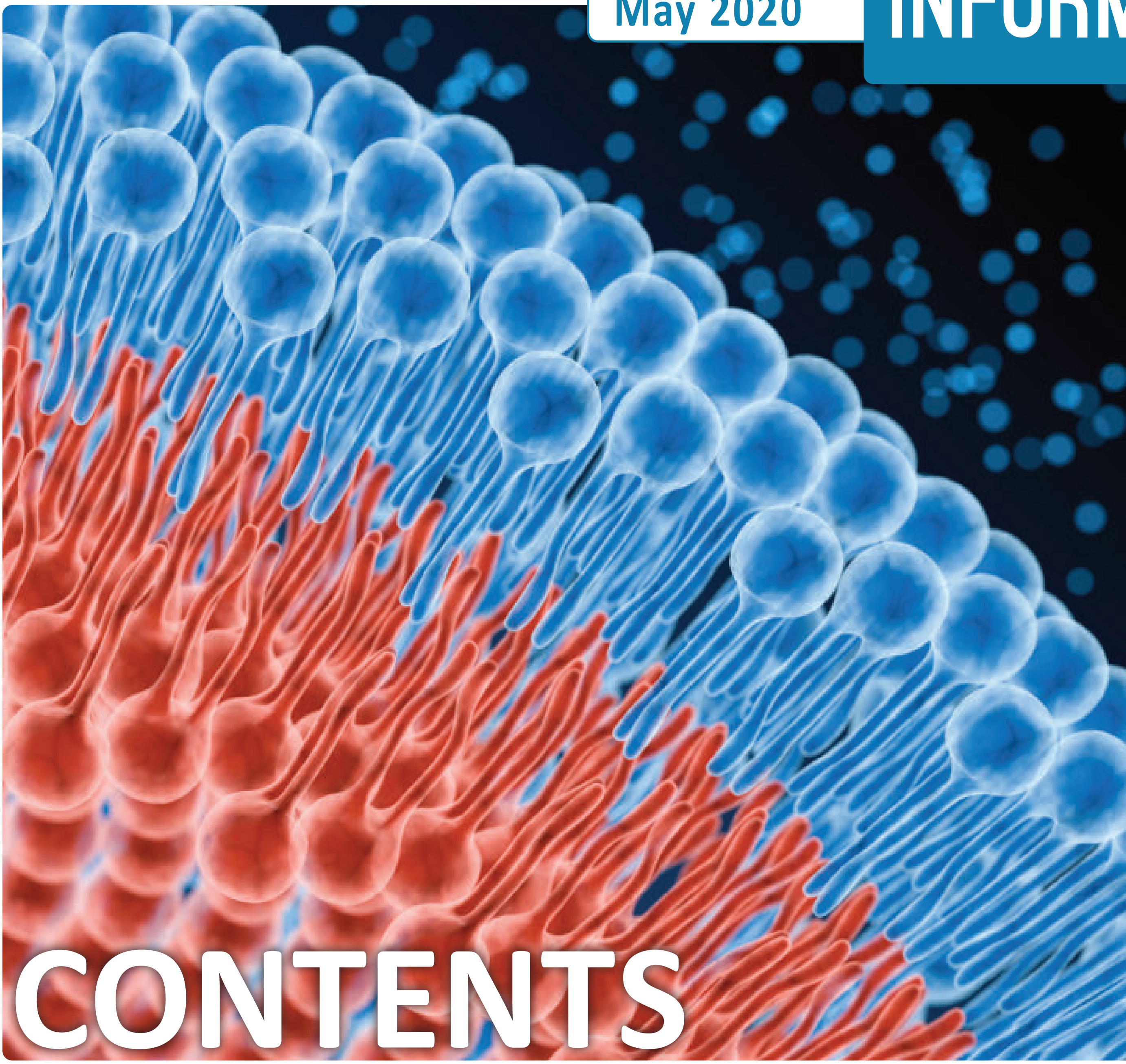

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Inform (ISSN: 1528-9303) is published 10 times per year in January, February, March, April, May, June, July/August, September, October, November/December by AOCS Press, 2710 South Boulder Drive, Urbana, IL 61802-6996 USA. Phone: +1 217-359-2344. Periodicals Postage paid at Urbana, IL, and additional mailing offices. **POSTMASTER:** Send address changes to *Inform*, P.O. Box 17190, Urbana, IL 61803-7190 USA.

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Lipidomics comes of age

Rebecca Guenard

Scientists spent 30 years focusing their molecular biology experiments on DNA, RNA, and proteins. In the past decade, lipids research has gained more attention. Now, biological lipids are getting the spotlight as potential solutions to medical, nutritional, and cosmetic challenges. As scientists use lipidomics to sift through the thousands of molecules that make up the lipidome, they are increasingly realizing that lipids do much more than just serve as an energy source or a cell barrier for proteins.

- **The lipidome is the term for the wide range of lipids found in biological systems. For decades, researchers have been identifying and classifying these molecules.**
- **Lipids participate in most important biological processes. They compose cell membrane structures and organellar membrane structures, where they facilitate intracellular trafficking and cell-signaling.**
- **More sensitive analytical techniques allow today's lipidomics researchers to examine the interactions of lipids with other types of biological molecules in a variety of human diseases.**
- **By studying lipid metabolism and signaling in human cells, researchers are discovering important aspects of human diseases like cancer, cardiovascular disease, neurological disorders, and diabetes that will lead to the development of new treatments.**

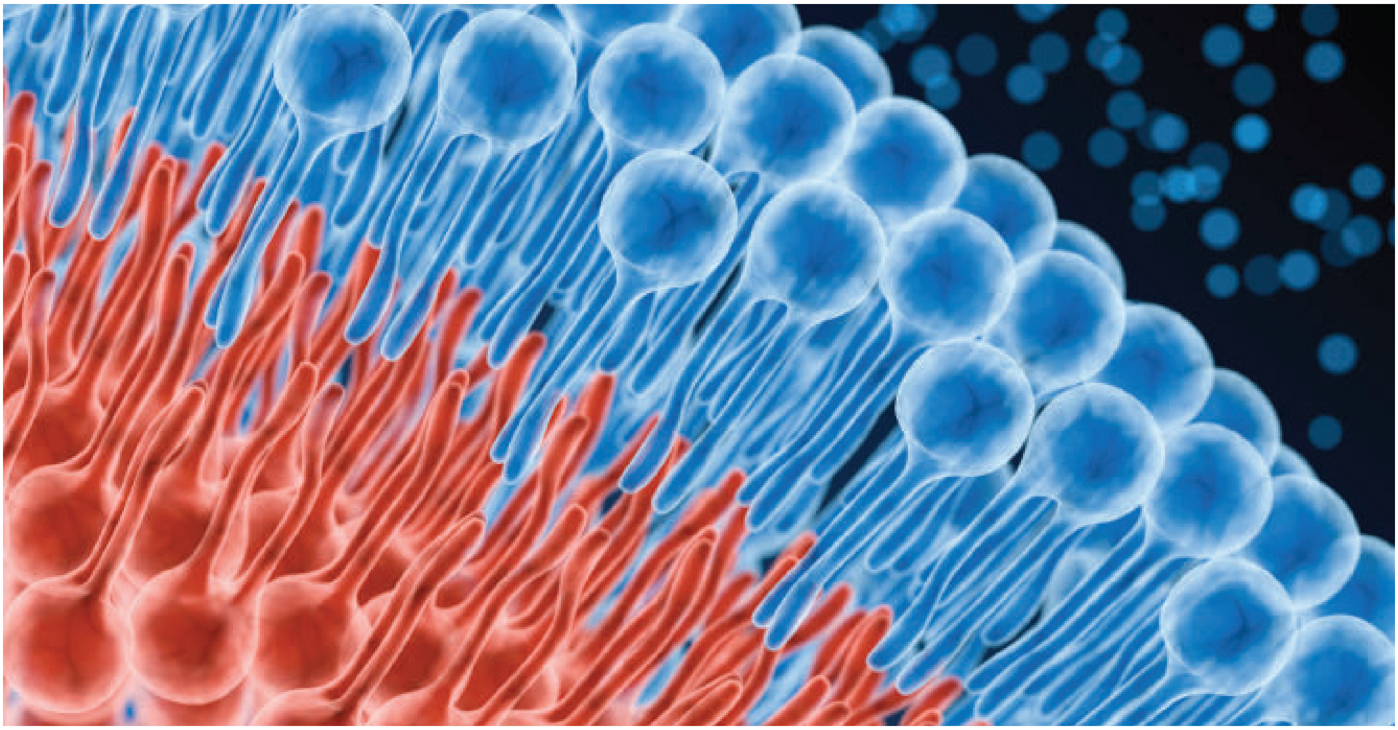
"What we have started to realize is that lipids and their chemical diversity are very important to organizing cellular function," says Anne-Claude Gavin, a biochemistry professor at the University of Geneva in Geneva, Switzerland, who studies lipid metabolism and cellular membrane regulation. Lipids are made up of a limited number of simple chemical building blocks, but they have the potential to generate up to 100,000 different molecular species.

"Lipids are more difficult to study than proteins, which have a genetic code that provides instructions on how the molecules should operate," says Gavin. Despite this, the past 10 years, have been fruitful for lipidomics researchers. Mass-spectral techniques, including three-dimensional analysis that maps densities, make it possible to evaluate the role of lipids in human cells.

Consequently, researchers are now teasing apart the lipids that serve critical biological roles, identifying their distinctions, and developing targeted products for anti-aging cosmetics and treatments for disease. As lipid-focused consumer products become a reality, lipid scientists are turning their interests to bigger questions, such as: Can lipidomics help us understand the relationship between nutritional and biological lipids? Some seem confident that it can, and that nutritional lipids will be a prominent focus of lipidomics in the coming years.

CELLULAR LIPIDS

Biological lipids represent a broad class of compounds involved in a range of cellular roles. Lipids both comprise a cell's membranes and direct the membrane's traffic. Proteins attach to a membrane surface or nestle within, but their tasks depend on the lipid composition. Lipids also form clusters, called rafts, that accommodate specific types of proteins and regulate their use. To begin to understand the diversity of lipid functions, scientists needed a way to categorize the corresponding variations in lipid molecular structures.



Genes are mostly constructed from only four nucleic acids, and proteins are made from 20 amino acids. Lipids have comparatively more building blocks, resulting in far more structural options. Lipids are a heterogeneous set of molecules sharing the common property of being insoluble in water. In the early 2010s, a consortium set out to wrangle different classification schemes into one system that would be useful for a bioinformatics approach to lipids (doi:10.1016/j.bbalip.2011.06.009). The consortium redefined lipids as hydrophobic or amphipathic molecules originating from two groups: 1. carbanion condensations of ketoacyl thioesters or 2. carbocation condensations of isoprene. From these two groups, lipids can be divided into eight categories. Six are produced from ketoacyl subunits (fatty acyls, glycerolipids, glycerophospholipds, sphingolipids, saccharolipids, and polyketides), while two (sterols and prenols) are derived from isoprene units (Fig. 1, page 8). These categories are further divided to distinguish lipid chemistry and function. Like sorting the edge pieces before starting on a challenging jigsaw puzzle, researchers could begin to build the picture of lipids within eukaryotic cells.

The spectrum of lipids in cells are known to originate mostly from the endoplasmic reticulum, with contributions from a few organelles like mitochondria and peroxisomes. Much of the current lipidomics focus is on understanding how lipids are sorted and distributed after synthesis. Sterols and sphingolipids, for example, concentrate at the cell's surface, although they are formed deep within the cell.

"Lipids accumulate in very specific areas in cellular systems. This is absolutely key to cell biology," says Gavin. These lipid gradients generate cellular organization, but researchers still do not know exactly how these gradients are created and maintained, she says. In the past, proteins were believed to be the sole operators in transportation, but it is becoming clear that they work in unison with lipids to perform the task. Gavin maps lipid highways to understand transport schemes. "We can measure lipids inside the cell and follow their metabolic fate," she says.

Metabolic enzymes also offer clues about how lipid gradients form. For a long time, the location of enzymes in different membranes and organelles seemed to indicate a compartmentalization of lipid metabolism, Gavin says. "For example, you take a very simple lipid, phosphatidylserine. It is made in the lipid factory, the endoplasmic reticulum," she says. "But then this lipid is required in the mitochondria, where it will be decarboxylated to phosphatidylethanolamine."

Her lipidomics analysis revealed that lipid-transfer proteins bind more than one lipid species. This result indicates a high-level management of lipid metabolism within the cell. "The community's hypothesis is that the proteins act as a lipid exchanger, taking a lipid in one direction and then a different lipid in the other direction," says Gavin. "This is a very interesting concept because it would suggest that metabolism is integrated." In other words, cell organelles coordinate the production and movement of lipids as if they were parts in a manufacturing process. Her team will continue to elaborate on these recent findings.

According to Gavin, lipid-transport proteins represent an emerging lipidomics research area. At least 131 lipid-transfer proteins have been found in humans so far. The complexity of organizing lipids and connecting their metabolic pathways means that lipid-transfer proteins can make mistakes. Researchers now understand that this is the case in Gaucher disease and Farber disease, and they are considering treatments. Gavin also sees lipid-transfer proteins as a potential avenue for drug delivery.

"Some of those lipid transporters are known to bind drugs like ibuprofen," Gavin, explains. "If we could learn more about how the protein binds hydrophobic drugs, it could be an interesting drug-delivery mechanism." She says a drug could target the proper cell or even the proper cellular compartment.

COMPLEX ANALYSIS

Gavin is able to study lipids in detail because of a high-throughput liposome microarray-based assay (LiMA) her group developed that allows researchers to quantify and image protein-lipid interactions. Specialized techniques like this are necessary since the properties of lipids make them difficult to study in a systematic manner.

For example, fatty acids are known to attach to proteins and change their signaling behaviors. To study these lipid-based modifications, researchers developed fluorescence-labeled fatty acid and isoprenoid probes. The probes can be incorporated into the cell through its own biosynthetic processes. Once inside, researchers can track the probe to study how lipids modify certain proteins.

Typical biotechnology tools—like overexpression, which is used to study genes—are not useful for studying lipids, because their population increases non-selectively. To target specific, low-abundance lipids and analyze them without getting confounding signals from other lipids, scientists feed labelled precursors of lipids to cells. Using these techniques, lipidomics is being conducted in live cells, organoids, and tissues that represent an authentic lipid environment.

"Twenty, twenty-five years ago, it was really tough to work with these lipids," says Besim Ogretmen, a biochemistry professor at the Medical University of South Carolina, in Charleston. "We were mostly dependent on analogs of lipid molecules." Lipidomics researchers now combine organic and analytical chemistry with genetics. "So instead of looking at lipid analogs, we can actually change the synthesis in the cells," he says.

Along with new synthesis tools, the field has benefited from advances in mass-spectrometry. Electrospray ionization first made it possible for lipids and biological compounds to be analyzed by mass-spec. Other vaporization methods use high temperatures that decomposed the compounds before they could be analyzed. When electrospray ionization became established, the National Institute of Standard and Technology (NIST) started developing methods to analyze lipids.

"About 15 years ago, we began building a tandem mass-spectral library of ions formed in electrospray which, of course, includes lipids or almost anything that is an organic molecule in a biological system," says Stephen Stein, director of the Mass-Spectrometry Data Center Group. His colleague and project leader, Xiaoyu Yang, mentioned that this mass-spectral library now contains 1.3 million mass spectra for more than 30,000 compounds, including various lipids such as steroids, phospholipids, and glycolipids. The standards have been collected from commercially available lipids, as well as metabolites from human samples.

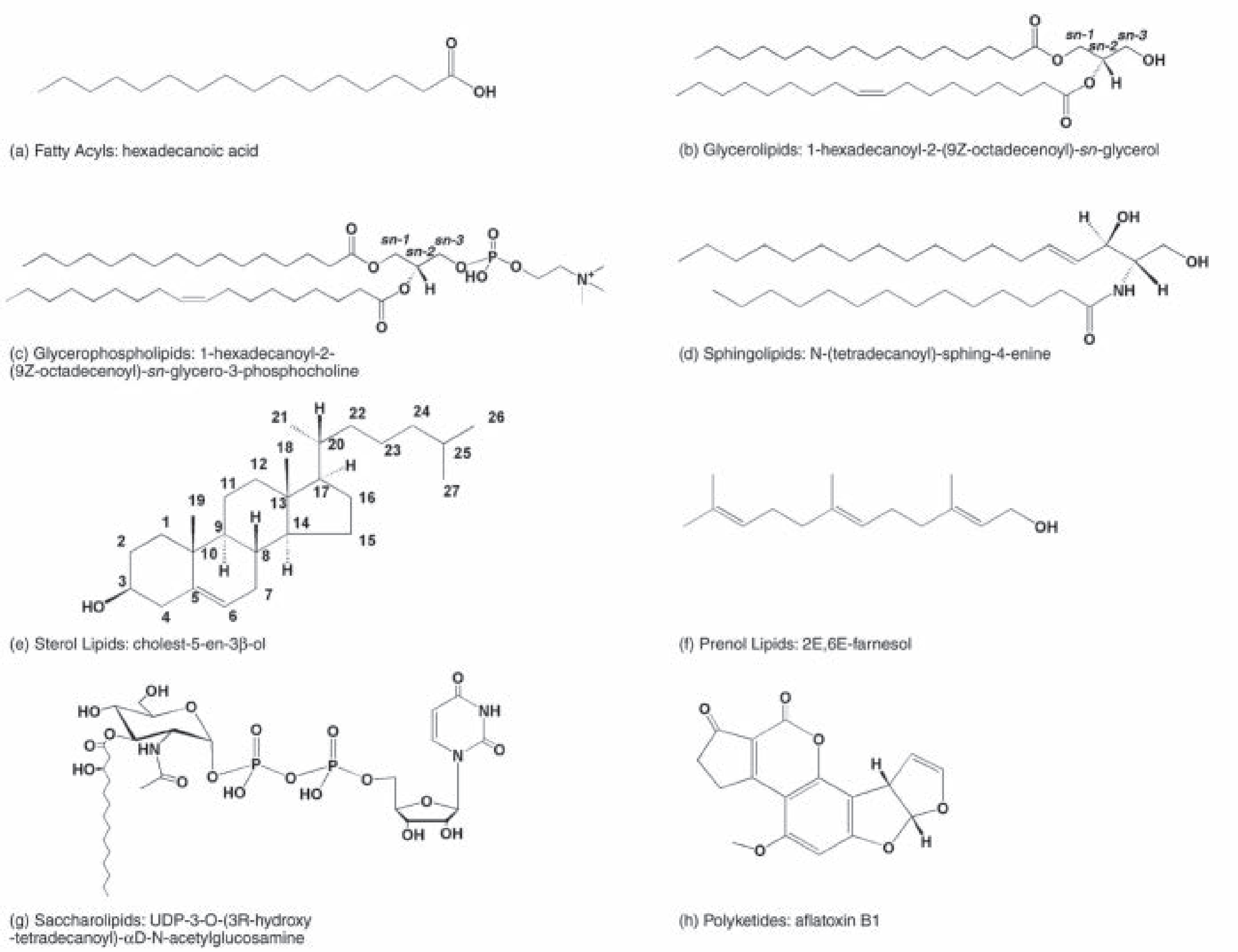


FIG. 1. Eight categories of lipid molecules

Imaging mass-spectrometry has especially contributed to lipidomics analysis, because it reveals the spatial distribution of lipids in tissue. In a complex cellular context, such as liver or muscle tissue, the technique can be used to compare healthy and diseased tissue to reveal how lipid composition differs. This type of analysis would be difficult to do with classic techniques, because one would need to average results from millions of cells.

"Using MALDI (matrix-assisted laser desorption ionization) imaging coupled with liquid chromatography/mass-spectrometry, we are now able to follow lipid-based compounds or their metabolites to identify the tissues where they are localized, and how much they accumulate in a given experiment," says Ogretmen.

The resolution is not yet subcellular, but it is getting closer. Scientists will soon be able to obtain information on lipid dynamics—like the arrangement of lipid head groups—within cell membranes. Understanding the intricacies of lipids at the cellular level has primed the field for a flood of new studies centered on health and nutrition.

"We have started our focus on intercellular transporters," says Gavin. "But, of course, there is an entire world of secreted transporters that deliver lipids from peripheral tissues to the liver or, in the brain, between astrocytes and nerves."

TREATING DISEASE

A variety of research facilities are focused on understanding the impact of different types of lipids: glycolipids, phospholipids, and cholesterol, for example. However, studies indicate that sphingolipids, found in cell membranes, play an important role in aging and its related diseases. These lipids are converted into sphingosine-1-phospate and ceramide, which perform the opposing duties of cell proliferation and cell death (Fig. 2, page 10). Biological development and homeostasis require the critical process of balancing these lipids. It is now clear to researchers that a shift can lead to cancer and other illnesses.

"One important aspect of these sphingolipids is that they are stress-response molecules," says Ogretmen. "They signal the production of lipids in response to aging." Ogretmen employed lipidomics to follow the metabolic processes of sphingolipids and identify the enzymes that are responsible for ceramide production. He then genetically altered mice so the machinery that manufactures the enzymes was turned on or off. "Instead of targeting the lipids, we went after the enzymes that metabolize them," he says.

By this means, Ogretmen developed anticancer therapies that regulate ceramides through the enzymes that build or destroy them. "We are conducting a clinical trial for one of these enzyme inhibitors for prostate cancer patients," he says. "The idea is to inhibit the enzymes that eliminate ceramide signaling to improve cell death pathways in cancer cells." His clinic is currently recruiting patients for a phase 2 trial of this therapy. In addition, they are investigating Alzheimer's disease, immunotherapy, and aging.

ON THE HORIZON

Building the lipidomics knowledge base to begin answering questions surrounding human health and disease has been a slow process. But now that libraries are being compiled and the necessary analytical tools are being established, researchers are eager to use what they have learned.

"We have really struggled to understand these lipid molecules, to identify enzymes, their metabolic sites, and how they are regulated," says Ogretmen. "Now that we have all these tools, people will start asking those important questions about diet and environmental factors that affect lipid metabolism and signaling." He says, these include a myriad of age-related

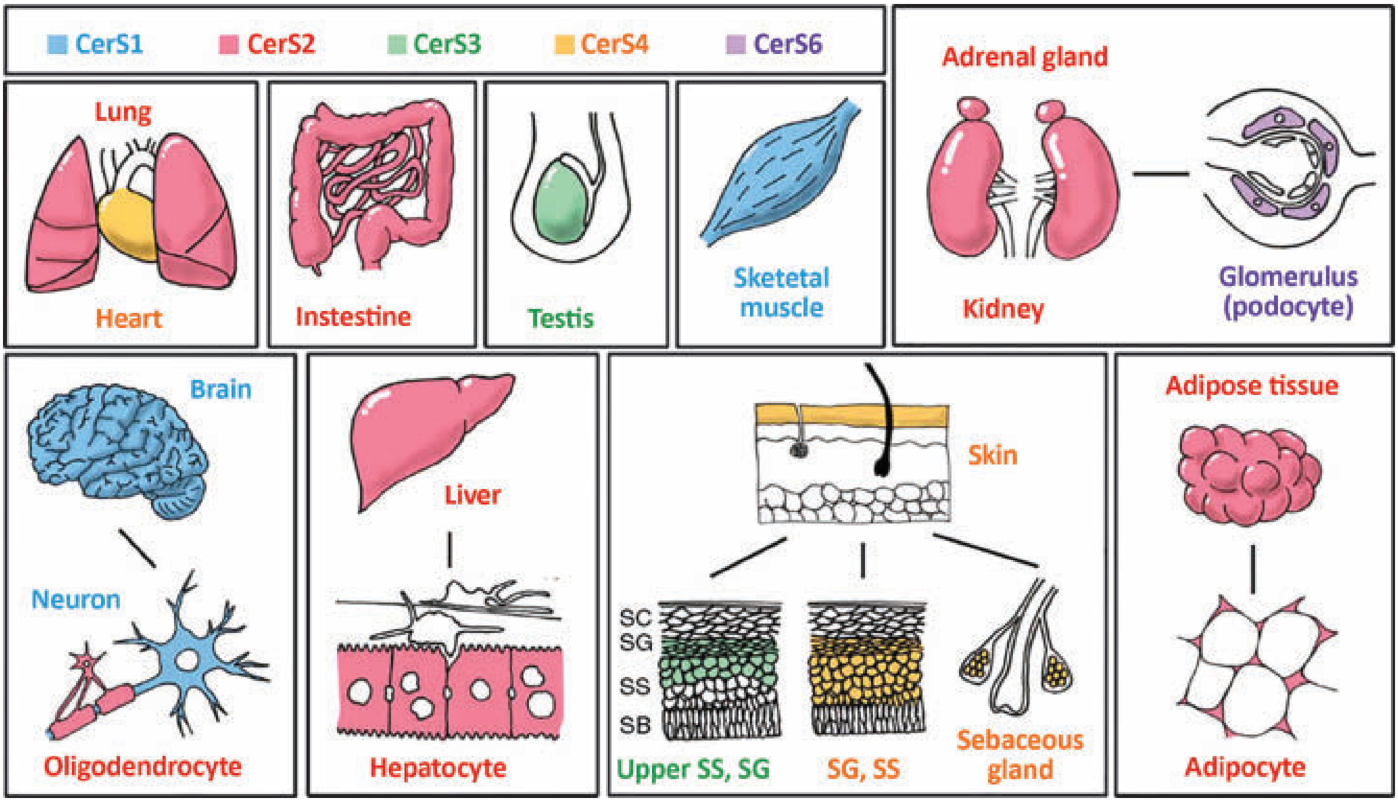


FIG. 2. Color-coded illustration indicating the specific tissue or cell where each of the six ceramide-producing enzymes are found, showing how widely distributed the lipid is in the body

diseases, such as, cancer, neurodegeneration, cardiovascular dysfunction, diabetes, and obesity.

Aging is accompanied by changes in lipid levels and in their fatty acid composition, notably desaturation. Specific chemical properties, like solubility and fluidity, are determined by the level of saturation along the lipid chain. Unsaturation also makes lipids more susceptible to oxidative damage. Hence, polyunsaturated fatty acids, which contain multiple double bonds in their carbon chains, are more susceptible to oxidation than monounsaturated fatty acids. Oxidized lipids are particularly detrimental to cellular function. Studies show that these effects have an influence on cell membranes and that longevity coincides with unaltered cell membranes. What dietary choices or environmental precautions should consumers make to protect their cellular lipids? Are there products that can reverse aging effects? These are questions that will be answered by lipidomics in the coming years.

For example, a diet rich in omega-3 fatty acids has the known benefit of lowering cardiovascular disease; however, little is known about how the lipid content of the diet affects the lipid composition of cell membranes. So far, researchers have studied the most common lipid classes, such as triacylglycerols, cholesterol, cholesterol esters, major glycerophospholipids, and ceramides. Profiling of the molecular composition of the plasma lipidome suggests that a few species of relatively low-abundant lipid classes may be involved in diet-related disorders. To really know, Gavin says it is time to put together the equivalent of a genetic code for lipids. "It is absolutely critical now that we have a comprehensive list of all the body's lipids. That we really start to compile the human lipidome," she says.

After building its foundation for decades, the field of lipidomics is posed to answer long-standing questions surrounding human aging and disease.

Rebecca Guenard is the associate editor of Inform *at AOCS. She can be contacted at rebecca.guenard@aocs.org.*

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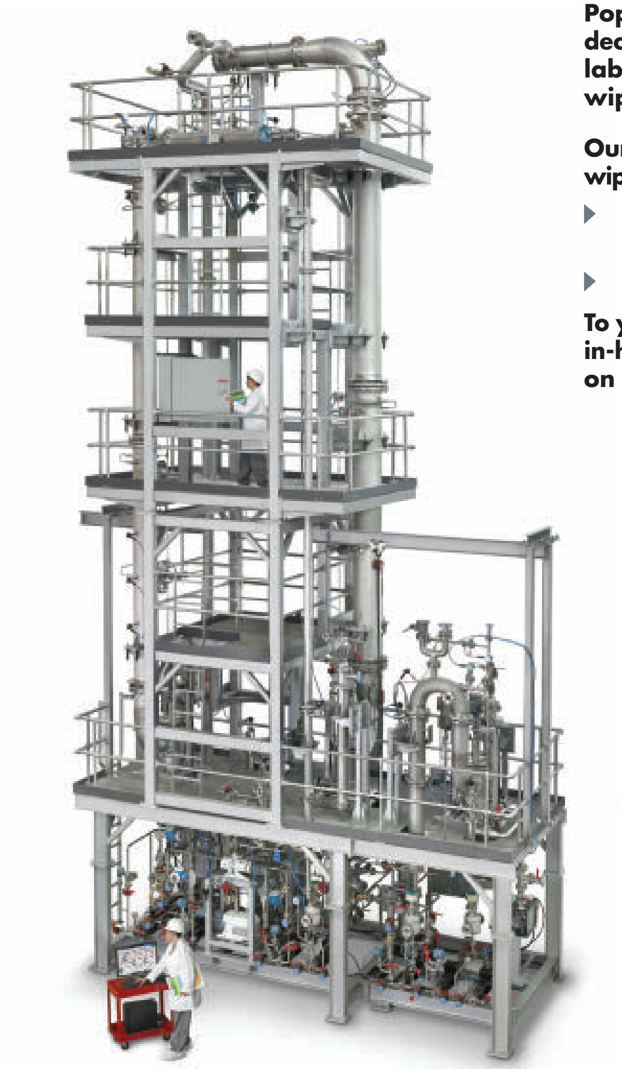

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Mitigating the influence of biodiesel on the deterioration of engine oil using adsorbents

Jerome D.A Kpan and Jürgen Krahl

- The use of biodiesel negatively affects engine oil performance, reducing time between oil changes.
- The impact of magnesium aluminum hydroxycarbonate and 1,3,5-trimethyl-2,4,6-*tris*(3,5-di-tert-butyl-4-hydroxybenzyl)benzene adsorbents on the formation of oligomers in the base oil-RME mixture was recently evaluated using Fourier Transform Infrared Spectroscopy (FTIR) analysis.
- The addition of the adsorbents reduced the formation of oligomers by about 90% and the total acid number and viscosity increment by 50%, demonstrating that adsorbents enhance the oxidative stability of biodiesel and its blends.

The work described in this article was scheduled to be presented at the cancelled 2020 AOCS Annual Meeting & Expo.

Biodiesel, a fatty acid methyl ester (FAME) derived from various plant oils, is renewable, has a low environmental impact, and is a green alternative fuel for diesel engines that could help mitigate the urgent need for climate change [1]. The molecular structure of biodiesel varies only slightly from that of conventional diesel fuel and depends on the degree of unsaturation of the fatty acids in the vegetable oil that is used [2].

Biodiesel fuels contain significant amounts of esters of oleic, linoleic, or linolenic acids which influence the fuel's oxidative stability. A small percentage of more highly unsaturated fatty compounds have a disproportionately strong effect in reducing oxidation stability, thereby promoting oligomers formation. It is these oxidation products of the biodiesel in the engine which influence the degradation of the lubrication oil.

We recently assessed the influence of adsorbents on the formation of oligomers. To avoid the influence of additives on oil oxidation during the aging studies, base oil and rapeseed oil methyl ester (RME) without additives were used.

The oil samples used in this study were mixed with the adsorbents and aged to verify the influence the adsorbents could have in stabilizing the oil against oxidation. The level of degradation or oligomerization was assessed by monitoring the area under the carbonyl bands in the FTIR spectrum before and after aging for 24 h at 170°C with the adsorbents. Other physio-chemical properties such as acid number, kinematic viscosity, and buildup of molecular masses of oligomers were also determined [3].

SIZE EXCLUSION CHROMATOGRAPHY (SEC)

SEC analysis detects the change in molar mass of molecules formed during the aging procedure. Figure 1 is an illustration of the molar mass distribution of the oxidative products formed in the course of the oxida-

tion with respect to their relative molar masses. As seen in the graph, as oxidation progresses, the relative molar masses of the sample aged without the use of the adsorbents increased to about 1,200 g/mol. This is because the degradation of methyl ester produces hydroperoxides and other low-molecular-weight carboxylic acids, aldehydes, and ketones. These primary oxidation products are very reactive and therefore polymerize into higher-molecular-weight products, leading to an increase in the relative molar masses of the oxidative products formed. In contrast, the mixtures aged with the adsorbents have molecular masses of about 800 g/mol. This translates into an approximate 90% reduction in the amount of oligomers formed.

FTIR ANALYSIS OF NEAT AND AGED BASE OIL WITH RME AND ADSORBENTS

Figure 2 (page 14) shows the FTIR-spectra of the mixture, base oil, and RME mixed with and without the adsorbents after an aging duration of 24 h. The region between 1,600 and 1,900 cm^{-1} and 3,000 and 3,600 cm^{-1} registered an enhanced absorption for the mixture aged without the use of the adsorbents. As seen in Figure 2, the base oil mixed with RME before aging showed an ester vibration. As the aging proceeded, the aged samples showed carbonyl bands that were wider than a mere ester vibration. A broad band of about 1,750 cm^{-1} is due to the presence of carbonyl-containing degradation products. These include but are not limited to aldehyde, ketone, and alcohol. The presence of these varieties of oxidation products in the mixture aged without the adsorbents widens the peak registered. The OH band can be visualized between the regions of 3,000 to 3,600 cm^{-1} and is attributable to the organic compounds, including water, alcohol, hydroperoxide, and carboxylic acids with an OH functional group. The increase in these signals in the mixture aged without the use of the adsorbents translates into higher acid content, and this correlates with the total acid value determined in this study. The broadness of the peak registered in the regions of 1,600 to 1,900 cm^{-1} and 3,000 to 3,600 cm^{-1} for the mixture aged without the adsorbents are conspicuously absent or greatly reduced in the mixture aged with the adsorbents. The adsorbents used thus resulted in significant effect on the signals, demonstrating some positive impact on the oil stability.

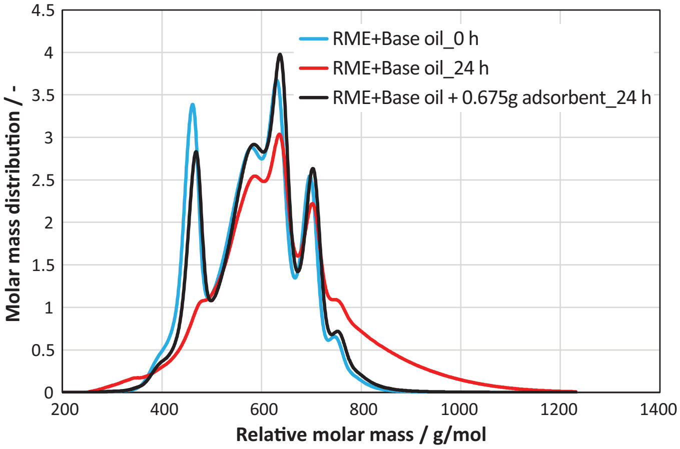

FIG. 1. SEC of base oil and RME mixed with and without adsorbents and aged at 170°C for 24 h

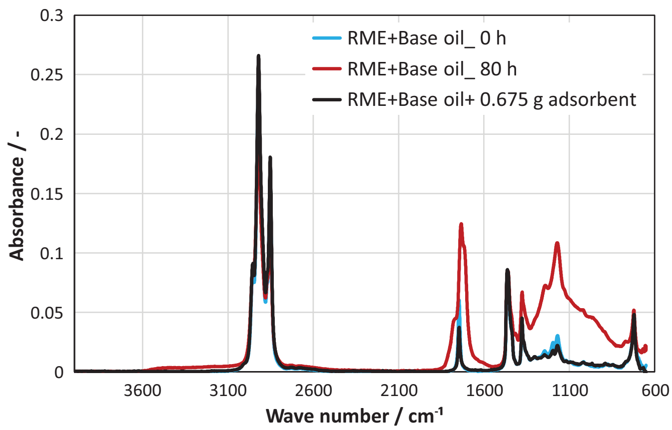

FIG. 2. FTIR spectra of base oil mixed with and without adsorbents and aged at 170°C for 24 h

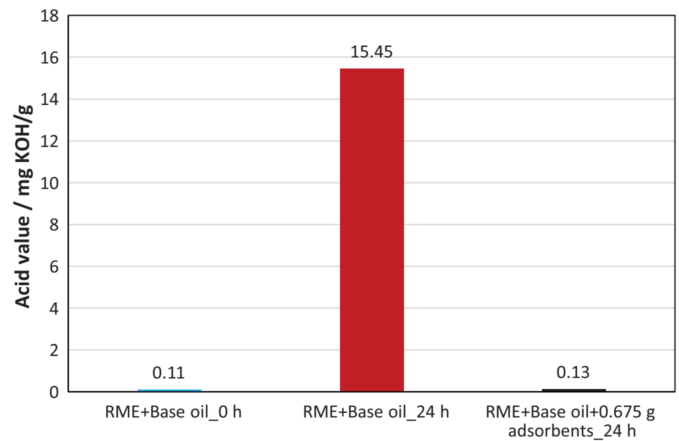

FIG. 3. The acid value of the mixture of base oil and RME mixed with and without the adsorbents and aged at 170°C for 24 h

TOTAL ACID NUMBER (TAN)

Figure 3 illustrates the acid values of the neat samples and mixtures mixed with and without the adsorbents over the entire aging period of 24 h. There is an insignificant increase of 0.02 in acid value in the sample mixed with the adsorbents and aged. While the sample aged without the adsorbent had 15.45 mg KOH/g acid value, the sample mixed with the adsorbent and aged had 0.13 mg KOH/g. The acid values relates to the level of degradation or oxidation products. The higher the degradation, the higher the acid values. The acid values of the samples aged with the adsorbent again indicates that the adsorbent had a key influence on the formation of oxidative products in

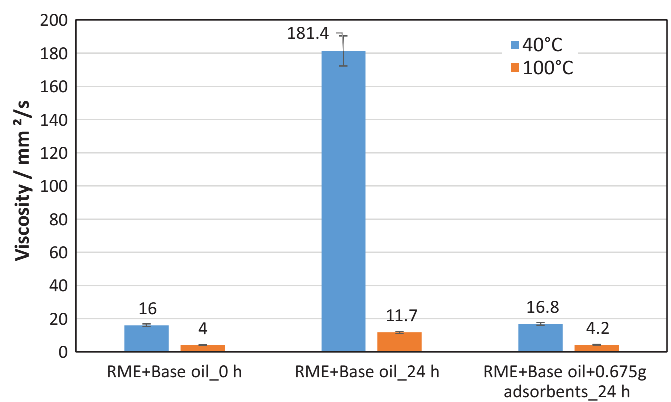

FIG. 4. Viscosity of base oil and RME mixture mixed with and without adsorbents and aged at 170°C for 24 h

the base oil-RME mixture. The use of the adsorbents, on the other hand, might have interrupted the breaking down of the fatty acid ester molecules, thereby preventing the complex secondary oxidation reactions which would have led to the formation of more reactive aldehydes. It is these reactive aldehydes which then oxidize into acids, increasing the acidic value.

VISCOSITY

The impact of the adsorbents on aging of the mixture was determined by the change in viscosity. Figure 4 is a representation of the change in viscosity measured at 40°C and 100°C respective to the use of the adsorbents and aging duration of 24 h. The viscosity of the sample mixed with the adsorbent and aged had insignificant increase in viscosity values at both temperatures. This can be explained in that the use of the adsorbents retarded the formation of higher molecular weight substances, leading to low viscosities registered [4]. The adsorbent is a radical scavenger and has hydrogen atoms which can be readily donated to radicals, leading to their stabilization. Consequently, little or no oxidative products formed. This, in turn, gives the oil more resistance to any increase in viscosity and hence more useful service life.

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[4] Jerome Kpan and Jürgen Krahl. Impact of Adsorbents on Oxidative Stability of Biodiesel and the Deterioration of Engine Oil. Proceedings of the 22nd International Colloquium Tribology Industrial and Automotive Lubrication Technische Akademie Esslingen (TAE), Stuttgart, Germany ISBN 978-3-943563-11-5 Pg 45-46

WHAT WE LEARNED

The study aimed at evaluating the impact of adsorbents on the oxidative stability of biodiesel and its blends by tracking the physio-chemical changes that occur during oxidation. The adsorbents used have demonstrated greater efficiency in stabilizing the biodiesel and its blends by retarding the aging processes. The use of the adsorbents led to about 90% reduction in oligomers formation. The use of the adsorbents resulted in about 90% reduction in acid value and more than 95% reduction in viscosity increment. The adsorbents must have increased the resistance of the oil towards the formation of secondary oxidation products which usually lead to increase in acid number, viscosity, density, and other measures.

It can therefore, be concluded that the adsorbents magnesium-aluminium hydrotalcite and 1,3,5-trimethyl-2,4,6-tris (3,5-di-tert-butyl-4-hydroxybenzyl) benzene have an enhanced impact in suppressing the influence of biodiesel and its blends on the oxidative stability of the oil.

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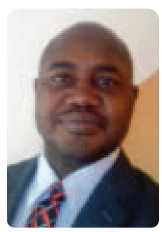


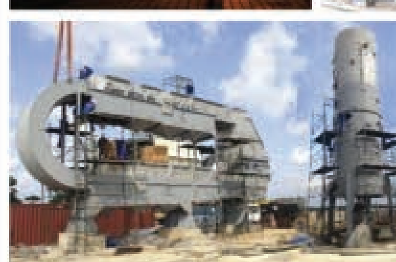
Jürgen Krahl is a professor and President of Technische Hochschule Ostwestfalen-Lippe (OWL) University of Applied Sciences and Arts in Germany, and supervisor of Jerome Kpan. He can be contacted at juergen.krahl@th-owl.de.

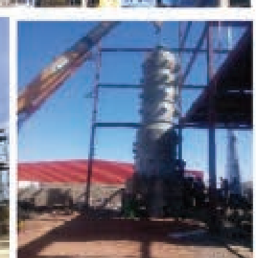
AOCS MEETING WATCH

May 2–5, 2021. AOCS Annual Meeting & Expo, Oregon Convention Center, Portland, Oregon, USA.

May 1–4, 2022. AOCS Annual Meeting & Expo, Hyatt Regency Atlanta, Atlanta, Georgia, 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: +1 217-693-4843).





How different cultures and habits influence the safety of fried foods

Richard F. Stier

- **Fried foods are delicious and part of almost every food culture in the world.**
- **Concerns about the healthfulness of fried foods have prompted a small number of countries to establish regulations for frying fats and oils in restaurant operations.**
- **Global harmonization of quality and safety guidelines or regulations for restaurant frying oil could improve the safety of fried foods throughout the world.**

This article is based on a presentation at the 10th International Symposium on Deep-Fat Frying in Hagen, Germany, March 8–10, 2020.

Foods are fried throughout the world in spite of warnings from nutritionists and others about issues pertaining to such products. There are concerns about how fried foods may lead to obesity, that oils used for frying are unhealthy, and that fried foods contain potentially dangerous compounds like acrylamide. Yet, fried foods are not going away for two reasons. First off, fried foods are delicious. They have a wonderful texture, a pleasant mouthfeel, great flavors, and are what many call comfort foods. Anyone who has had a chance to travel the world and believes that sampling foods from the countries they are visiting is part of the experience has probably had the opportunity to try many different fried items. There is tempeh in Southeast Asia, dumplings in China, schnitzels in Germany, fish and chips in Great Britain, and fun foods like deep-fried candy bars at county fairs across America, to name a few of the many, many fried foods available the world over. In addition, many fried items are produced industrially and sold to foodservice or restaurant operations and at the retail level, including snack foods, nuts of all kinds, potato products, and a wide range of coated products. Fried food flavor is also the primary quality index for frying, according to recommendations from the 3rd International Symposium on Deep-Fat Frying (2000; see box on page 17).

The second reason that operators fry food is that it is an extremely efficient means of preparing food. Food is immersed in hot oil at temperatures in excess of 300°F (149°C). It might take 25–35 minutes to cook a piece of chicken in a pre-heated oven, yet only 4–6 minutes to fully cook that same cut of chicken in a fryer. For businesses like restaurants, where turnover is essential, this is a recipe for success (no pun intended).

Deep-fat frying is also the most dynamic and complex system for preparing food available to humankind. The frying oil is affected differently by each type of food that is fried. In addition, the oil is affected by heat, oxygen, water from the food, and the breakdown products formed in the oil. This complex relationship was summarized by Fritsch in 1981 (Fig. 1).

Industrial operators and chain restaurants generally understand the dynamics of their fryers and frying oils, but small operators do not. It was a series of complaints from consumers regarding fried foods in Germany in the early 1970s that prompted the first two international symposiums on deep-fat frying in 1973 and 1979. Consumers alleged gastrointestinal distress, among other issues. The end results of these two meetings was the establishment of regulations and/or guidelines for restaurant and foodservice frying operations throughout Europe. This came about through extensive analysis of frying oils throughout the country.

Firestone, *et al.* (1991) summarized the regulatory situation in *Food Technology* magazine. Nine European nations have established regulations for frying fats and oils in restaurant operations. Polar materials are the prime chemical index of oil degradation that is used, but there are others. These limits are not all enforced at the national level. Some nations, such as Switzerland and Germany, regulate at the state or canton level.

- Austria – 27% TPM plus
- Switzerland - 27% TPM
- Portugal – 25% TPM
- Netherlands – 27% TPM plus
- Italy – 25% TPM
- Spain – 25% TPM
- Germany – 24% TPM plus
- France – 25% TPM
- Belgium – 25% TPM plus

The Scandinavian countries have established guidelines for oil management. When one goes beyond the European Union, only Chile and Israel have established any regulations for frying oils. Japan has established guidelines but no regulations. What one must understand, however, is that these regulations were established based on badly abused oil, that is, oil which could cause a health issue. In reality, most fryer operators do not abuse oil to that point. As noted, foods fried in badly abused oils would probably be of poor quality and could well be rejected by the consumer. For an industry that relies on repeat business, this is simply bad business. Greater detail on the regulatory situation may be seen in Table 1 from Stier (2007).

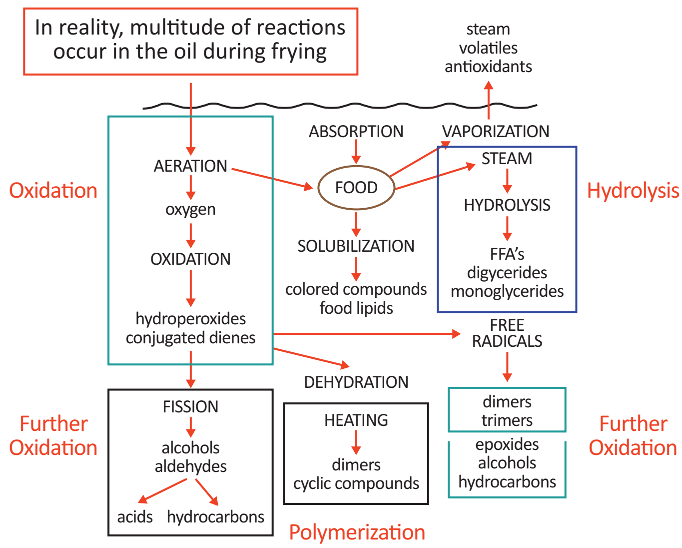


FIG. 1. Summary of the breakdown products formed in oil during deep-fat frying

The European Union has not harmonized the regulations for the whole European Union since Firestone, *et al.*'s publication in 1991. Harmonization would be a greater challenge today, as there are now 27 members in the European Union. At the 10th International Symposium on Deep-Fat Frying held in Hagen, Germany, in March 2020, the participants did call for harmonization of frying regulations across the EU.

Recommendations of the 3rd International Symposium On Deep-fat Frying (Hagen, Germany, 2000)

1. Principle quality index for deep-fat frying should be sensory parameters of the food being fried.
2. Analysis of suspect fats and oils should utilize two tests to confirm abuse. Recommended analyses should be:
   - Total Polar Materials (<24%)
   - Polymeric triglycerides (<12%)
3. The use of rapid tests for monitoring oil quality is recommended and should:
   - Correlate with internationally recognized standard methods
   - Provide an objective index
   - Be easy to use
   - Be safe for use in food processing/preparation area
   - Quantify oil degradation
   - Be field rugged
4. Affirming previous work: There are no health concerns associated with consumption of frying fats and oils that have not been abused at normal frying conditions.
5. Encourage development of new and improved methods that provide fats and oils chemists and the food industry with tools to conduct work more quickly and easily. Work should strive to develop methods that are environmentally friendly and use lower quantities of and less hazardous solvent systems.
6. Encourage and support basic research focused on understanding the dynamics of deep-fat frying and the frying process. Research should be cross-discipline encompassing oil chemistry, food engineering, sensory science, food chemistry, and nutritional sciences.
7. One of the basic tools to ensure food and oil quality is the use of filtration. Filter materials should be used to maintain oil quality as needed.
8. Used, but not abused oils, may be topped up or diluted with fresh oil with no adverse effects on quality. Abused fats and oils were defined in the first two recommendations developed during this program.

TABLE 1. Regulation of frying fats and oils

Country	Regulations: (Yes/No)	Year Est.	Fed/Local	Polaris	OFA (1)	Acid (2)/FFA (2)	Smoke Point	Heat Limits	DPTG*	Appearance	Sensory	Comments
Austria	Yes		Fed	<27%	<1%	<2.5 (AV)	<170°C	<180°C		No carbonaceous residue, dark color or foaming.	No unpleasant odor or taste.	Found in Frying Fats Section of 3rd Edition of *Austrian Food Stuffs Book.*
Belgium	Yes	1988	Fed	<25%		<2.5 (FFA)	<170°C	<180°C	≤10%			Viscosity not >37 mPa-sec @ 50oC (fats) or 27 mPa-sec (oils). Frying fats may not have >2% linlenic.
Chile	Yes	1996	Fed	≤25	<1.0	≤1.0 (FFA)	≤170°C					Maximum linolenic content of 2%. Antioxidants may be used as allowed.
France	Yes	1973 & 1979	Fed	25%								Frying fats may not have >2% linolenic; silicone additives prohibited.
Germany	Yes	1973 & 1979	Local	<24%	<0.7%		>170°C					Regulations enforced by individual states.
Hungary	No	1988		<25%								
Spain	Yes	1989	Fed	<25%								Frying fat must not alter quality of food and may not be sold for use in preparing foods.
Israel	No											Use guidelines published by Swedish National Food Administration for restaurant operations.
Italy	Yes	ca. 1993	Fed	<25%				<180°C				
Japan	No					<2.5 (AV)	>170°C					No regulations, but use guidelines. Also, carbonyl value <50.
Netherlands	Yes		Fed	<27%		<4.5 (AV)			<16%			Sensory qualities can result in rejection.
Portugal	Yes	ca. 1993	Fed	<25%								
Denmark	No											
Norway	No											
Finland	No											
Sweden	No											
Switzerland	Yes		Local	<27%			>170°C			Color	Sensory qualities can result in rejection.	Silicone additives are forbidden; enforcement by cantons.
USA	No (1)					2% (FFA)				Smoking, color		USDA Guidelines for Meat & Poultry Operations.

*Dimeric & Polymeric Triglycerides (1) Oxidized fatty acids (2)Free fatty acids

So, there really are no regulations governing frying oils once one leaves the European Union. This is certainly a challenge given that frying is conducted throughout the world. Lack of knowledge is significant issue in developing nations and also with street foods throughout the world. Having worked in developing nations on projects focusing on food quality and safety, I have been told by small processors in those countries that they were really not concerned with food quality because they were currently selling everything that they could produce. In addition, the potential for frying oil abuse is also much higher with small operations that simply do not understand the relationship between oil and food quality. Part of the concern also stems from the equipment that is used for frying in many parts of the world. Some street food sellers and small operators fry foods in open kettles that are heated using direct flames. These operators often do not grasp the importance of cleaning their fryers which are often coated with polymers that have built up over time. Consequently, regulating temperature and minimizing thermal abuse is going to be difficult.

Nevertheless, there should be global harmonization when it comes to establishing quality and safety guidelines or regulations for restaurant frying oils. The European Union should take the lead on this subject. It would be in keeping with the EU mission to ensure a safe and high-quality food supply. There are nine nations that have established such regulations and four that have set guidelines, leaving 14 nations with nothing on the books. If the EU goes this route, there would be a reasonable chance for establishing something globally. This effort could be spearheaded by the German Society for Fat Research (DGF) or the Euro Fed Lipid Group and may well be supported by fast food and restaurant chains that operate across Europe. Multinationals tend to support harmonized regulations and guidelines.

Richard F. Stier is a consulting food scientist in Sonoma, California, USA. He can be contacted at rickstier4@aol.com.

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Hexane-free mechanical extraction by screw pressing: a viable alternative to chemical extraction of oilseeds

Michal Kaválek

While chemical extraction is an effective way of obtaining raw vegetable oil, screw pressing of oilseeds is becoming increasingly popular for good reasons. The benefits of mechanical extraction (without chemical solvents) by screw pressing over chemical extraction include lower investment costs, lower space requirements, less stringent safety measures, and better food safety of the products. On the other hand, there are limitations in terms of yield and capacity. Different screw pressing technologies lead to different product qualities (the two main products are vegetable oil and expellers). This article presents the results of company studies comparing expellers (EX) and extracted meals (EM), the most common sources of protein in animal nutrition.

- **Screw pressing of oilseeds is becoming increasingly popular, but different screw pressing technologies lead to different protein qualities.**
- **The relative protein digestibility in soybean, rapeseed, and sunflower seed expellers and extracted meals from different technologies was recently compared.**
- **This article describes what was learned.**

There are currently several technological sources of EX and EM with varying nutritional value. In our project, we analyzed relative protein digestibility in soybean, rapeseed, and sunflower seed expellers and extracted meals from different technologies. These technologies differ mainly in the exposure of heat that EX or EM undergo. The temperature and the time for which the material is exposed to the heat are the main parameters that influence its digestibility. The heat causes the proteins to denature (unfold), which inactivates a part of the enzymes that decrease protein digestibility. On the other hand, overexposure to heat leads to the formation of Maillard reaction products as saccharides fuse with amino acids into indigestible complexes.

In chemical extraction, heat exposure of extracted meal is the highest in the desolventizer/toaster, where the meal is heated up for the remaining solvent to evaporate away. In the case of screw pressing, the highest heat exposure occurs inside the screw press as well as in the equipment for preliminary heat treatment (toaster/extruder). In screw pressing, we distinguish several modes of processing depending on the number of pressing steps and oilseed treatment. The most common division is into either single-stage or two-stage pressing, indicating the number of times the

This author was invited to present this topic at the cancelled 2020 AOCS Annual Meeting & Expo.

FIG. 1. CP2 technology for rapeseed—40,000 metric tons (MT) per year

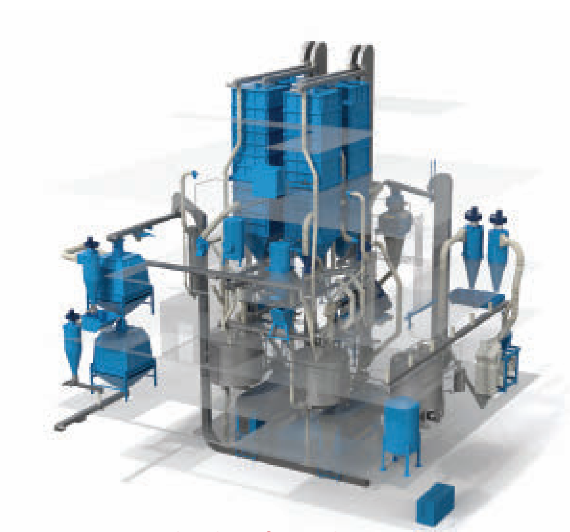


FIG. 2. EP1 technology for soybean produces—100,000 MT per year

FIG. 3. EP2 technology for rapeseed, sunflower—15,000 MT per year

oilseed undergoes expression. Furthermore, technologies differ in seed pre-treatment, being either cold (absence of heating), hot (with heating), or combined with extrusion. Generally speaking, the most common technologies are those of single-stage cold pressing (CP1), two-stage cold pressing (CP2, Fig. 1), single-stage pressing with extrusion (EP1, Fig. 2), two-stage pressing with extrusion (EP2, Fig. 3), single-stage hot pressing (WP1), and two-stage hot pressing (WP2). Seeds may be pre-heated to increase oil yield. The highest heat exposure (temperature over time period) occurs in hot pressing and extraction technologies. It is the extended time period at a high temperature and low humidity that causes the formation of unwanted Maillard reaction products. In pressing technologies combined with extrusion, the seeds are heated up to a very high temperature but only for a short time. That's why this process is very gentle to the nutritionally valuable substances while effectively eliminating the digestibility-decreasing agents.

DIGESTIBILITY OF RAPE, SUNFLOWER, AND SOYBEAN PROTEINS

One of our studies looked at the digestibility of proteins in the expellers and extracted meal from rapeseed, sunflower seed, and soybeans from different technological sources, which we tested via balance trials in chickens (Table 1). The experiment involved cockerels at the age of 35 days. The cockerels were held in balance cages in pairs and given feed *ad libitum* with an addition of chromium oxide as an external indicator of digestibility (it is not absorbed in the intestine). The chyme and feed were analyzed for their contents of proteins and chromium

TABLE 1. Relative protein digestibility

Oilseed	CP1 [%/protein content]	CP2 [%/protein content]	EP1 [%/protein content]	EP2 [%/protein content]	WP1 [%/protein content]	Extracted meal [%/protein content]
Rapeseed	84	81	-	85	80	74
Sunflower	85	82	-	86	-	78
Soybean	-	-	87	-	78	81

TABLE 2. Evaluation of layers

	Feed consumption/ egg [g]	Feed consumption/ day [g]	Average egg weight [g]	Intensity of lay [%]
Extracted soy meal (EM)	182.2	137.2	69.1	76.5
Soy expellers (EX)	178.2	137.4	68.0	78.1
Full-fat extruded soy	179.1	135.8	69.1	76.9

oxide. The results demonstrated significantly better digestibility levels in technologies of pressing with extrusion, compared to other technologies. This is because of the short retention time at high temperature and pressure, which causes a "thermal enhancement" of the press-cake. Upon extrusion, the expellers become more digestible, while the heating and disruption of cellular structures allow for a higher yield in the subsequent pressing step, achieving levels similar to those of hot pressing. On the opposite side of the spectrum, the lowest values were measured for the WP1 technology and chemical extraction. This is caused by the prolonged exposure of the seeds to high temperatures.

COMPARISON OF SOY PRODUCTS

In another study, we focused on comparing extracted soy meal (EM), soybean expellers (EX), and full-fat soy. The tests were performed in chicken layers ISA Brown and broilers ROSS 308.

Layers

The layers were split into 3 groups of 40 individuals. Experimental feeding started in their 20th week and ended in the 60th week. The layers were fed a granulated complete compound feed containing either EM, EX, or full-fat soy. The compound feed was divided into individual mixes according to the age of the animals. We evaluated the consumption of feed per egg, the consumption of feed per day, average egg weight, and the intensity of lay (Table 2).

In terms of nutrition and compound feed production, soybean expellers appear to be the most efficient source, considered an optimal protein component for layers, both with respect to their energy demands and their need for linoleic acid. EX-containing compound feed resulted in the greatest intensity of lay as well as the lowest feed consumption per egg.

Broilers

Chicken broilers were fed a complete compound feed designed according to nutritional norms for meat chickens, specifically for the hybrid combination ROSS 308.

TABLE 3. Nutrient conversion of different soy products

	Conversion [kg/kg]
Extracted soy meal	1.56
Soy expellers	1.43
Full-fat extruded soy	1.44

In terms of feed conversion, best results were achieved with full-fat soy, closely followed by expellers (Table 3). Overall, extruded full-fat soy can be considered the best of the three observed protein sources, because the mixture doesn't need any additional fat source, and the granules exhibit the right consistency.

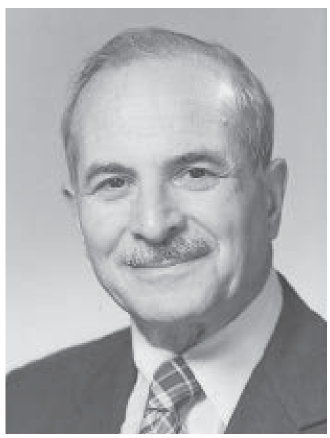
EXTRUSION IS BENEFICIAL

In general, expellers have the same or better relative protein digestibility compared to extracted meals. Combining screw pressing with dry extrusion brings benefits to the process, such as increasing the nutritional value of expellers and increasing vegetable oil yield. Because of a higher oil content, expellers have a higher energy value and need to be seen as an independent product with an added market value. The technology of screw pressing has an outstanding potential, especially for local processing of oilseeds at capacities up to 500,000 metric tons (MT) of seeds/year. A significant advantage of local processing is possible quality control from seeds to the final products. This technology is also convenient for the processing of certified products, such as GMO free, Certified Organic, and Clean Label.

Michal Kaválek is the head of R&D projects at Farmet a.s, where he seeks to find innovative ways of processing local agricultural products for feed and food. The aim of company R&D is to design and manufacture highly efficient technologies for production of vegetable oils and fodder in small and medium capacities. The company's customers are looking for effective processing of local commodities and efficient use of local resources as a path to sustainable use of food and natural resources.

Giants of the past: Milton J. Rosen (1920–2020)

Dennis Murphy



Milton J. Rosen was born on February 11, 1920, in Brooklyn, New York. He obtained his bachelor's degree from City College of New York, his master's degree from the University of Maryland, and his Ph.D. in organic chemistry in 1949 from the Polytechnic Institute of Brooklyn. During World War II, he served his country as a member of the US Army in the Philippines.

Prior to his military service, Milton worked at Glyco Products in Brooklyn, which sold surfactants in the form of emulsifiers and food additives. At the time, even though Glyco was able to sell and make money from their surfactants, the company knew nothing about how this class of compounds worked or what other structures might have similar properties.

After World War II, Milton obtained a teaching and research position at Brooklyn College and used his experience at Glyco Products to focus his research on surfactants. Milton went on to have a long and distinguished career as a professor in the chemistry department at Brooklyn College. When he began work in his lab in 1946, dedicated research on surfactants was in its infancy. In his over 65 years as a surfactant researcher, Milton made major contributions in shifting the understanding of how surfactants work, and how to use them, from an art to a science.

Milton published over 150 research papers and patents, and authored or edited 8 books on surfactants. Some of his more significant scholarly contributions are: first and foremost, *Surfactants and Interfacial Phenomena*, which set the standard for surfactant texts and is widely used in both academia and industry (the book is now in its fourth edition); a series of papers on structure/property relationships of surfactants (as part of this series, many new surfactants were synthesized and introduced to the world); derivation of equations which predict the conditions for producing synergism in mixed surfactant systems; application of modern chemical analytical methods to the analysis of surfactants; several of the earliest papers on gemini surfactants; and use of thermodynamic parameters to estimate the environmental effects of surfactants.

In 1981, Milton established the Surfactant Research Institute (SRI) at Brooklyn College, which has the stated goal of "acquiring and disseminating fundamental and scientific knowledge in the area of surfactant chemistry, especially related to the applications of surfactants." SRI has been well-funded over the years both from government grants and many industrial companies. In 1991, he established the AOCS Samuel Rosen Memorial Award in honor of his father, who was a largely self-educated, enthusiastic, and dedicated industrial chemist. Milton also served many years on the Editorial Advisory Board for the *Journal of Surfactants and Detergents* (*JSD*). He published many papers in *JSD* including the very first paper of Issue 1 in 1998.

Milton has been recognized in several ways for his contributions to the field of surfactant science. In both 1989 and 1999, he won the Soap and Detergent Association (now the American Cleaning Institute) Distinguished Paper Award. In 1999, Milton was inducted as an AOCS Fellow. He was the 2003 recipient of the prestigious AOCS-Supelco/Nicholas Pelick Award and received the Distinguished Service Award from the Surfactant and Detergent Division of AOCS in 2006. And, to honor Milton's distinguished career, a special session was held at the 2017 AOCS Annual Meeting where talks were given by former graduate students, Samuel Rosen Memorial Award recipients, and collaborators. This session was sponsored by *JSD* as part of its 20th anniversary celebration.

Milton loved scientific research and on more than one occasion shared a thought he had when he first started out at Brooklyn College: "I get to do this and get paid for it?" But he also had interests which extended beyond science. He was extremely well traveled, enjoyed international (especially Israeli) folk dancing, gardening, playing bridge, and ten-

AOCS Fellow Milton J. Rosen in his lab at Brooklyn College

nis. Some of Milton's travels involved four sabbaticals he did in Israel during his career. After his retirement from Brooklyn College, he continued to have passion for learning and social interaction. To pursue those passions, he joined a local organization in Great Neck, New York, known as REAP (Retired, Energetic, Active, People) where he would attend lectures and discussions covering wide-ranging topics including art, science, religion, and politics. Of all his hobbies, Milton only gave up tennis and traveling in his later years.

Ellen was his wife of 71 years. They met at Brooklyn College in the 1940s while she was a staff member and he was faculty in the Chemistry Department. At the time, staff and faculty were strongly encouraged not to fraternize. Milton and Ellen would cleverly meet for lunch almost every day anyway. Ellen sat one floor directly above Milton and when it was time for lunch, she would lower a chain of paperclips out of her window and clank them against his window. She would say to her colleagues "I'm going to lunch now," and he would do the same with his colleagues. Shortly before they were married, on a day when the chairperson of the department was in a particularly good mood, they spilled the beans. Ellen is a scholar in her own right. She holds a doctorate degree in political science and was a professor at John Jay College of Criminal Justice in New York. She also authored a book about her father titled, *A Wobbly Life, IWW Organizer, E.F. Doree*. In the preface to that book, Ellen wrote the following about her "Milty": "The person to whom I am most indebted, and to coin a phrase, without whom this work would not have been possible, is my husband, Professor (of Chemistry) Milton J. Rosen. The most purposeful man I have ever met, he prodded me on and picked me up when the going got rough. He is an honest, sophisticated, invaluable critic. He is also my best friend."

Milton truly liked people and took a personal interest in them. He and Ellen owned a summer home in the Catskill Mountains of New York, and every summer they would invite his lab researchers to visit. At the annual AOCS meetings, I've heard several people in the industry say that they were intimidated to approach Milton because of his towering reputation. But once they mustered up the courage, Milton immediately put them at ease and freely shared his time. Milton was always interested in what his former students were working on and how their lives were unfolding. I had the privilege of being his graduate student from 1985 to 1989. He attended my doctorate graduation, my wedding, and my 40th birthday celebration. That was the kind of man he was.

Milton had a great sense of humor. Every semester, a local middle school would take a tour of Milton's lab. In the lab, there was a transparent glass still where you could see the heating coils inside turn red hot. He would make sure it was on and the heating coils glowing before the students would arrive. Invariably, the students would ask "what's that?" and he would answer "a nuclear reactor." This, of course, wasn't just humor. Milton said that getting the attention of students was key to curiosity and learning.

As many of us were, I was fortunate to have Milton in my life. He passed away on February 2, 2020, just 9 days shy of his 100th birthday. Milton is survived by his wife Ellen, his three children, Leslie, David, and Craig, and five grandchildren. Milton wanted to live to 100—he made it to 99.97. Knowing Milton, I think he would approve of rounding that up.

Milton J. Rosen will be dearly missed but his legacy as a caring person, an enthusiastic scientist, and a giant of surfactant science will live on.

Dennis Murphy is a research fellow at Stepan Co., as well as an active member of AOCS and the Division of Surfactants and Detergents. He can be contacted at DMurphy@stepan.com.

AOCS 2020 award recipients

AOCS honors those individuals and institutions who have taken research and technology to the next level, who have advanced the quality and depth of the profession, and who have leveraged their knowledge for the benefit of the Society. Their contributions are critical to AOCS, and we regret that we could not honor them in person this year.

SOCIETY AWARDS

A. R. BALDWIN DISTINGUISHED SERVICE AWARD

Recognizes an active or previously active member of the Society making outstanding contributions and service to the Society over a substantial period of time.

Sevim is internationally recognized as an authority on the industrial utilization of vegetable oils, and her research has had major impact in the areas of lubricants, coatings, inks, and related applications.

Sevim Z. Erhan has a B.S. and an M.S. in chemical engineering from the University of Istanbul, Turkey (1980) and a Ph.D. in organic-polymer chemistry from Western Michigan University in Kalamazoo, Michigan (1987). She has been with the US Department of Agriculture, Agricultural Research Service (ARS), since 1988. She was a postdoctoral associate, research scientist, and research leader at the ARS National Center for Agricultural Utilization Research in Peoria, Illinois, from 1988–2008, and then became center director of the ARS Eastern Regional Research Center in Wyndmoor, Pennsylvania, 2008–present.

Her research subjects are vegetable-oil-based industrial products, including printing inks, paints, coatings, lubricants, biodiesel, hydraulic oils, and composites. She has authored or coauthored over 250 scientific articles, including nine US Patents, two books, and 29 book chapters. She has been invited to present her research findings at more than 200 national and international scientific meetings. She has received several Agricultural Research Service awards and industrial awards, including the Land of Lincoln Soybean Association Market Award; US Department of Agriculture, Agricultural Research Service Distinguished Service Award; Federal Laboratory Consortium Award for Excellence in Technology Transfer; United Soybean Board Outstanding Achievement Award; Oil Technologists Association of India KT. Achaya Award; Fellow, Society of Tribologists and Lubrication Engineers; Fellow, AOCS; Federal Laboratory Consortium Laboratory Director of the Year Award; American Chemical Society Distinguished Achievement and Service in Agricultural and Food Chemistry Award; and NEA Research Leadership and Center Directorship Award.

AOCS AWARD OF MERIT

Recognizes an AOCS Member who has displayed leadership in administrative activities, meritorious service on AOCS committees, or performed an outstanding activity or service.

In addition to his committee work, Masaki has served as the primary liaison between AOCS and the Japan Oil Chemists' Society and the Japan Soap and Detergents Association since the mid-2000s, leading to successful joint meetings and collaboration between the organizations.

Masaki Tsumadori retired in February 2016 from Kao Corporation, where he was a research fellow in strategy research, R&D, and director of the Kao Eco-Lab Museum. He is now a senior R&D advisor at Kao Corporation, and also runs his own global consulting business in the field of R&D planning. Mr. Tsumadori earned a master's degree in polymer chemistry from the Nagoya Institute of Technology in 1977. He began his career at Kao Corporation in 1977, working as a research chemist developing fabric and home care products. He subsequently held senior positions across research and development, including manager of hard surface cleaners from 1987, and director of fabric care products, such as laundry detergents, fabric softeners, and bleaches, from 1997. During 1997–2002, he played key roles in the development and launch of powder and liquid laundry detergents in Japan and Asian countries, including the Attack brand. He was appointed vice president of global R&D, fabric, and home care, of Kao Corporation in 2002. Mr. Tsumadori was a member of the governing board of AOCS from 2011–2016, and has been supporting the World Conference on Fabric and Home Care as a member of the Executive Committee since 2010.

AOCS FELLOW AWARD

Recognizes achievements in science or extraordinary service to the Society.

Not only has Fred established himself as an expert in the field of supercritical fluids, but he has also devoted substantial time and effort to support AOCS through volunteering for many duties within the Society.

Fred J. Eller, III is a research chemist in the Functional Foods Research Unit at the National Center for Agricultural Utilization Research, USDA-ARS, Peoria, Illinois. Dr. Eller is a native of Saint Paul, Minnesota, and received his B.Sc. and M.Sc. from the University of Minnesota and his Ph.D. from the University of Florida. He joined ARS in 1990, initially investigating insect chemical attractants (e.g., the isolation and identification of the aggregation pheromone of the pepper weevil). He subsequently redirected his research efforts and focused on the utilization of supercritical fluids for the extraction and analysis of lipids under the tutelage and mentorship of Drs. Jerry W. King and Gary R. List.

Dr. Eller has been an active member of AOCS since 1996 and has organized symposia at AOCS Annual Meetings, held leadership roles in the Analytical Division, served on a variety of AOCS committees, and currently serves as an associate editor for the *Journal of the American Oil Chemists' Society* (2007–present). Dr. Eller was awarded the AOCS Herbert J. Dutton Award in 2013. He has authored or coauthored 90 publications and is first inventor on two US Patents. He has also made 46 presentations at national and international meetings. Dr. Eller's current research interests include the utilization of critical fluids for the extraction, counter-current fractionation, and processing of agricultural materials, as well as the isolation and identification of bioactive natural products. He is especially interested in cedarwood oil extraction, bioactivity, and utilization.

Lars' commitment to sound science and methodology has enabled not only his employer, but the members of AOCS to reap the benefits of his knowledge, wisdom, and forward thinking.

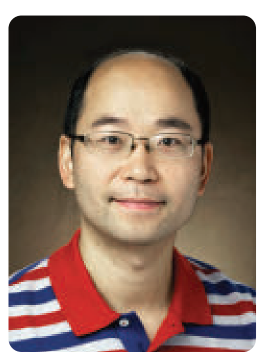
Lars Reimann received a Cand Scient. in biochemistry/analytical chemistry from University of Copenhagen. He has worked in food/feed and agriculture-related areas for more than 20 years, and has managed laboratories specializing in the analysis of a wide variety of foods and feeds as well as their ingredients to determine compliance with industry standards, to verify nutritional value and to ensure the absence of food safety issues. Mr. Reimann has been an active AOCS member since 1982, and has fully participated in many AOCS Technical committees and divisions. His passion for good science coupled with his critical thinking abilities has furthered the success of AOCS.

Mr. Reimann has been proposing and moderating sessions for the Analytical and Health and Nutrition Divisions since 2000. He has mentored countless employees and students throughout his AOCS tenure and always encourages people to join AOCS and to get involved with the Society. Mr. Reimann has ensured his laboratories were participating in multiple Smalley Check Sample series and Laboratory Proficiency Program (LPP) series as well as serving on Smalley and LPP committees. His labs are also home to several AOCS Approved Chemists and are AOCS-NOPA Certified Labs. He ensured his labs participated in every collaborative study administered by AOCS since the 1980s. He has been enthusiastically involved with the Uniform Methods Committee and its Subcommittees since he joined AOCS, and currently is a voting member of the Uniform Methods Committee. He has worked tirelessly to ensure AOCS Methods are relevant and up-to-date. He is a behind-the-scenes force championing for AOCS to be the very best. Mr. Reimann's most recent efforts include organizing a new series for Dried Distillers Grains (DDGs) for LPP; involvement with the method validation studies for 3-MCPD and Glycidyl Esters; and working on the Forum Organizing Committee for the AOCS Pulse Science and Technology Forum.

SCIENTIFIC AWARDS

AOCS YOUNG SCIENTIST RESEARCH AWARD

Recognizes a young scientist who has made a significant and substantial research contribution in one of the areas represented by the Divisions of AOCS. Sponsored by the International Food Science Centre A/S.



Bingcan is an exceptional scientist and his scientific breakthroughs make him one of the most promising young food lipid chemist in the world.

Bingcan Chen received his Ph.D. in 2012 from the University of Massachusetts, Amherst. He is currently an assistant professor of cereal and food chemistry at North Dakota State University. The primary goal of his research is to gain better understanding of lipid oxidation mechanisms in foods and cereal products and to provide efficient means to improve food quality. Dr. Chen has been very active in lipid oxidation research since he was graduate student. His Ph.D. thesis focused on the impact of reverse micelles on bulk oil oxidation and the effectiveness of antioxidants. His current research focuses on lipid oxidation, novel antioxidants, specialty oil from new and emerging crops, and flavor chemistry. He has published more than 60 peer-reviewed articles and four book chapters. Dr. Chen has received several awards from AOCS, including the Lipid Oxidation and Quality (LOQ) Division Junior Researcher Travel Grant, *JAOCS* Young Scientists to Watch, and the Thomas H. Smouse Memorial Fellowship. Dr. Chen has been an active member in the AOCS LOQ Division since 2009 and currently is the Secretary-Treasurer of the Division.

ALTON E. BAILEY AWARD

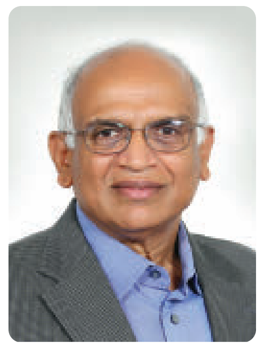
Recognizes outstanding research and exceptional service in the field of lipids and associated products. Sponsored by Archer Daniels Midland Company.

Tong has established herself as an international authority in lipid chemistry and its application to processing edible fats and oils, biobased products, biofuels, and egg and soybean lipid products.

Tong (Toni) Wang has been a professor of food science at University of Tennessee (UT) since April 2019, after her faculty tenure at Iowa State University (ISU) from 2000–2019. Professor Wang's research focuses on chemistry and value-added utilization of agriculture products such as soybeans, corn, egg, dairy, and other oleaginous biomass, primarily for their lipid components. The two primary areas of her research are (1) creating smart lipid materials and developing sustainable oil processing technologies, and (2) enhancing egg and dairy product quality and applications, such as egg nutrient enrichment via feeding and extraction of yolk and dairy polar lipids. She has received numerous industry and federal research grants that support her creative work and training of 36 graduate students and 20 post-docs and visiting scientists. She was recognized as an AOCS Fellow in 2016, with the ISU Mid-Career Achievement in Research in 2014, and the AOCS' Timothy L. Mounts Award in 2013. She found her academic home from her young graduate school age and ever since has been passionately serving the JAOCS family in various capacities.

STEPHEN S. CHANG AWARD

Recognizes a scientist, technologist, or engineer who has made decisive accomplishments in research for the improvement or development of products related to lipids. Provided by the Stephen and Lucy Chang endowed fund.



Dharma's work indicates an excellent combination of creativity, practicality, and industrial utility.

Dharma R. Kodali is a world-recognized expert in lipids and new product development and has 40 years of research experience in academia and industry. He is currently an adjunct professor in bioproducts and biosystems engineering at the University of Minnesota. Previously, he was a professor at the University of Minnesota and Boston University, studying the fundamental aspects of structurally defined lipid synthesis, molecular packing, properties, and their influence on metabolism and development of value-added products. His industrial experience includes working as a scientist and R&D manager at Cargill and as a senior principal scientist at General Mills, developing several new products from concept to commercialization. His primary areas of research continue to be developing value-added products from fats and oils and agricultural materials for food and industrial applications.

2020 AWARD SPONSORS

AOCS thanks all award sponsors for their generous support. Sponsors make it possible for AOCS to recognize outstanding scientists, researchers, technicians, and students within our community.

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Peter and Clare Kalustian Estate
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Nitto Pharmaceutical Industries, Ltd.
Nouryon
Milton J. Rosen
Seawit Co., Inc.
Vijai K.S. Shukla
Thomas H. Smouse and Family

Dr. Kodali authored or co-authored over 75 publications and book chapters and edited two books on trans fats. He is an inventor/co-inventor on 30 patents. His accomplishments include Cargill's Chairman's Innovation Award (2001), the American Chemical Society's Industrial Innovation Award (2002), the AOCS Timothy L. Mounts Award (2003), and the Alton E. Bailey Award (2017). He is an elected Fellow of the American Institute of Chemists (2004) and an AOCS Fellow (2010). He has served in AOCS in various capacities, including chair, Industrial Oil Products Division; teaching short courses; as an associate editor and peer reviewer for *JAOCS*; as session chair at national meetings; and a member of the Books and Publications and Recognition Program committees.

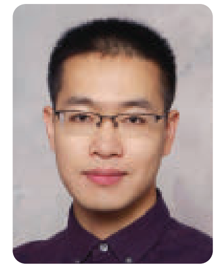
SUPELCO AOCS RESEARCH AWARD

Recognizes outstanding original research in fats, oils, lipid chemistry, or biochemistry. Sponsored by MilliporeSigma, a subsidary of Sigma-Aldrich Corp.

Michael's research on edible oils, particularly canola oil, opened new and exciting possibilities for the utilization of this crop in Canada and throughout the world.

N.A. Michael Eskin is a professor at the University of Manitoba, and a Fellow of AOCS, Institute of Food Technologists, Canadian Institute of Food Science and Technology, and the Institute of Food Science and Technology in the UK. He is recognized for his work on edible oils and played a key role in the successful development of canola oil. Dr. Eskin has published over 250 research articles, book chapters, monographs, abstracts, and several patents. He has published 15 books, including two on canola. He has also done extensive research on enzymes and gums as well as developed a number of colorimetric methods, including one for phytate that is still used worldwide. He recently celebrated his 50th year at the university, where he served as department chair and associate dean. In 2017, he was selected by the students in his faculty as Professor of the Year. Dr. Eskin is the recipient of many awards, including the Order of Canada in 2016 for his contributions to the worldwide success of canola oil. He served as chair of the AOCS Lipid Oxidation and Quality Division and was the first chair of the AOCS Division Council. In addition to serving as an associate editor of *JAOCS*, he was co-editor of *Lipid Technology* for seven years and is associate editor of education for the AOCS Lipid Library. Dr. Eskin was the recipient of the Stephen S. Chang Award from IFT in 2012 and AOCS in 2018. He also received the AOCS Herbert J. Dutton Award in 2017, the AOCS Alton Bailey Award in 2013, and the AOCS Timothy L. Mounts Award in 2007. He is well known for his Lipid Raps and just completed his latest one on protein.

Brenna



Song

Ogawa

Zhang

Kim

Zavadil

DIVISION AWARDS

ANALYTICAL

Herbert J. Dutton Award

J. Thomas Brenna, University of Texas at Austin; Cornell University, USA

Student Award

Ziliang Song, University of Saskatchewan, Canada

BIOTECHNOLOGY

Ching Hou Biotechnology Award

Jun Ogawa, Kyoto University, Japan

Student Award

First place:
Siyu Zhang, University of Georgia, USA
Second place:
Jiwon Kim, Korea University, Republic of Korea
Third place:
Andrea L. Zavadil, South Dakota State University, USA

NEXT YEAR'S AWARDS

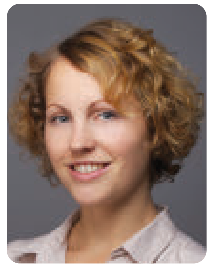
Nominations for 2021 AOCS awards open soon! Having trouble deciding which award is right for you?

Each award has unique nomination and deadline requirements, but all materials must be submitted to AOCS by the nomination deadline, and self-nominations are welcomed and encouraged.

The nomination and deadline requirements for each award can be found on the AOCS website (aocs.org/awards). For more information regarding award eligibility, please contact Victoria Santo at victoria@aocs.org.


Patel


DeBonte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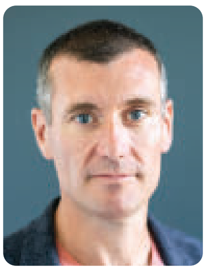
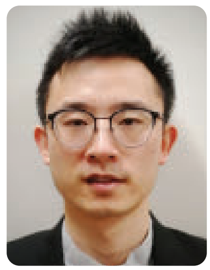

Bazinet


Clulow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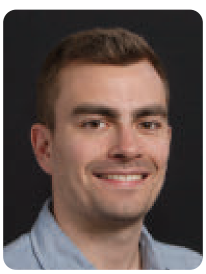
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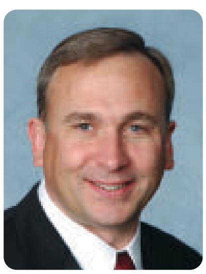
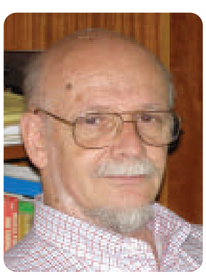

Bloomer


Keshun Liu


Vinson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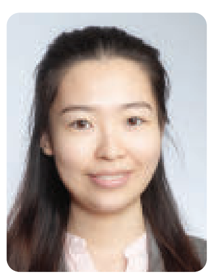

Jinning Liu

EDIBLE APPLICATIONS TECHNOLOGY

Timothy L. Mounts Award
Ashok R. Patel, Guangdong Technion Israel Institute of Technology, China

Outstanding Achievement Award
Lorin R. DeBonte, Cargill, Inc., USA

Student Award
Maria Scharfe, Technical University Berlin, Germany

HEALTH AND NUTRITION

Ralph Holman Lifetime Achievement Award
Richard P. Bazinet, University of Toronto, Canada

New Investigator Research Award
Andrew J. Clulow, Monash University

Student Award
Hongbing Fan, University of Alberta, Canada

PHOSPHOLIPID

Student Award
Mitchell Culler, University of Massachusetts-Amherst, USA

PROCESSING

Distinguished Service Award
Scott Bloomer, American Oil Chemists' Society (AOCS), USA

PROTEIN AND CO-PRODUCTS

Lifetime Achievement Award
Keshun Liu, US Department of Agriculture, USA

SURFACTANTS AND DETERGENTS

Distinguished Service Award
Phillip K. Vinson, Procter & Gamble, USA

Samuel Rosen Memorial Award
Jean-Louis Salager, Universidad de Los Andes, Venezuela

Student Award
Jinning Liu, University of Massachusetts-Amherst, USA

STUDENT AWARDS

HANS KAUNITZ AWARD

Mahesh M. Kharat, University of Massachusetts-Amherst, USA

RALPH H. POTTS MEMORIAL FELLOWSHIP

Parichat Phaodee, University of Oklahoma, USA

LIPID CHEMISTRY AND NUTRITION AWARD

Hualu Zhou, University of Massachusetts-Amherst, USA

LIPID PROCESSING AND BIOTECHNOLOGY AWARD

Yunbing Tan, University of Massachusetts-Amherst, USA

AOCS FOUNDATION

Manuchehr (Manny) Eijadi Award
Bingjing Zheng, University of Massachusetts-Amherst, USA

Honored Student Award
Yang Lan, North Dakota State University, USA
Marnie Newell, University of Alberta, Canada
Lirong Xu, Jiangnan University, China
Bingjing Zheng, University of Massachusetts-Amherst, USA

Peter and Clare Kalustian Award
Marnie Newell, University of Alberta, Canada

Thomas H. Smouse Memorial Fellowship
Deena B. Snoke, The Ohio State University, USA

BEST PAPER AWARDS

AMERICAN CLEANING INSTITUTE (ACI) DISTINGUISHED PAPER AWARD

Understanding and Prediction of the Clouding Phenomenon by Spontaneous and Effective Packing Concepts
(JSD 22(5): 1011–1021).
Maximilian Pleines, Werner Kunz, and Thomas Zemb

ARCHER DANIELS MIDLAND (ADM) AWARD FOR BEST PAPER IN PROTEIN AND CO-PRODUCTS

Chemistry/Nutrition Category

Effect of a Mutant Danbaekkong Allele on Soybean Seed Yield, Protein, and Oil Concentration (JAOCS 96(8): 927–935).
Mia J. Cunicelli, Hem S. Bhandari, Pengyin Chen, Carl E. Sams, M. A. Rouf Mian, Leandro A. Mozzoni, Christopher J. Smallwood, and Vincent R. Pantalone

Engineering/Technology Category

Nutrient Enhancement of Corn Distillers Dried Grains by Addition of Coproducts of the Enzyme-Assisted Aqueous Extraction Process of Soybeans in Corn Fermentation
(JAOCS 96(9): 1047–1057).
Jasreen K. Sekhon, Kurt A. Rosentrater, Stephanie Jung, and Tong Wang

EDWIN N. FRANKEL AWARD FOR BEST PAPER IN LIPID OXIDATION AND QUALITY

The Furan Fatty Acid 9M5 Acts as a Partial Ligand to Peroxisome Proliferator-Activated Receptor Gamma and Enhances Adipogenesis in 3T3-L1 Preadipocytes
(Lipids 54(5): 277–288).
Judith Lauvai, Anna-Karina Becker, Katja Lehnert, Monika Schumacher, Bettina Hieronimus, Walter Vetter, and Lutz Graeve

PHOSPHOLIPID DIVISION BEST PAPER AWARD

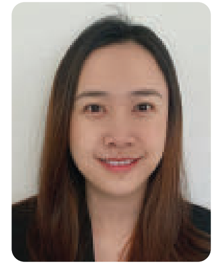
Encapsulation of Lactoferrin into Rapeseed Phospholipids Based Liposomes: Optimization and Physicochemical Characterization (Journal of Food Engineering 262 (2019: 29–38).
Daniela Vergara and Carolina Shene

OTHER AWARDS

LABORATORY PROFICIENCY PROGRAM AWARDS

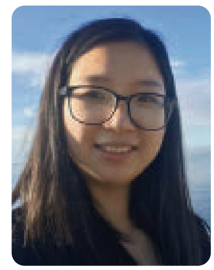
AOCS' Laboratory Proficiency Program is the world's most extensive and respected collaborative proficiency program for oil- and fat-related commodities, oilseeds, oilseed meals, and edible fats. A full listing of the Laboratory Program winners is available on aocs.org/series.


Kharat


Phaodee


Zhou


Tan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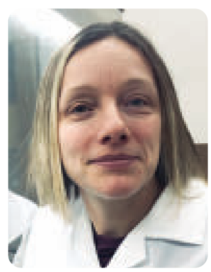
Newell


Xu


Snoke

New regulations and consumer demand drive change for surfactants and detergents

Olio is an Inform *column that highlights research, issues, trends, and technologies of interest to the oils and fats community.*

Rebecca Guenard

EDITOR'S NOTE: As of press time, the COVID-19 outbreak has likely affected the consumer trends outlined in this article.

As with so many industries, surfactant and detergent manufacturers have been reformulating their products for a public increasingly protective of the environment. Consumers study product labels and turn their back on brands that do not share their environmental concerns. The pressure to develop clean ingredients is compounded by complex regulatory standards, with differences between the European Union and the United States, as well as among US states. How are companies in the surfactants and detergents industries adapting to these regulatory and consumer changes?

In the United States, decreasing federal oversite has resulted in the undesirable effect of state governments imposing their own unique regulations, burdening manufacturers with the task of compliance state-by-state. The United States established the Toxic Substances Control Act in 1976, to manage the production, importation, use, and disposal of chemicals, and has maintained a list of the existing chemical substances in commerce since January of 1975. Four years ago, the US government revised the law and began risk-assessment for chemicals on the market believed to present human health or environmental concerns. In November 2016, the US Environmental Protection Agency (EPA) selected 10 chemicals that had been declared high-priority for a safety evaluation. Last year, the agency finalized reports for the pigment violet 29, a group of cyclic aliphatic bromides and 1,4-dioxane. However, the EPA's scientific advisory committee expressed its disagreement with the reports, because they did not contain data on toxicity and exposure, and failed to impose new limitations.

Decentralized regulations are the current trend. The state of California, for example, continues to add to a "list of chemicals known to the state to cause cancer or reproductive toxicity," under the Safe Drinking Water and Toxic Enforcement Act (also known as, Proposition 65), established in 1986. Laundry detergent and hard-surface cleaner formulators were forced to consider labeling their products as carcinogenic or finding new chelating agents when the state added diethanolamine to the list in 2016. New York State just passed a law prohibiting more than 2 ppm of 1,4-dioxane in household cleaning and personal care products starting in 2022. In 2024, the limit will drop to 1 ppm. The US EPA lists the compound as a likely carcinogen but did not recommend a drinking water standard in its recent report. Some areas of the state have the highest concentration of 1,4-dioxane in drinking water than anywhere else in the United States. Last year, the Connecticut legislature proposed a bill that all personal care items sold in the state must first be able to pass the European Union's Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) regulations. The bill never passed into law, but its proposal indicates that a growing contingency of consumers want greater oversite.

In the European Union (EU), REACH has led to the ban or restriction of more than 1,300 chemicals. REACH regulations require that manufacturer prove a product is safe before it can be used. Formaldehyde, parabens, and coal tar dyes are examples of commonly occurring personal care ingredients in the United States that are banned under EU laws.

Aside from government decisions affecting the surfactant and detergent industry, consumers are exerting a preference for products whose ingredients are friendly to human health and the environment. In the past five years, sulfate-free products have become popular with consumers who are concerned about sulfate sensitization or 1,4-dioxane traces resulting from sodium laureth sulfate synthesis. As a result, the industry has focused on bio-based surfactants, but until now these compounds were relegated to the laboratory.

BASF advertises an extensive product line of over 100 bio-based surfactants for the personal care industry. They range from anionic surfactants made from fatty acid sulfates to non-ionic surfactants made from sugars, like alkyl polyglucosides. About 20% of the surfactant product line claims to be entirely bio-based, produced via fermentation.

However, the specialty chemical company Evonik holds the claim for producing the first commercial product containing a biosurfactant. In 2016, the company began building world-scale fermentation facilities in Slovakia to produce rhamnolipids and sophorolipids (Fig. 1). Late last year, Unilever announced the launch of a hand dishwashing liquid containing rhamnolipids. Peter ter Kulve, president of Unilever's Home Care business says that until now biosurfactants remained an innovation on the lab bench that could not be scaled for commercialization. The biosurfactant is making its debut in Unilever's Quix products that are sold in Chile.

As the surfactants and detergents industry experience success with natural replacements for their main ingredient, personal and home care products still need natural sources of protection from decay, discoloration, oxidation, and bacterial growth. Environmentally friendly products that are water-based and made with biodegradable surfactants are potentially more susceptible to microbial activity than synthetic products. Parabens, a common antibacterial preservative, have been illegal in the EU for use in cosmetics products since 2014, due to evidence that they disrupt the endocrine system. They are among a growing list of preservatives that are banned by regulations or avoided by consumers, and the industry is eager for new sources.

Organic acids have been commonly used as a mild preservative for products in the pH range of 2 to 6. Pilot chemical, for instance, preserves its low-foam surfactant (sodium c14-16 olefin sulfonate) with benzoic acid. Organic acids only function in certain applications and are not effective in alkaline products like all-purpose cleaners and laundry detergents. Ingredient producer, Lincoln manufacturing in Lincoln, Road Island, USA, has produced a preservative that it claims is a broad-spectrum product. The antimicrobial is a mixture of naturally sourced propanediol, benzyl alcohol, and pentylene glycol suitable for cosmetics, but again probably not with a high enough pH for an alkaline product. Recently, a group known as The Green Chemistry & Commerce Council, a collaborative of consumer products companies, organized a competition with a cash reward to the inventors of a new preservative. Awards were given to multiple first place winners from industry, academia, and national labs. Their innovations included a preservative that decomposes in wastewater and an extract from white button mushrooms. However, none of the products have been commercialized since 2018, when the awards were granted.

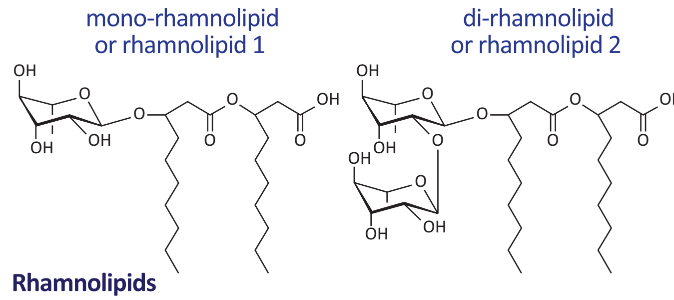

FIG. 1. General structure on mono- and di-rhamnolipids

It is difficult to balance the functional requirements of product preservation with the environmentally friendly expectations of product formulation. Many in the industry believe an environmentally acceptable status should be assigned to traditional, synthetic microbicidal ingredients. Proctor & Gamble, for instance, is straightforward with their customers. Their website reads, "Some people believe natural product ingredients are safer to use than man-made, synthetic ones. The reality is that it's not that simple; both natural and synthetic ingredients have a safe range and an unsafe range." Until new preservatives come online, consumers have to accept the limitations of current natural preservatives along with the fact that some ingredients may need to be less natural to be more safe.

The surfactants and detergents industry has experienced significant change in the past decade. A focus on greener products has led to advances in product design and biotech applications for specific ingredients. Consumers are seeing more options like concentrated or solid versions of their favorite cleaning products, along with more fermentation-manufactured ingredients. Not long ago, the idea that bio-based surfactants would truly be commercialized seemed like an unreachable goal. Today, it is formulated into a popular product. If the industry continues to push for these types of green innovations to satisfy government regulations and consumer demand, new preservatives for household cleaner could be available in no time.

Rebecca Guenard is the associate editor of Inform *at AOCS. She can be contacted at rebecca.guenard@aocs.org.*

Further reading

Why chemical makers love the cleaning product industry, Michael McCoy, *Chemical and Engineering News*, Volume 98, Issue 7, 2020.

Surfactants as antimicrobials: A brief overview of microbial interfacial chemistry and surfactant antimicrobial activity, Falk, N.A., *J. Surfactants Deterg. 22*: 1119–1127, 2019.

Saponins as natural raw materials for increasing the safety of bodywash cosmetic use, Nizioł-Łukaszewska, Z. and T. Bujak, *J. Surfactants Deterg. 21*: 767–776, 2018.

US EPA fast-tracks coronavirus efficacy claims

Disinfectant applications to be processed within 90 days

Regulatory Review is a regular column featuring updates on regulatory matters concerning oils- and fats-related industries.

In response to the coronavirus outbreak, the US Environmental Protection Agency (EPA) is fast-tracking requests by companies to add emerging viral pathogen claims to the labels of surface disinfectants.

The EPA normally allows companies to make efficacy claims against new pathogens— such as SARS-CoV-2, the coronavirus that causes COVID-19—if they have been pre-registered in line with its emerging viral pathogens guidance.

Earlier this year, the agency activated a procedure allowing disinfectant product manufacturers to publicly communicate efficacy claims against the coronavirus on pre-registered products.

Now, companies can more speedily register new products to make these claims.

They can submit their applications as non-Pesticide Registration Improvement Extension Act (PRIA 4) fast-track amendments, the EPA has announced.

Non-PRIA reviews come with no set decision timeframes and have historically slipped, says Andrea Mojica, vice president of regulatory affairs at the Household & Commercial Products Association (HCPA).

"With the fast-track announcement, the EPA is making the statement that they will, in fact, prioritize these applications and that companies should have a response before 90 days," says Mojica, who used to work at the EPA in the Office of Chemical Safety and Pollution Prevention.

"Given the current public health crisis, this should help consumers feel confident that there are more products available on the market that are effective against COVID-19."

The agency says it will only expedite claims that do not need a review of new efficacy data.

It has given companies a list of information to include in their requests, such as:

- a description of how the product meets the eligibility criteria for use against one or more categories of viral pathogens consistent with the EPA's emerging viral pathogens guidance; and
- the identification of the virus(es) from the product label that the company is using to support the emerging viral pathogen claims.

If an application is approved by the EPA, the product will be added to the agency's List N: Disinfectants for Use Against SARS-CoV-2 in the next update.

LIST N: DISINFECTANTS FOR USE AGAINST SARS-COV-2

The EPA-registered surface disinfectant products on our Disinfectants for Use Against SARS-CoV-2 list (https://tinyurl.com/unpxrc9) have qualified under EPA's emerging viral pathogen program (https://tinyurl.com/wdyalkt) for use against SARS-CoV-2, a coronavirus that causes COVID-19. Coronaviruses are enveloped viruses, meaning they are one of the easiest types of viruses to kill with the appropriate disinfectant product.

EPA strongly recommends following the product label use directions for enveloped viruses, as indicated by the approved emerging viral pathogen claim on the master label.

HOW TO USE THE LIST

1. Locate the EPA Registration Number on the disinfectant
2. Look for that number on List N: Disinfectants for Use Against SARS-CoV-2 (https://tinyurl.com/unpxrc9)
3. Click on a product's Registration Number
4. Look for the Emerging Viral Pathogens Claims section on the master label

5. Look for the **Enveloped Virus** information in the chart to find which organism's directions for use you should follow
6. Go to the product label and follow the directions for use against the listed organism
   - If there are multiple organisms listed, use the longest contact time, and if applicable, the highest concentration

Note: There may be additional disinfectants that meet the criteria for use against SARS-CoV-2. EPA will update this list with additional products as needed.

EMERGING VIRAL PATHOGEN CLAIMS

The emerging viral pathogen guidance was triggered for SARS-CoV-2 on January 29, 2020. A company can apply for an emerging viral pathogens claim, even before an outbreak occurs, based on previously EPA-approved claims for harder-to-kill viruses. EPA reviews the supporting information and determines if the claim is acceptable. Once approved, a company can make certain off-label claims as specified in the policy in the event of an outbreak such as the SARS-CoV-2. For instance, the company can include an efficacy statement on:

- technical literature distributed to health care facilities, physicians, nurses, public health officials;
- non-label-related websites;
- consumer information services; and
- social media sites.

Other COVID-19 resources

- CDC's Coronavirus Disease 2019 Site (https://tinyurl.com/wz7ojes)
- CDC's Cleaning and Disinfection Recommendations for COVID-19 (https://tinyurl.com/wbg7r3u)
- NPIC 's COVID-19 Virus Factsheet (https://tinyurl.com/r6nlwpo)

Due to the outbreak of the novel coronavirus, EPA is expediting the review of submissions from companies requesting to add Emerging Viral Pathogens claims (https://tinyurl.com/slv28os) to their product labels.

For instructions on what to include in an expedited request, visit Emerging Viral Pathogen Claims for SARS-CoV-2: Submission Information for Registrants (https://tinyurl.com/wphq9xh).

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Impact of coronavirus in Argentinean exports

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

Leslie Kleiner

As we follow the spread of coronavirus in many countries around the world, I came across an article by Agustín Szafranko (published by the newspaper *El Cronista* (https://www.cronista.com/economiapolitica/Coronavirus-y-exportaciones-que-negociosse-ponen-en-juego-por-la-epidemia-para-la-Argentina-20200226-0027.html) that addresses the impact of this virus on exports from Argentina. Below, I have adapted some highlights into a Q&A format. Note that at the time of writing this article, there was one confirmed case of coronavirus in Brazil, and four people were being tested for coronavirus in Argentina.

Q: What were the exports like for Brazil and Argentina this past January?

For the month of January, Brazilian exports accounted for US$697 million, which represents 15% of the exports of the region. During the same period, Argentina exported US$448 million. However, both countries fear that if the disease spreads, there may be restrictive measures that would prevent exports.

Q: How does coronavirus in China affect Argentinean exports?

China is the main buyer of raw ingredients globally. If Chinese demand diminishes, there is a reduction on volume of exports, as well as pressure to adjust international prices. At the time of writing this article, this was not of high concern. However, it is estimated that should the coronavirus continue to negatively influence the Chinese economy, then investments may be delayed in parallel to a decrease in volumes and drop in prices. Furthermore, logistical restrictions in China, implemented to prevent the spread of the coronavirus (e.g., closing transportation routes and harbors), are more detrimental than a lack of consumer demand.

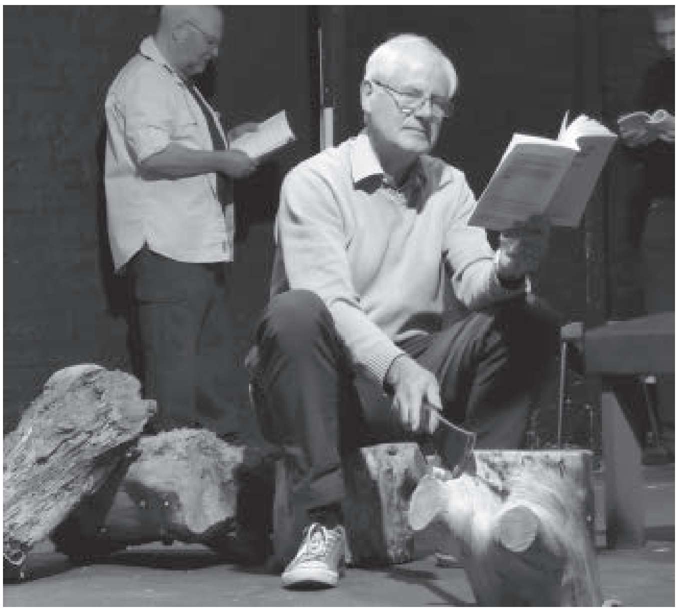
Q: How were the Argentinean exports to China this past January? (There was a high incidence of coronoavirus in China in January.)

In general, the exports to China grew by 6% last January. However, primary product exports declined by over 30% (US$66 million). This was compensated by production of agribusiness products which increased by 34% (US$201 million). For Argentina, 95% of the sales to China come from this area. Specifically regarding soy, the metric ton dropped by 10% since the beginning of the year to end of February (from US$350 to US$321.6). This is in agreement with Moody's views on risk analysis for emerging countries, which estimated that they would be affected by the spread of coronavirus in China, and potentially by a global recession.

Latin America Update is produced by Leslie Kleiner, a senior research scientist and contributing editor of *Inform*.

Meet Alan Paine

Member Spotlight is a regular column that features members who play critical roles in AOCS.



Alan Paine in rehearsal. Photo credit: Michele Reid

Fast facts

Name	Alan Paine
Joined AOCS	2017 ("But I've been lurking on the sidelines for much longer.")
Education	Degree in chemical engineering from Surrey University (1977)
Job title	Group Technology Support
Employer	Desmet Ballestra, Brussels, Belgium
Current AOCS involvement	Session chair for AOCS Annual Meeting, speaker, *Inform* article author, and regular contributor to the inform|connect forum. "I seem to have achieved at least 15 minutes of fame through this route. I often meet people I've never met before who tell me that they have read my posts."

PROFESSIONAL

Flash back to when you were 10 years old. What did you want to be when you grew up?
When I was 10, I knew nothing of the world of industry and commerce and imagined growing up to do jobs that I saw around me, such as being a postman or a zookeeper. I can see now that neither of these would have been a good career move.

Why did you decide to do the work you are doing now?
When I was about 16, I was at sick and was at home. I still remember watching a television program about chemical engineering and being captivated by what they said about solving problems. If I'd been at school that day I would have missed seeing the show and so presumably would now be doing something else.

Is there an achievement or contribution you are most proud of? Why?
I am most proud of the versatility that enables me to sell, engineer, and start up equipment on the same project. It is satisfying to be able to overcome the problems and see the plant working. I remember near the end of a difficult start-up, the customer came into the control room to find the automation engineer and me just looking at the screens. He said that it made him happy to see us doing nothing instead of running around trying to solve problems.

What event, person, or life experience has had the most influence on the direction of your life?
A person who had a big influence on me as a chemical engineer was the head of the department at Surrey University, Professor Russell Tailby (1917–2009). He used to say, "You won't find this in any book," before telling us something from his own experience. It's an important lesson that education is more than what you read or can read.

PERSONAL

How do you relax after a hard day of work?
By playing classical guitar.

What is the most impressive thing you know how to do?
Learning a part in a play. In my most recent play, I had to speak over 300 times saying anything from one word to a speech lasting half a page.

What are you looking forward to in the coming months?
I have had three short stories published in recent years as a result of writing competitions. I have submitted a synopsis and opening of a science fiction novel to the publisher and hope that they will want to take that further.

PATENTS

Lyotropic composition of carbohydrates in fats, method for obtaining it, and application thereof in the preparation of chocolate and substitutes

Miguel, J.F.G., *et al*., Natra Cacao, S.L. Unipersonal, US10537120, January 21, 2020

A lyotropic composition related to the food industry field, and particularly to the chocolate industry field is described. Specifically, a lyotropic composition comprising carbohydrates in fats is described. Also described is a method for producing the lyotropic composition. Moreover, different uses of said composition, particularly for the manufacture of chocolates and chocolate substitutes, including chocolate with honey and fruity chocolate are described.

Conditioning shampoo with ester mixtures of plant oils

Fuhr, D., *et al*., Henkel AG & Co. KGaA, US10537508, January 21, 2020

Subject matter of the present disclosure is a conditioning shampoo containing (A) a mixture of the mono-, di- and tri-esters of a fatty acid mixture (F1) and glycerine, and (B) a mixture of the mono- and di-esters of a fatty acid mixture (F1) and a polyethylene glycol having a mean molecular mass of from 200–800 g/mol, wherein the fatty acid mixture (F1) is a mixture of fatty acids which has the same fatty acid composition as a plant-based oil, and, relative to the total weight of the shampoo, the total quantity of all the plant-based oils included in the shampoo, which are not the same as the tri-esters of the fatty acid mixture (F1) and glycerine is a value of maximum 0.25 wt.%, and the total quantity of all the silicone compounds included in the shampoo is a value of maximum 0.25 wt.%.

Rubber composition for tires and pneumatic tire

Matsuura, A., *et al*., Sumitomo Rubber Industries, Ltd., US10538647, January 21, 2020

The present invention aims to provide rubber compositions for tires that contain a natural rubber achieving a balanced improvement in abrasion resistance, breaking performance, and processability to achieve a balanced improvement in abrasion resistance, breaking performance, and processability, and also provide pneumatic tires containing such rubber compositions for tires. Included is a rubber composition for tires comprising a modified natural rubber prepared by treating natural rubber latex with a proteolytic enzyme, and then treating the treated natural rubber latex with a lipolytic enzyme and/or a phospholipid degrading enzyme. Also included is a rubber composition for tires, comprising a modified natural rubber prepared by centrifuging natural rubber latex to recover a latex fraction comprising latex particles having an average particle size of 0.25 micrometer or less.

Method for mixing of particles

Bach, P., *et al*., Novozymes A/S, US10543464, January 28, 2020

Continuous mixing in a static mixer is possible and can be used to add one kind of particle (such as an enzyme granular product) in a small amount to a larger amount of a different kind of particle (such as a powder stream of detergent powder), even if the powder characteristics are substantially different, with substantially no damage to the enzyme particles and with a high degree of homogeneity.

Methods and apparatus for producing alkyl esters from a reaction mixture containing acidified soap stock, alcohol feedstock, and acid

McNeff, C.V., *et al*., SarTec Corporation, US10544381, January 28, 2020

Embodiments herein relate to the production of alkyl esters from acidified soap stock. In an embodiment, a process for producing alkyl esters is provided. The process can include mixing acidified soap stock with an alcohol, water, carbon dioxide, and/or carbon monoxide, to form a reaction mixture, and contacting the reaction mixture with a catalyst under supercritical conditions for the alcohol, the catalyst including a metal oxide. Other embodiments are also included herein.

Cocoa butter substitute

Cruz, A.F., *et al*., Team Foods Colombia S.A., US10548334, February 4, 2020

A trans-fat-free cocoa butter substitute and its production process which has a lower quantity of saturated fatty acids than cocoa butter, common cocoa butter substitutes, and lauric fats, for coating and molding applications in chocolate products with adequate texture, gloss, and melting profile characteristics, and a good speed of crystallization during a cooling process without tempering.

Infant nutrition for improving fatty acid composition of brain membranes

Van Der Beek, E.M., *et al*., N.V. Nutricia, US10548869, February 4, 2020

The present invention relates to infant nutrition, in particular to infant nutrition comprising special lipid globules for improvement of the fatty acid composition in brain membranes.

Patent information was compiled by Scott Bloomer, a registered US patent agent and Director, Technical Services at AOCS. Contact him at scott.bloomer@aocs.org.

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The need to circulate current results within a scholarly community quickly—during a disease outbreak like COVID-19, for example—has made preprints a popular and important part of research publishing. A preprint is a full draft of a research paper that is shared publicly (usually online via a preprint database, or server). Most preprints have their own unique DOI which can be cited; listed in a *curriculum vitae* (CV); used for grant applications, job interviews, tenure reviews, and shared through social media and other communication channels.

All three AOCS journals allow submissions that have already been deposited in a preprint repository to be considered for peer review and publication. This year, the *Journal of the American Oil Chemists' Society (JAOCS)* is also helping Wiley pilot a new optional service that makes it easy for authors to showcase their work to the global research community as a preprint while it is under review at a number of Wiley's journals, before it is accepted or published.

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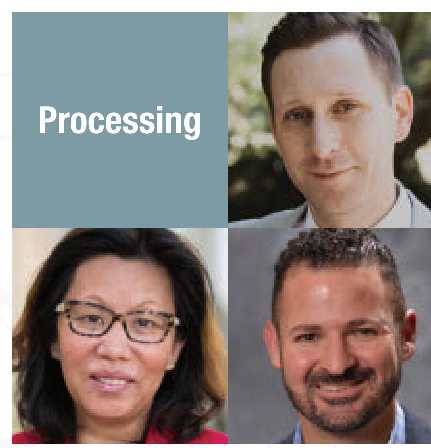

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LOQ Lipid Oxidation and Quality
IOP Industrial Oil Products
PCP Protein and Co-Products

Review Articles

IOP PRO Biofuels from oilseed fruits using different thermochemical processes: opportunities and challenges

Cruz, G., *et al.*, *Biofuel. Bioprod. Bior.*, February 2020, https://doi.org/10.1002/bbb.2089.

The characterization of the physical–chemical properties and the thermal behavior of oilseed fruits for biofuels production has gained interest in the scientific community and society more generally, particularly with regard to their use as partial replacements for fossil fuels and for the possible reduction of air pollutants that cause problems for human health, animals, and plants. These oilseed fruits, which are rich in lipids, triglycerides, fatty acids, carotenoids, and other greasy compounds, can be transformed into solid, liquid, and gaseous products by different thermochemical conversion processes (conventional combustion, pyrolysis, oxy-fuel combustion, gasification, and transesterification). This review investigates the different oleaginous feedstocks commonly found in the forests and plantations of Brazil—for example, olive stones, palm fruits, babassu coconut, macauba fruits, tucumã seeds, and soybeans—and the respective residues generated from biofuel production and manufacturing processes. The main opportunities and challenges associated with the use of biofuels produced from these oilseed fruits lie in the fact that internal combustion engines using fossil fuels do not need to undergo modifications and mechanical adaptations to operate, and there is no corrosion risk and/or deterioration of metallic parts. Biofuels produce less greenhouse gas, or their pollution is considered neutral. Finally, the native forests of Brazil and the world present a vast number of different oleaginous species that still need be studied because they have excellent potential to be used as biofuels, as they are renewable energy sources and are sustainably eco-friendly.

Techno-economic analysis of pennycress production, harvest, and post-harvest logistics for renewable jet fuel.

LOQ EAT Encapsulation of food bioactives and nutraceuticals by various chitosan-based nanocarriers

Akbari-Alavijeh, A., *et al.*, Food Hydrocoll. *105*: 105774, 2020, https://doi.org/10.1016/j.foodhyd.2020.105774.

Nanoencapsulation as a leading technique using nanostructures, can considerably enhance the bioavailability and durability of bioactive food components. For this purpose, chitosan as a bioactive polysaccharide has been widely utilized as carrier, due to its unique chemical and biological characteristics, such as polycationicity, biocompatibility, and biodegradability. In this review, various approaches and techniques for development of chitosan-based nanodelivery systems, with an overview of the related studies, will be discussed. Nutritional and functional properties of the nanostructures and relevant safety issues are also highlighted. Scientists have developed various nanostructures, such as nanoparticles, nanohydrogels, nanofibers, and nanocomposites from chitosan, which have been successfully applied as nanocarriers for encapsulation of a diverse range of bioactive compounds including phenolic compounds, essential oils, carotenoids, vitamins, etc. This review gives a new insight into the investigation of potent uses of chitosan-based nanostructures in the food and pharmaceutical manufacturing sectors.

Original Articles

BIO Strategy for the identification of micro-organisms producing food and feed products: bacteria-producing food enzymes as study case

Deckers, M., *et al.*, *Food Chem. 305*, 125431,2020, https://doi.org/10.1016/j.foodchem.2019.125431.

Recent European regulations require safety assessments of food enzymes (FE) before their commercialization. FE are mainly produced by micro-organisms, whose viable strains or associated DNA can be present in the final products. Currently, no strategy targeting such impurities exists in enforcement laboratories. Therefore, a generic strategy of first-line screening was developed to detect and identify, through PCR amplification and sequencing of the 16S-rRNA gene, the potential presence of FE-producing bacteria in FE preparations. First, the specificity was verified using all microbial species reported to produce FE. Second, an in-house database, with 16S reference sequences from bacteria producing FE, was constructed for their fast identification through blast analysis. Third, the sensitivity was assessed on a spiked FE preparation. Finally, the applicability was verified using commercial FE preparations. Using straightforward PCR amplifications, Sanger sequencing and blast analysis, the proposed strategy was demonstrated to be convenient for implementation in enforcement laboratories.

H&N EAT Mechanism of lipid metabolism regulation by soluble dietary fiber from micronized and non-micronized powders of lotus root nodes as revealed by their adsorption and activity inhibition of pancreatic lipase

Chen, H., *et al.*, *Food Chem. 305*: 125435, 2020, https://doi.org/10.1016/j.foodchem.2019.125435.

Soluble dietary fiber (SDF) of micronized and non-micronized powders of lotus root nodes were investigated based on its adsorption and activity inhibition of pancreatic lipase (PL) by using circular dichroism, fluorescence spectroscopy, and modification. Results showed that SDF2 (SDF from micronized powders of lotus root nodes) had stronger PL adsorption and enzyme activity inhibition than SDF1 (SDF from non-micronized powders of lotus root nodes). Specifically, SDF2 showed more binding sites than SDF1 in PL. There were hydrogen bonds and van der Waals interactions between SDF and PL, with Trp on PL probably serving as the main binding site. Carboxyl groups exhibited a stronger inhibition on PL by carboxymethyl and hydroxypropyl modification. The common mechanisms between SDF1 and SDF2 can be attributed to the combination between Trp and carboxyl groups, while the differences may be generated by the variations in structures or chemical groups induced by micronization.

H&N Neuroprotective and anti-inflammatory effects of pterostilbene metabolites in human neuroblastoma SH-SY5Y and RAW 264.7 macrophage cells

Peñalver, P., *et al.*, *J. Agric. Food Chem. 68*: 1609–1620, 2020, https://doi.org/10.1021/acs.jafc.9b07147.

Oxidative stress is known to be a key factor in many neurodegenerative diseases. Inflammation also plays a relevant role in a myriad of pathologies, such as diabetes and atherosclerosis. Polyphenols coming from dietary sources, such as pterostilbene, may be beneficial in these types of diseases. However, most of them are rapidly metabolized and excreted, yielding very low phenolic bioavailability, which makes it difficult to identify the mechanisms responsible for the observed bioactivity. Herein, we evaluate the effects of pterostilbene and its metabolites against H_2O_2-induced cell damage in human neuroblastoma SH-SY5Y cells and against lipopolysaccharide (LPS)-challenged RAW 264.7 macrophages. Among the metabolites tested, 3-methyl-4′-glucuronate-resveratrol (also called 4′-glucuronate pinostilbene, PIN-GlcAc, 11) prevented neuronal death via attenuation of reactive oxygen species (ROS) levels and increased REDOX activity in neurons. This compound is also able to ameliorate LPS-mediated inflammation on macrophages via inhibition of IL-6 and NO production. Thus, polyphenol from dietary sources could be part of potential functional foods designed to ameliorate the onset and progression of certain neurodegenerative diseases via oxidative stress reduction.

H&N PRO EAT Effect of EDTA-enriched diets on farmed fish allergenicity and muscle quality: a proteomics approach

De Magalhães, C.R., *et al.*, *Food Chem. 305*, 125508, 2020, https://doi.org/10.1016/j.foodchem.2019.125508.

Fish is one of the most common elicitors of food-allergic reactions worldwide. These reactions are triggered by the calcium-binding muscle protein beta-parvalbumin, which was shown to have reduced immunoglobulin E (IgE)-binding capacity upon calcium depletion. This work aimed to reduce gilthead seabream allergenicity using diets supplemented with a calcium chelator. Three experimental feeds were tested, differing in ethylenediaminetetraacetic acid (EDTA) supplementation, and its effects on muscle, and parvalbumin's IgE-reactivity were analyzed. Chromatographic determination of EDTA showed no accumulation in the muscle, and sensory results demonstrated that the lowest concentration did not affect fish quality as edible fish. Proteomics revealed one protein related to muscle contraction with significantly different relative abundance. Immunoblot assays performed with fish-allergic patients sera indicated a 50% reduction in IgE-reactivity upon EDTA presence. These preliminary results provide the basis for the further development of a non-GMO approach to modulate fish allergenicity and improve safety of aquaculture fish.

IOP PRO Techno-economic analysis of pennycress production, harvest, and post-harvest logistics for renewable jet fuel

Mousavi-Avval, S.H. and A. Shah, *Renew. Sustain. Energ. Rev. 123*, May 2020, https://doi.org/10.1016/j.rser.2020.109764.

Pennycress (*Thlaspi arvense* L.) is a winter annual oilseed crop with relatively high seed oil content (25–36%-wet basis), which can be planted as cover crop in corn-soybean rotation in the Midwestern United States, to provide both economic benefits and ecosystem services. Pennycress oil has adequate quality for conversion to renewable jet fuel (RJF); however, the technical feasibility and cost of pennycress supply at the commercial scale have not been evaluated. The objective of this study was to evaluate techno-economics of the production, harvest, and post-harvest logistics of pennycress as an RJF feedstock. In addition, an uncertainty analysis was performed to address the inherent variability of the parameters used for this evaluation. This study considered the feedstock supply for a biorefinery with RJF production capacity of around 19 million liters per year (i.e., 5 million gallons per year) in Ohio. Technical feasibility included the assessment of resources (land, infrastructure, machineries, fuel, labor, and consumables) for the production (i.e., planting, fertilizer and pesticide applications), harvest and post-harvest logistics (i.e., grain handling, transportation, drying, and storage). Economic analyses included estimation of pennycress production and logistics costs. Annual pennycress seed requirement for the selected biorefinery capacity was estimated to be 90–115 thousand t (90% central range–CR), which would require pennycress plantation in 41–63 thousand ha (90% CR) land in corn-soybean rotation. The direct fossil fuel use ratio (i.e., fossil fuel use per liter of RJF produced) for pennycress production and logistics was estimated to be 0.06–0.09 L/L (90% CR). Estimated total cost for the production and logistics was 170–230 $/t (90% CR); and it was identified to be highly sensitive to pennycress seed yield. The outcomes of this research contribute to identifying the bottlenecks and hotspots for establishment of pennycress at the commercial scale in corn-soybean rotation in Ohio and Midwestern United States.

H&N EAT PRO Dynamic changes in the phenolic composition and antioxidant activity of oats during simultaneous hydrolysis and fermentation

Bei, Q., *et al.*, *Food Chem. 305*: 125269, 2020, https://doi.org/10.1016/j.foodchem.2019.125269.

Solid-state fermentation (SSF) is the preferred method of enhancing the phenolic content of oats, while scientific optimization for improving specific phenolic compounds is limited. In this study, sequential targeting of phenolic conversion in simultaneous hydrolysis and fermentation (SHF) of oats was investigated. The results revealed that SHF with adding cellulase at 0, 6, and 12 days could increase the total phenolic content by 4.4%, 67.8%, and 59.1%, respectively, over that of SSF. The alpha-amylase and CMCase activity were highly correlated with the soluble and insoluble phenolic contents in SHF (–6 and –12) systems ($r > 0.8$, $p < 0.05$). Interestingly, the content of phenolic fraction, such as ferulic acid, was up-regulated, whereas sinapic acid was down-regulated. These results indicated that the phenolic conversion occurred in SHF, resulting in variation in DPPH and ABTS+ radical scavenging abilities. This research provided metabolic understanding of the optimization of phenolic compounds to increase the functional ingredient of oats.

H&N Differential catabolism of an anthocyanin-rich elderberry extract by three gut microbiota bacterial species

Bresciani, L., *et al.*, J. *Agric. Food Chem. 68*: 1837–1843, 2020, https://doi.org/10.1021/acs.jafc.9b00247.

Elderberries are good sources of anthocyanins, which are poorly absorbed in the upper gastrointestinal tract but extensively transformed into phenolic metabolites at the colonic level. Because different gut microbiota strains have different metabolism, the catabolism of anthocyanins may lead to interindividual differences in metabolite production. In this work, an anthocyanin-rich elderberry extract was incubated with three single gut microbial strains (*Enterobacter cancerogenous*, *Bifidobacterium dentium*, and *Dorea longicatena*) up to 4 days, to assess differences in their phenolic metabolism. All of the strains degraded the elderberry anthocyanins, but the metabolic pathways followed were different. Although some metabolites were common for all of the strains, a wide disparity was observed in the kind and amount of several phenolic metabolites produced by each species. These *in vitro* preliminary results may be of help in the interpretation of the bioavailability of anthocyanins and give a clue to understand interindividual variability in metabolite production.

IOP PRO Catalytic and thermal cracking of bio-oil from oil-palm empty fruit bunches, in batch reactor

Wibowo, S., *et al.*, Indonesian J. Chem., https://doi.org/10.22146/ijc.44076.

The world's potency of fossil-derived petroleum fuels has declined steadily, while its consumption continues to rise ominously. Therefore, several countries have started to develop renewable fuels like bio-oil from biomass. Relevantly, the aim of this research was to explore the technical feasibility of upgrading the qualities of crude bio-oil (CBO) produced from the pyrolysis on oil-palm empty fruit bunches (OPEFB) using Ni/NZA catalyst in a batch reactor. The natural zeolite (NZ) was activated by HCL 6 N and NH_4Cl (obtained sample NZA). Supporting Ni onto NZA was conducted with an impregnation method using a salt precursor of $Ni(NO_3)2{\cdot}6H_2O$ followed by calcination with a temperature of 500°C. Catalyst characterization includes determining the site of TO4 (T = Si or Al) in zeolites, acidity, crystallinity, and catalyst morphology. Cracking reaction of CBO was carried out in batch reactor in varied temperatures of 250 and 300°C with the variation of catalyst weight of 0, 4, 6, and 8% toward CBO. Several analyses of the liquid product such as product yield, specific gravity, pH, viscosity, calorific value, and chemical compound were conducted. The results showed that acidification and Ni loading on zeolite samples increased their acidity. The optimum CBO's cracking condition was judged to be the temperature of 300°C with 6% Ni/NZA catalyst use, whereby the fuel yield reached 26.42% and dominated by particular compounds comprising phenol, octanoic acid, and alkane hydrocarbons. Under such conditions, the characteristics of fuel were pH 3.54, specific gravity 0.995, viscosity 14.3 cSt, and calorific value 30.85 MJ/kg.

IOP PRO Primary evaluation of a synthesized surfactant from waste chicken fat as a renewable source for chemical slug injection into carbonate oil reservoirs

Nowrouzi, I., *et al.*, *J. Mol. Liq. 306*: 112843, May 2020, https://doi.org/10.1016/j.molliq.2020.112843.

Oil and fat extracted from plant seeds and animal tissues, as renewable sources, are used to produce various surfactants. These surfactants can be used in diverse industries including the petroleum industry. One of the most important applications of surfactants is the reduction of water-crude oil interfacial tension (IFT) during chemical injection into oil reservoirs. In the current study, chicken skin fat was used as the primary substance for the synthesis of a surfactant. The surfactant was synthesized by the processes of esterification and sulphonation and was characterized by Fourier-Transform Infrared Spectroscopy (FTIR). Its temperature stability was studied using thermal gravimetric analysis (TGA). Pendant drop surface tension tests, spinning drop IFT, contact angle, and chemical alkali-surfactant-polymer (ASP) slug injection at optimal salinity and optimal alkali with polymer were used to measure the usage of surfactant in the process of enhanced oil recovery (EOR). In addition, the surfactant foamability with nitrogen was investigated by foam generation in a temperature-controlled Ross-Miles foam generator. The emulsion stability formed by the surfactant was also tested by observational experiments. According to the results, the reduction of IFT to a low value ($4.3 \times 10{-}2$ mN/m) at critical micelle concentration (CMC), altering the wettability of carbonate rock from oil-wet to water-wet and eventually, about 18% increase in oil recovery by flooding the chemical ASP slug were obtained.

LOQ H&N Effects of four polyphenols loading on the attributes of lipid bilayers

Zhang, Y., *et al.*, *J. Food Eng. 282*: 110008, 2020, https://doi.org/10.1016/j.jfoodeng.2020.110008.

The low bioavailability of polyphenol limits their use in functional foods. This study focused on the effects of luteolin, quercetin, proanthocyanidins, and apigenin loading on the attributes of lipid bilayers. Liposomes loaded with quercetin and proanthocyanidins were smaller in size and dispersed more uniformly than those loaded with luteolin and apigenin. The spherical structures of these four liposomes were investigated via transmission electron microscope (TEM) and atomic force microscope (AFM). Raman spectra showed that the choline groups in all the liposome bilayers were mainly gauche conformations. Furthermore, polyphenolics had different effects on the liposomes' mobility and structure, which were dependent on the localization and orientation of polyphenolics in the lipid bilayer. X-ray diffraction (XRD) analysis indicates that four kinds of polyphenolics exist in an amorphous form in these liposomes. Fluorescence analysis indicates that the four polyphenolic compounds could load into the liposomes with different orientations. The ability of the four polyphenols to chelate Al3+ was significantly reduced in the lipid environment. The results reveal that polyphenolics' localization in lipid bilayers and their effects on lecithin membranes can be attributed to the polyphenols' structural characteristics. These were vital factors that should be taken into account when designing a liposome delivery system.

IOP PRO Soybean biodiesel purification through an acid-system membrane technology: effect of oil quality and separation process parameters

Moreira, W.M., *et al.*, *J. Chem. Technol. Biotechnol.*, February 2020, https://doi.org/10.1002/jctb.6395.

Biodiesel produced from renewable energy sources has gained significant attention in the arena of fuel diversification from fossil sources. However, the conventional treatment to separate biodiesel from glycerol produces large volumes of wastewater, causing environmental concerns. The present study aims to assess ceramic membrane technology for improving biodiesel separation and purification and overcome the traditional process constraints. Biodiesel was obtained by ethylic transesterification of crude, degummed, and refined soybean oil. The tangential ultrafiltration (alpha-Al_2O_3/TiO_2) performance in separating and purifying the produced biodiesel was evaluated based on the glycerol retention capacity and on the permeate flux values. The separation was improved by use of acidified water [0.5% and 1% (m/m)] which promoted the demulsification of the reaction final mixture. In the proposed system, the glycerol was retained, and the biodiesel was the continuous phase. Higher free fatty acid content in the crude and degummed soybean oil, not only favored the glycerol transfer over the aqueous phase, which was retained by the membrane, but also resulted in the lowest flux decline rates. An increase in the oil acidity reduced the consumption of acidified water. As the pore diameter (0.05 micrometer and 20 kDa) and the transmembrane pressure (1 and 2 bar) decreased, the glycerol retention increased allowing the system to fulfill commercialization requirements.

The results of this study showed that the novel ultrafiltration process is efficient in separating biodiesel from glycerol and reducing wastewater generation when compared with the conventional process.

LOQ Dietary flaxseed and turmeric is a novel strategy to enrich chicken meat with long-chain omega-3 polyunsaturated fatty acids with better oxidative stability and functional properties

Kumar, F., *et al.*, *Food Chem. 305*: 125458, 2020, https://doi.org/10.1016/j.foodchem.2019.125458.

The purpose of the present study was to elucidate the effects of feeding flaxseed meal (FSM) and turmeric rhizome powder (TRP) supplementation on tissue lipid profile, lipid metabolism, health indices, oxidative stability, and physical properties of broiler chicken meat. The 100 g FSM along with 10.0 g TRP supplementation significantly increased the omega-3 PUFA, particularly ALA, EPA, DPA, and DHA of broiler chicken meat due to the corresponding increase $\Delta 9$ and $\Delta 5 + \Delta 6$ desaturase activities. The increased activities of the desaturases resulted in significantly better health indices of the broiler chicken meat. The feeding of 100 g FSM along with 10.0 g TRP supplementation reduced the atherogenic and thrombogenic indices of broiler chicken meat. The 100 g FSM feeding reduced the oxidative stability, water holding capacity, extract release volume of broiler chicken meat and increased drip loss, whereas, 10.0 g TRP supplementation reversed these negative effects of FSM.

LOQ EAT Phytochemical characterization and antimicrobial activity of *Cymbopogon citratus* extract for application as natural antioxidant in fresh sausage

Boeira, C.P., *et al.*, *Food Chem. 319*: 126553, 2020, https://doi.org/10.1016/j.foodchem.2020.126553.

The development of natural additives is considered an important research topic. In this work, the use of *Cymbopogon citratus* (CC) extract as a natural additive for refrigerated chicken sausage was investigated. The CC extract was characterized by electrospray ionization with high-resolution time-of-flight mass spectrometry (ESI-ToF-MS) and the identified compounds were directly related to the antioxidant activity demonstrated by CC in the fresh sausage. In total, 31 phytochemical compounds were identified, and 27 of these had not yet been described in the literature for CC. The antimicrobial activity showed that CC extract is a potential antibacterial agent. Besides, the results showed that CC extract reduced lipid oxidation compared to synthetic additive. The sensorial characteristics were maintained, demonstrating good acceptability by the consumer. The results confirmed that CC can keep the quality of chicken sausage refrigerated for up to 42 days of storage.

LOQ EAT Improving the efficiency of natural antioxidant compounds via different nanocarriers

Maqsoudlou, A., *et al.*, *Adv. Colloid Interface Sci. 27*: 102122, 2020, https://doi.org/10.1016/j.cis.2020.102122.

Encapsulation technology, as a promising approach, has been employed for the protection and controlled release of different bioactive compounds including natural antioxidants; there are restrictions for applying these valuable ingredients in real food products, pharmaceuticals, and cosmetics such as low solubility, low shelf life, difficultly in their packaging and handling, losses due to environmental stresses and food processes, undesirable flavors and odors, untargeted release, and instability in various conditions during digestion in gastrointestinal tract. Nanocarriers can be employed to overcome these challenges. There are five groups of nanocarriers based on the principal mechanism/ingredient used to make them for the encapsulation of natural antioxidants titled biopolymeric nanoparticles, lipid-based and surfactant-based nanocarriers, nanocarriers made with specially designed equipment, nature-inspired nanocarriers, and miscellaneous ones. The main goal of this study is to have an overview of role of different nanocarriers in improving the efficiency of natural antioxidant compounds for different purposes. It has been verified that antioxidant-loaded nanocarriers can be applied in many formulations with a higher and controlled release antioxidant activity, which would meet the current needs of consumers' expectations towards clean label products.

LOQ H&N Antioxidant performances of corn gluten meal and DDGS protein hydrolysates in food, pet food, and feed systems

Hu, R., *et al.*, *J. Agric. Food Res. 2*: 100030, 2020, https://doi.org/10.1016/j.jafr.2020.100030.

Protein hydrolysates from corn gluten meal (CGM) and distillers'-dried grains with solubles (DDGS) were prepared with Neutrase and Alcalase, and the antioxidant activity of those hydrolysates in bulk oils, ground pork, canine pet food, and pig feed were evaluated by measuring oxidation stability based on peroxide value (PV) and thiobarbituric reactive substances (TBARS) value. Alcalase-hydrolyzed CGM (CPH-A) and Neutrase-hydrolyzed CGM (CPH–N) had stronger 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging activity than Alcalase-hydrolyzed DDGS (DPH-A) and Neutrase-hydrolyzed DDGS (DPH-N). The CPH-N showed better prevention on lipid oxidation in both corn oil and fish oil compared with other corn antioxidants. The best oxidation prevention in ground meat was observed with 2 g/kg of CPH-N. Lipid oxidation in pet food containing 2% DPH-A was efficiently retarded by 37.8% reduction at the end of the incubation, and TBARS value of pig feed containing 2% CPH-N was reduced the most compared with other treatments. However, there was no significant difference in growth performance and plasma antioxidant concentration between broilers fed with DDGS or Alcalase-treated DDGS. Overall, CGM and DDGS protein hydrolysates could potentially be used as naturally derived antioxidant in food, pet food, and feed systems with good protection efficiency for lipid oxidation to improve product storage stability.

PRO H&N First trials to assess the feasibility of grape seed powder (GSP) as a novel and sustainable bentonite alternative

Romanini, E., *et al.*, *Food Chem. 305*, 125484, 2020, https://doi.org/10.1016/j.foodchem.2019.125484.

Grape pathogenesis-related proteins can cause haze in wine that is undesirable for consumers. Bentonite is used to remove these proteins but is a non-renewable natural material and reduces wine volume due to poor settling. As a potential bentonite alternative, grape seeds powder (GSP) was added to four wines and two grape juice varieties. Addition to wine required high doses (25–32 g/L) for protein removal and haze prevention and this induced changes to wine composition. By contrast, addition to grape juice prior to fermentation required substantially lower doses of GSP (5 g/L) to prevent haze formation. Further 20 g/L of GSP added to the must induced less changes to wine composition than direct addition of GSP to the wine. No changes were recorded in the efficacy of protein removal by changing the GSP source (red or white grape marc), or by using grape seed roasting. Despite the need for additional trials, these preliminary results suggest that GSP may be considered as a viable alternative to bentonite especially when added to juice prior to fermentation.

PRO EAT H&N Influence of food matrix on the bioaccessibility of fruit polyphenolic compounds

Tarko, T. and A. Duda-Chodak, J. Agric. Food Chem. *68*: 1315–1325, 2020. https://doi.org/10.1021/acs.jafc.9b07680.

This study examined the bioaccessibility of polyphenolic compounds originating directly from fruits or from fruit extracts during their digestion conducted in a simulated human digestive tract. The results demonstrated that polyphenols bound to the food matrix are less bioavailable, but the type of food matrix plays an important role. Depending on the raw material, 14 to 58% of polyphenols present in fruit extracts were transferred to the supernatant, while in the case of polyphenols present in fruits, only 5–9% were transferred. Sediments obtained after *in vitro* digestion at the stomach and duodenum stage of fruit extracts contained virtually no polyphenols and demonstrated negligible antioxidant activity, whereas after digestion of whole fruits, the detected polyphenols constituted 5–44%. The intestinal microbiota were actively involved in the metabolism of polyphenols, mainly anthocyanins and glycosides remaining after the earlier stages of digestion.