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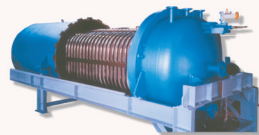
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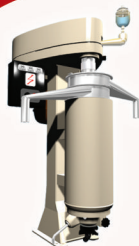
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April 2022

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INFORM

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Is it time to reconsider the role of saturated fats in the human diet?

Rebecca Guenard

- Dietary guidelines from multiple sources recommend people limit the amount of saturated fats in their diets.
- Some researchers say there is not a clear enough picture of how fats function in the body to assume saturated fats play a nefarious role.
- Recent findings on *in vivo* fat behavior indicate we need more science on saturated fats.

Do scientists have a clear or murky picture of the health risks associated with saturated fat consumption? That depends on who you ask.

According to the World Health Organization (WHO), “existing evidence suggests that the intake of fatty acids is a major determinant of the serum lipid and lipoprotein profile.” When measured through blood tests their values can determine a person’s risk for cardiovascular disease (CVD). Numerous epidemiological studies associate high amounts of total cholesterol and triglycerides with the disease. Moreover, studies have shown the effect is cumulative and large amounts of lipids in a young individual predict later incidence of CVD.

The extensive findings on the relationship between fatty acid intake and CVD supported the idea, particularly in the United States, that decreasing fat in the diet would result in a lean, healthy population. Public policy enforced this ideology for 40 years. In that time, rates of obesity and diabetes grew, prompting some scientists to question the basis for a low-fat diet.

Scrutiny of dietary fat research over the last two decades has revealed the importance of discerning between types of fat. As a result, the majority of health agencies around the world have banned trans-fatty acids as an artificial food ingredient. (Calculations in the US indicate that trans-fat bans reduced CVD mortality by 4.5% (<https://doi.org/10.1016/j.jhealeco.2015.09.005>).) Further analyses of research findings has also confirmed the health benefits of unsaturated fatty acids. The fate of saturated fats, however, still awaits consensus. Most guidelines recommend their consumption be limited, but some scientists question whether we have a clear enough understanding of the function of saturated fats in the body.

“I always circle back to the fact that the current dietary recommendations have been vetted,” says Penny Kris-Etherton, professor of nutritional sciences at The Pennsylvania State University in University Park, Pennsylvania, USA. “The Dietary Guidelines for Americans say there is strong evidence that saturated fats increase LDL cholesterol and that is a risk factor for CVD.”

CURRENT GUIDELINES

For the unfamiliar reader, dietary fats consist mainly of triglycerides—a molecule with three fatty acids attached to a glycerol backbone. The properties of the molecule depend on its fatty acid composition. The number and location of



their double bonds, as well as the length of their carbon chains distinguish fatty acids from each other.

Saturated fatty acids (SFA) have no double bonds, while monounsaturated fatty acids (MUFA) have one double bond and polyunsaturated fatty acids (PUFA) have two or more double bonds. The WHO says the most abundant SFA in the diet have 16 (C16:0; palmitic acid) or 18 (C18:0; stearic acid) carbon

atoms. Oleic acid (C18:1) is the most abundant MUFA and the most abundant PUFA are linoleic acid (C18:2n-6) and α -linolenic acid (C18:3n-3).

In 2016 Ronald Mensink, professor of molecular nutrition at Maastricht University, the Netherlands, conducted a systematic review of 84 dietary studies for the WHO to evaluate what happens to serum lipid and lipoprotein levels when

TABLE. 1. Major naturally occurring SFA. These fats are differentiated on the basis of their carbon chain length. The categories are not standardized, but tend towards short-chain (4 to 6 carbon atoms), medium-chain (8 to 12 carbon atoms), long-chain (14 to 20 carbon atoms), and very long-chain (22 or more carbon atoms). Source: Astrup, A. et al. *J Am Coll Cardiol.* 2020; 76(7):844-57.

Abbreviation	Common name	Chain length	Major Dietary Source
4:0	Butyric	Short	Dairy foods
6:0	Caproic	Short	Dairy foods
8:0	Caprylic	Medium	Dairy foods, coconut and palm kernel oils
10:0	Capric	Medium	Dairy foods
12:0	Lauric	Medium	Coconut milk and oil
14:0	Myristic	Long	Dairy foods
15:0	Pentadecanoic	Long	Red meat, dairy, oils
16:0	Palmitic	Long	Red meat, dairy, palm oil
17:0	Heptadecanoic	Long	Red meat, dairy
18:0	Stearic	Long	Dairy, meat, chocolate

MUFA, PUFA or carbohydrates replace SFA in the diet (<https://apps.who.int/iris/handle/10665/338049>). The researchers assessed total cholesterol, low-density lipoprotein (LDL) cholesterol, high-density lipoprotein (HDL) cholesterol, triglyceride, LDL cholesterol to HDL cholesterol ratio, total cholesterol to HDL cholesterol ratio, triglyceride to HDL cholesterol ratio, apolipoprotein A-I (ApoA-I) and apolipoprotein B (ApoB).

Mensink performed a multiple regression analysis and found that subjects had a more favorable serum lipoprotein profile when they increased PUFA and MUFA in a diet that still contained SFA instead of replacing it with a mixture of carbohydrates. He specified that partially replacing SFA with PUFA had a greater effect on lowering LDL cholesterol and triglycerides. When SFA intake remained below 10% of a subject's total energy intake, the individual maintained a desirable serum profile.

Based on Mensink's study which corroborates with many others, the WHO now indicates that maintaining cardiovascular health means reducing SFA intake to less than 10% of calories. Current US guidelines also advise this threshold, while the American Heart Association recommends that people limit saturated fat consumption to 5-6% of their energy intake. That percentage is equivalent to about 13 grams a day for a 2,000 calorie diet. In the United Kingdom, the recommendation is no more than 20 grams per day for women, 30 grams for men.

SFA DISTINCTIONS

However, there are aspects of reviews on dietary fat research that leave some scientists wondering if saturated fats really contribute to chronic disease. When researchers dig into the data to determine the effect of individual SFA on serum profiles they find that there are differences. Cholesterol and triglyceride levels can go up or down for fatty acids like, lauric (C12:0), myristic (C14:0) or palmitic acid, while studies show stearic acid has no effect. This SFA specific variation of serum lipid profiles has prompted some to question if we have a complete understanding of how SFA behave in the body.

Kris-Etherton says that concentrating on types of SFA diverts attention from the more relevant point. "What some people would say is that there are some SFA that are better than others, but it is important to point out that individual saturated fatty acids are not as good as unsaturated fats," she says. "Stearic acid may be neutral, but it is not as good as oleic acid and linoleic acid." Nevertheless, Kris-Etherton acknowledges there are interesting data to suggest we need to start paying attention to the food matrix.

"There is wider evidence that foods have different properties because of the rich mix of nutrients, vitamins, minerals, and phytochemicals which together make up what is called the food matrix," said Nita Forouhi, population health and nutrition professor at the University of Cambridge, School of Clinical Medicine, in Cambridge, England, UK, when interviewed by the online magazine *verywellhealth* (<https://tinyurl.com/yckvkr2u>).

THE COMPANY SFA KEEP

Last November, Forouhi and a team of researchers evaluated data from the European Prospective Investigation into Cancer and Nutrition (EPIC) study. They compared the dietary hab-

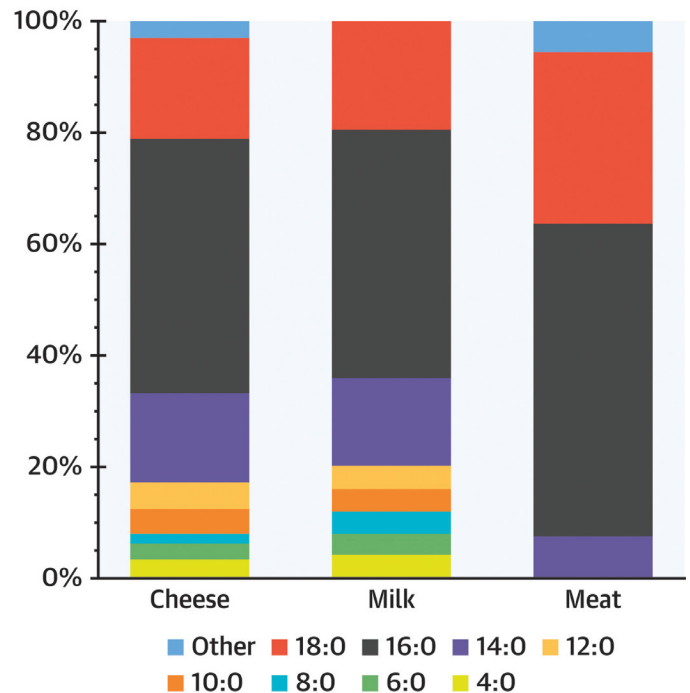


FIG. 1. Saturated Fatty Acid Profiles of Major Food Sources.

These data indicate that food sources contain saturated fatty acids in different proportions which leads to diverse physical and chemical characteristics and differing effects on various blood lipids and lipoproteins. Source: Astrup, A. et al. *J Am Coll Cardiol.* 2020; 76(7):844-57

its of 10,529 people in 10 European countries who developed heart disease against 16,730 people who did not (<https://doi.org/10.1161/JAHA.120.019814>).

After accounting for other factors that might influence heart disease like, age, sex, and lifestyle choices, such as smoking, Forouhi and her team found that total dietary fat intake did not determine a person's chance of developing heart disease. However, when they stratified the SFA by their food sources the team came to a different conclusion.

Nearly 80% of participants in the study consumed an excess of SFA, more than dietary guidelines recommend. Again, the high level of SFA alone did not represent a risk factor. Instead, they determined SFA from red meat and butter raised serum lipid levels in participants more than when they ate cheese, yoghurt, or fish. In their paper, Forouhi's team points out that fermented dairy generates Vitamin K and bioactive peptides, in addition to the probiotics that exist, which could counter the negative effects of SFA.

Forouhi acknowledges that her studies are observational and prohibit the assignment of a cause and effect. Based on the results of previous studies; however, a growing body of research does support some of her findings. The isomer composition of an SFA seems to influence its *in-vivo* behavior, with odd-chain SFA affecting serum lipids differently than even-chain SFA. Eating palmitic acid, for example, has been shown to increase blood cholesterol levels while pentadecanoic acid (C15:0) consumption may lower the risk of heart disease (<https://tinyurl.com/4r95by8x>). The former is more often found in red meat, the later in dairy. (For more on odd-chain fatty acids see *INFORM*, Oct 2021, <https://tinyurl.com/42weebmz>)

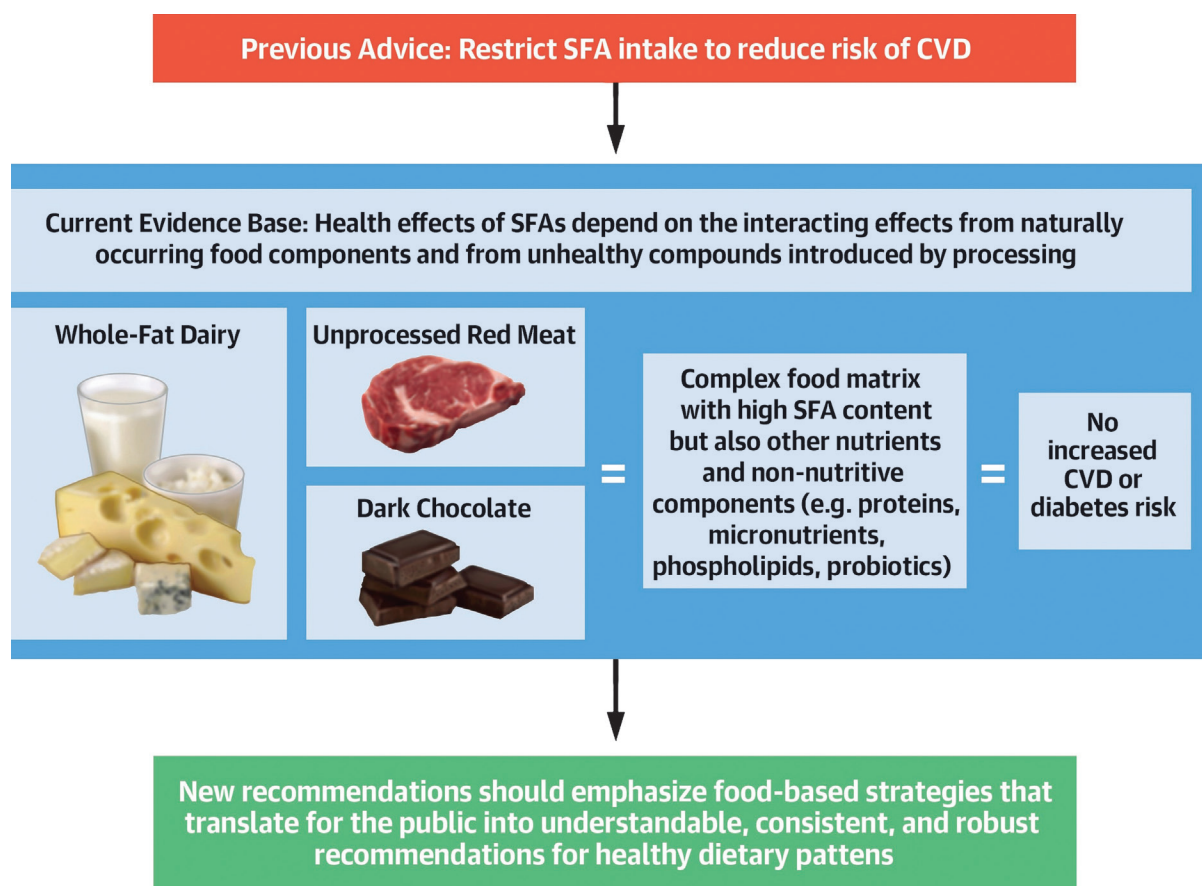


FIG. 2. Some researchers are arguing that the latest data dietary guidelines should be updated from a focus on limiting saturated fats to guidelines that educate the public on how to choose healthy foods. Source: Astrup, A. et al. *J Am Coll Cardiol.* 2020; 76(7):844-57

One research team argues that conjuncture based on observed associations does not sufficiently explain the role of SFA. Marit Kolby (formerly Marit Kolby Zinöcker), assistant professor of nutrition at Oslo New University College, in Oslo, Norway has proposed that studying short-term changes in serum lipid profiles does not provide an adequate understanding of dietary fats in the body throughout a lifetime.

A NEW HYPOTHESIS

Like many researchers, Kolby is eager for direct evidence of a molecular mechanism that explains cholesterol's role in developing CVD. In a paper published in *The American Journal of Clinical Nutrition* last year, she argues that no current models explain the response of serum lipoprotein levels when altering dietary fatty acids (<https://doi.org/10.1093/ajcn/nqaa322>). Instead of being a pathogenic process, Kolby's team proposes serum changes could be part of cellular regulation of cholesterol in order to maintain homeostasis.

Kolby wanted an explanation for the association between SFA consumption and observed increases of LDL cholesterol in blood. "To me it was logical to start by looking at cells and membranes, because most of the body's cholesterol is contained in membranes not in the blood," she says. "I started looking for evidence that changes in intake of dietary fatty acids would affect regulatory mechanisms for cholesterol content in cell membranes."

According to Kolby's hypothesis, eating PUFA results in cell membranes that are fluid and require cholesterol from the blood to introduce stiffness into the membrane. Whereas, eating saturated fats leads to membranes that require less stabilization by cholesterol which instead flows into the blood stream. She presumes cholesterol in the bloodstream could be acting as a reserve to fortify cell membranes as needed (<https://tinyurl.com/47sbjdx>).

"It is possible that inflammation—in concert with other metabolic abnormalities, like insulin resistance—causes an increase in blood cholesterol due to dysfunctional lipid uptake and/or metabolism," says Kolby. This would provide an alternative explanation for why high cholesterol leads to heart disease. Eating whole foods instead of ultra-processed foods, moving enough, sleeping enough, stressing less, and keeping good social relations to avoid chronic inflammation is more important than avoiding saturated fat, she says.

Time, and more research, will tell if Kolby's hypothesis has clout, but findings in other areas of lipids research indicate we may be misunderstanding how the body uses fat stores.

EMERGING IDEAS

There is other evidence that stockpiles of lipids do not necessarily mean a sign of disease. In the September 2021 issue of *INFORM* magazine, we reported on a research group led by Alex Gould at The Francis Crick Institute in London, UK, using

Tracking cholesterol's movement

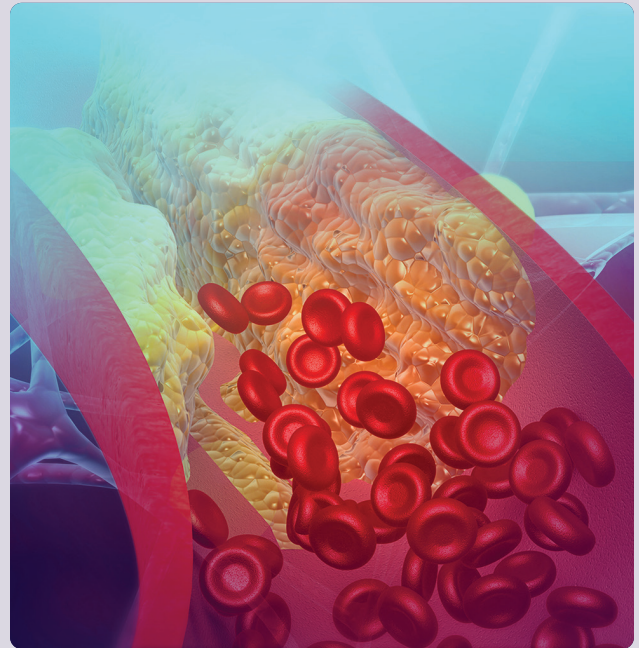
A research collaboration between Stanford University School of Medicine in Stanford, California, USA and the University of Barcelona in Barcelona, Spain has resulted in identifying the mechanism responsible for transporting cholesterol from organelles within cells. The researchers say their results could contribute to developing future treatments against pathologies caused by dysfunctions in the intracellular cholesterol transport. The findings also shed light on the function of cholesterol within the human body.

For the most part, the cholesterol that cells use comes from the blood, reaching the lysosomes where it is distributed to different intracellular compartments. However, there are still unsolved questions related to the precise molecular events that regulate the exit of cholesterol from this organelle and its transport towards the membrane and the cell endoplasmic reticulum.

For cells to maintain homeostasis it is important that an adequate supply of cholesterol flows in and out of lysosomes regularly. Carles Enrich, a biomedicine researcher at the University of Barcelona, and his collaborators determined which transporters were responsible for assisting cholesterol with its exit from lysosomes. "This process requires the coordinated action of NPC1 and NPC2 transporters together with the bis(monoacylglycero)phosphate (BMP) lysosomal lipid to mobilize and export free cholesterol," says Enrich in a press release for the publication of the findings in the *Journal of Cell Biology* (<https://doi.org/10.1083/jcb.202105060>).

Disorders such as Niemann-Pick type C disease are due to mutations in the lysosomal cholesterol transporters NPC1 and NPC2. The disease (currently without a cure) prevents cholesterol and other fats from being metabolized normally, eventually causing liver, spleen and brain damage.

In order to identify the genes that alter intracellular cholesterol or BMP levels, the researchers conducted two genome-wide CRISPR screenings—one under normal con-



ditions, the other with the NPC1 proteins blocked. "Our genetic screenings identified a high number of genes involved in the cholesterol and BMP metabolic regulation, whose role was unknown to date. In addition, we confirmed a tight correlation and regulation between the levels of these lipids," said Albert Lu, another University of Barcelona researcher on the team.

One of the molecules involved in this process is SNX13, a protein in the endoplasmic reticulum that negatively regulates the exit of cholesterol from lysosomes to the plasmatic membrane, thus reducing the amount of the lipid. "Given the lack of the function of NPC1, the reduction of SNX13 caused a redistribution of lysosomal cholesterol towards the plasmatic membrane, which indicates that SNX13 could be an important regulator in this cholesterol transport pathway," Lu says.

the *Drosophila* fruit fly to study lipid droplets (<https://tinyurl.com/ybndrb8>). Once considered pathogenic themselves, the tarnished reputation of lipid droplets may soon shine.

"The fact that they correlate with a disease does not mean they are causing that disease. Our work suggest that lipid droplets are actually one of the body's ways of fighting back against the disease," Gould told *INFORM* last year.

Lipid droplets were initially determined to serve as mere energy reserves, inertly waiting to provide a cell with fuel. But Gould discovered that they also perform an important role of protecting PUFAs during oxidative stress (<https://doi.org/10.1016/j.cell.2015.09.020>).

He found that the droplets encapsulated dietary linoleic acid, for example, to prevent free radical formation and preserve vital PUFAs during cell development.

More recently, the researchers focused on surface proteins on lipid droplets within renal cells to understand their involvement in kidney disease. When they turned the genes that generate the enzymes that synthesize or digest triglycerides on and off, the team observed an effect on the fly's cell health. The group ultimately concluded that when fruit flies feed on a high-fat diet, the renal cells protect the kidneys

from damage by sequestering lipids into droplets (<https://doi.org/10.1371/journal.pbio.30012302021>).

In January, a different research group observed another unique service role that lipid droplets provide. Animal science professor Shihuan Kuang and his postdoc Feng Yue at Purdue University in Lafayette, IN, USA discovered that fat inside adult muscle stem cells determine how the stem cells behave (<https://tinyurl.com/5tzrefkr>).

When adult muscle cells are injured, latent stem cells become active to repair the injury. Lipid droplets accompany the stem cells when they arrive at the injury site. The researchers determined the cells could differentiate into two types of cells: muscle cells that repaired damage and self-renewal cells to resupply the used stock. Kuang says the lipid droplets somehow maintain a healthy balance of cells. When there are more droplets around, the stem cells continue to divide. To keep the stem cells from dividing uncontrollably, as happens with cancer, the cells seem to deplete themselves of the droplets and return to a dormant state (<https://tinyurl.com/bdzcehx3>).

As new research on the good deeds conducted by lipid droplets continue to unfold, we have to remind ourselves not to draw any connections to human dietary choices. The experiments have only been conducted on cells and animals, thus far. However, these studies reveal that fat plays a more complex role in cellular function than we realize.

“For the scientists who say: ‘There are problems with the evidence.’ We should get more science and resolve some of the controversies,” says Kris-Etherton. “I tell people, pay attention to authoritative recommendations right now. That is the best thing we can do.”

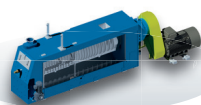
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Attend the 2022 AOCS Annual Meeting & Expo session on Health & Nutrition chaired by Matthew Picklo to learn more on the topic of saturated fats.

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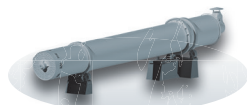
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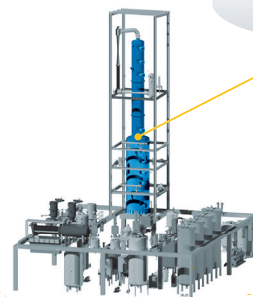
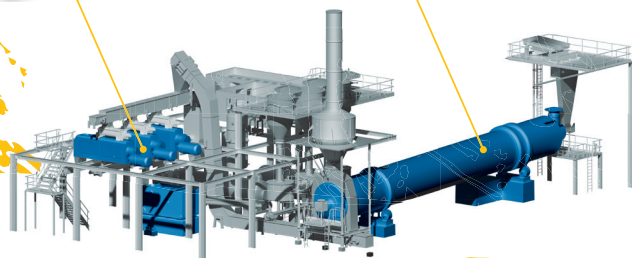
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Take a food science side trip

Jordan Powers and Jennifer Reynolds

Whether using drone technology and precision agriculture to dial in on crop yield or examining the interaction of social, economic and institutional factors on the production and distribution of goods and services, the University of Georgia (UGA) College of Agricultural and Environmental Sciences (CAES) is working to ensure the production of nutritious, safe and sustainable foods, the health of our planet and the well-being of the people on it.

- After two years exclusively online, the AOCS Annual Meeting and Expo will be in-person once again with livestreaming and recorded content also available. Register to attend!
- While you are in Atlanta, Georgia eat some barbecue at Rodney Scott's and try the Olive Oil gelato at Ecco restaurant.
- Most importantly, schedule a trip to nearby University of Georgia where one of AOCS's highly honored researchers, Casimir Akoh, conducts research. Read on to learn about some of the latest food science research taking place there.

A LEADER IN FOOD SAFETY RESEARCH

Including the Department of Food Science and Technology, CAES has nine academic departments, a plant breeding institute, and multiple centers, including the Center for Food Safety (CFS) and the Food Product Innovation and Commercialization Center (FoodPIC).

UGA founded CFS in 1992 to promote food safety and its role in protecting the agricultural system.

Since that time, CFS has been a leader in multidisciplinary, innovative research to improve the safety of food. CFS researchers develop ways to detect, control, and eliminate harmful microorganisms and their toxins from the food supply.

Located about 35 miles south of Atlanta on the UGA Griffin campus, CFS's state-of-the-art facilities enable faculty to conduct cutting-edge research in food safety. The expertise within CFS is broad and involves every stage of the food supply chain, from the growing fields and harvesting barns to consumer plates.

FACILITATING COMMERCIALIZATION OF CONSUMER-ACCEPTED FOOD PRODUCTS

FoodPIC was initiated by the faculty of the Department of Food Science and Technology. It is internationally recognized for the development of innovative food products and discovery, and for the implementation of cutting-edge science and technology.

The center forms a strategic alliance with external marketing, technology and engineering groups to help food companies take a new product from conception, through consumer research, formulation, prototyping, shelf-life analysis, and market launch. The center is guided by reliable consumer preference analysis and driven by client food company profit goals. It has a fully established international network of contacts and databases with which it serves new and established food companies.

FoodPIC is located at UGA Griffin, approximately 30 miles south of the Hartsfield-Jackson Atlanta International Airport.

FoodPIC, CFS and the Department of Food Science and Technology at CAES enable dozens of researchers to carry out studies that affect food systems worldwide. Here are four researchers and their current projects.



XIANGYU DENG, ASSOCIATE PROFESSOR, CENTER FOR FOOD SAFETY

Xiangyu Deng and his team are a group of microbiologists dedicated to improving food safety, working in the interdisciplinary areas of microbiology, public health and agriculture. Dealing with tens of thousands of bacterial genomes *in silico* as well as single bacterial cells *in situ*, they have two main areas of interest: agricultural and food microbiomes, and genomic epidemiology.

Within the arena of genomic epidemiology, Deng tracks foodborne pathogens from farm to table using large data sets and a data science approach, including finding the source of global spread of *Salmonella* Enteritidis and using machine learning for *Salmonella* source attribution.

Salmonella, a bacterium that causes roughly 1.35 million infections annually in the United States according to the US Centers for Disease Control and Prevention (CDC), is often a source of foodborne outbreaks. For more than six decades, public health surveillance of *Salmonella* in the US and worldwide has been built upon classifying different strains according to their distinct surface structures, or serotypes. There are more than 2,600 different serotypes of *Salmonella*. Traditional methods of determining *Salmonella* serotypes are cumbersome or limited in scope, often only identifying a limited number of serotypes, but now anyone can determine the serotype



of *Salmonella* in seconds thanks to software tools developed by Deng's laboratory and collaborators.

Called SeqSero2, the bioinformatics software determines *Salmonella* serotypes using whole genome sequencing data.

"SeqSero2 has been used globally and validated by agencies such as the CDC, US Department of Agriculture and Food and Drug Administration," Deng said. "It has been incorporated into the Pathogen Detection database by the National Center for Biotechnology Information (NCBI), which makes serotype prediction available for nearly every *Salmonella* genome in the public domain."

It is also the first software tool to be approved for inclusion in the FDA's Bacteriological Analytical Manual known as BAM. BAM is considered by many to be the gold standard of laboratory procedures in microbial food safety.

MELISSA MITCHUM, PROFESSOR, DEPARTMENT OF PLANT PATHOLOGY

At her lab on UGA's Athens campus, Melissa Mitchum and her team are conducting research to understand how microscopic plant-parasitic roundworms called nematodes cause disease in soybeans, which leads to more than \$1 billion in annual yield losses. The nematodes infect soybeans by releasing secretions (spit) through a hollow mouth spear into the root tissues to establish feeding sites. Mitchum's lab



attempts to understand what types of molecules are in the nematode spit and how they cause disease on their host so that they can use the information to develop novel strategies to stop infection by interfering with this process.

Some soybeans are naturally resistant to these nematodes. Mitchum and her collaborators are working to identify the genes in the resistant soybean plants that confer resistance to these nematodes and determine how they function with an end goal to possibly engineer novel types of resistance or modify these genes to enhance their durability. Nematodes, like other pathogens, are good at evading and overcoming resistance genes. The researchers also work closely with soybean breeders and seed-industry partners to develop and release nematode-resistant soybean varieties.

"I am thrilled to have the ability to translate research discoveries into solutions to help soybean growers manage soybean cyst nematode and root-knot nematodes—the two most economically important groups of plant-parasitic nematodes," Mitchum said.

ANAND MOHAN, ASSOCIATE PROFESSOR, DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY

Recent scientific findings in Anand Mohan's research lab have demonstrated that the lipid oxidation byproduct 4-oxo-2-nonenal (4-ONE) tends to accumulate over time in fresh meats and is highly toxic compared with other oxidation species found in oxidized beef. More importantly, 4-ONE is known to cause oxidative deterioration of meat proteins, including some key metabolic enzymes and subcellular organelles such as mitochondria. Mohan's team has published research articles in peer-reviewed journals revealing for the first time that 4-ONE is a novel toxic chemical species that forms during the storage of meat and is known to cause meat-quality deterioration that impacts human health.

His recent research has focused on the oxidative pathology of 4-ONE and developing methods to detect the formation of 4-ONE in fresh meat. More importantly, Mohan is actively pursuing strategies to understand the molecular interaction of 4-ONE and meat proteins and their influence on protein functionality and digestibility. The 4-ONE-induced oxidized meat proteins may have pathological consequences in the human gut. It is currently unknown how 4-ONE induces protein oxidation or the potential health implications of ingested oxidized proteins. Mohan aims to find solutions to prevent the formation of 4-ONE in meat using novel food ingredients.

"I am most excited about working for a highly ranked food science department in the US and the world alongside world-renowned food scientists," Mohan said. "Our students are highly talented and respected future food science leaders, and they do excellent research while pursuing their higher degrees here. Being a food scientist, I am always excited to learn about many different foods, and the most exciting part—I get to taste them. My product development research has led to many new products, such as maple-flavored quail sausage,

food flavoring from food waste, shelf-stable meat powder from meat-animal offal and country-style lamb ham."

CHAD PATON, ASSOCIATE PROFESSOR, DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY



Chad Paton's research focuses on the bioactive properties of two specific lipids—dihydrosterculic acid (DHSA) and linoleic acid. DHSA is a cyclopropene fatty acid that blocks endogenous lipid and cholesterol production and is found naturally in cottonseed oil. Paton is actively pursuing methods to assess its ability to treat hyperlipidemia and hypercholesterolemia in animal and human models.

Paton's work in the bioactive properties of linoleic acid has centered on its role in modulating skeletal muscle development and metabolic function, looking at the role of linoleic acid in promoting age-related declines in skeletal muscle mass (sarcopenia). As a long-chain omega-6 polyunsaturated fatty acid, it promotes DNA transcriptional activity by promoting protein-DNA interactions that impair muscle stem cells from differentiating into mature skeletal muscle. The purpose of Paton's research is to help restore normal metabolic function in disease states using molecular biology and biochemistry to understand how lipid metabolism is regulated in cell and animal models.

"I appreciate studying the unique biology of free fatty acids and how they can differentially impact mammalian cell physiology. The more we learn about lipid-composition and its unique effects on cell function, the better we can understand how diet impacts human health and well-being," Paton said.

AOCS MEETING WATCH

May 1–4, 2022. AOCS Annual Meeting & Expo, Hyatt Regency Atlanta, Atlanta, Georgia, USA and Online.

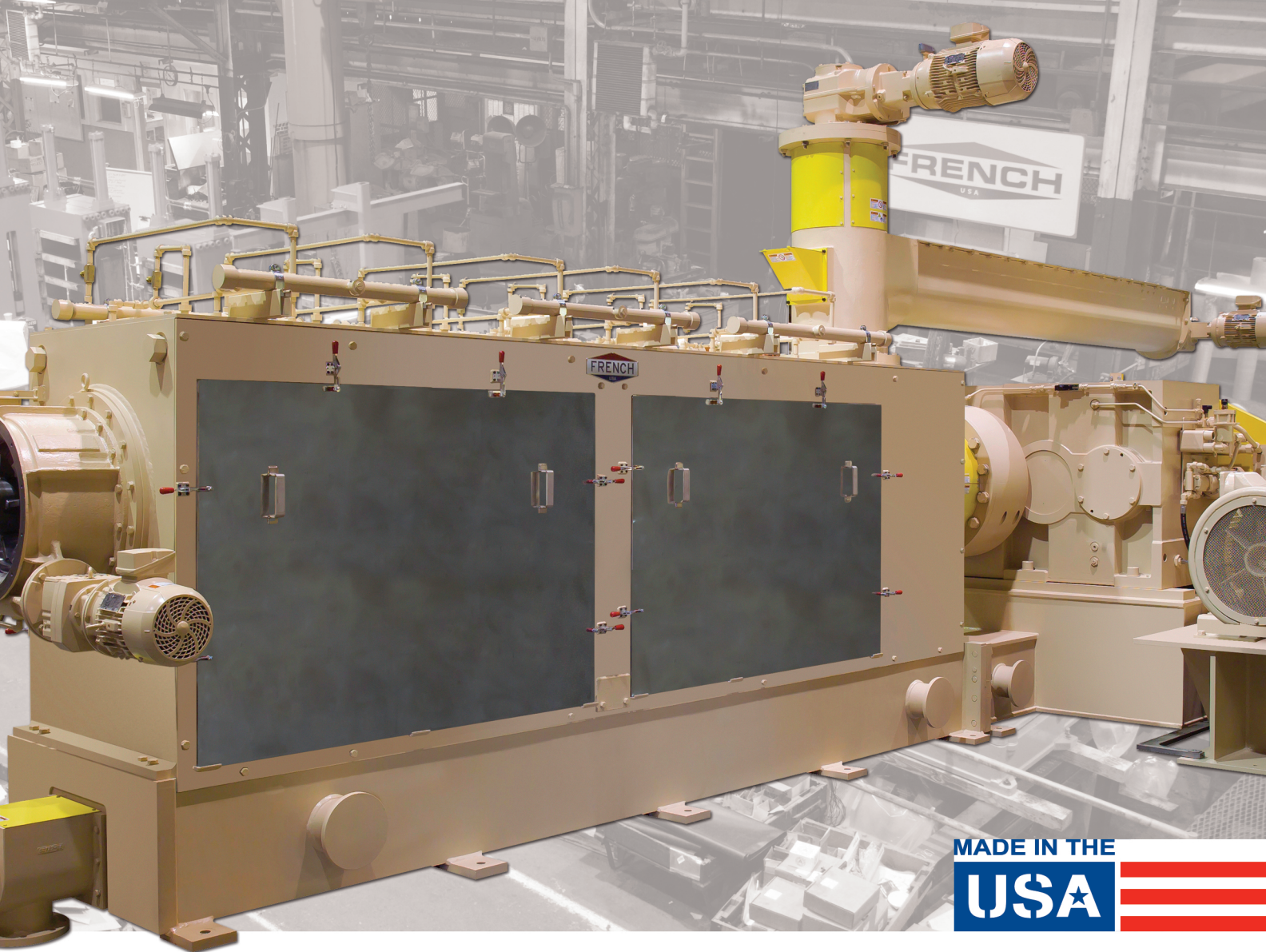
July 31–August 3, 2022. Edible Oil Products Processing Course, Fats and Oils R&D Center LLC, College Station, Texas, USA. (<https://fatsandoilrnd.com/annual-courses/>)

October 4–6, 2022. Sustainable Protein Forum, Millennium Knickerbocker Hotel, Chicago, Illinois, USA and Online.

August 27–September 1, 2022. World Congress on Oleo Science, hosted by the Japan Oil Chemists' Society, Online. (<https://jocs.jp/en/conference-meeting/>)

April 30–May 3, 2023. AOCS Annual Meeting & Expo, Colorado Convention Center, Denver, Colorado, 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: +1 217-693-4831).



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Meet AOCS's next president

SILVANA MARTINI WILL TAKE OFFICE AS AOCS PRESIDENT AT THE 2022 ANNUAL MEETING & EXPO IN ATLANTA, GEORGIA. *INFORM* PUT TOGETHER THIS BRIEF INTRODUCTION TO HELP YOU GET TO KNOW HER BETTER.

Leaving a metropolitan town in Latin America to relocate to a place with a completely different culture in the Northern Hemisphere requires a sense of adventure. But then, Silvana Martini is the type of person inclined to spend a week camping in the desert with her husband, Steve, and their three Belgian Malinois—Tika, Alchemist, and Loki.

Raised in Lomas de Zamora, one of the most populous districts in the greater Buenos Aires region of Argentina, Martini discovered her love of chemistry as a high school student. “I had a very good chemistry teacher,” she says. “It was evident from the beginning that I loved chemistry!”

Martini earned a Bachelor of Science in biochemistry with a minor in chemistry from the University of La Plata in Buenos Aires. At the time food science degrees were not common, she says, but fate would guide her to her future career.

A nearby research institute associated with her university offered a food science course that Martini took in her final year. She became engrossed in the subject and volunteered with the professor to study the crystallization of waxes, fundamental food science research that she would continue as a doctoral candidate.

Martini says her favorite memories from graduate school were making friends and attending conferences, like the AOCS annual meeting. “Preparing for the meetings, making proper travel arrangements, designing the posters, practicing oral presentations in a language that is not my native language, feeling butterflies in my stomach before giving a lecture—all this was very exciting and brings back good memories,” she says.

After spending two years in the department of food science at the University of Guelph in Guelph, Ontario, Canada for a postdoc, she joined the department of nutrition, dietetics, and food sciences at Utah State University in Logan, Utah, USA where she is now a full professor.

Martini is a self-proclaimed research addict. “I like that every day is different,” she says. “Every day you face new challenges.” The independent research program she built gives her a sense of pride and she is grateful for the support of her peers and the hard work of her students.


An AOCS member since 1999, Martini says she offers her time to the Society because it is like a family and she is happy

to give back to an organization that has given a lot to her. “I have learned so much thanks to AOCS—in the annual meetings, with the journals, volunteering as a reviewer and then being part of the editorial board. AOCS helped me build my professional network and create friendships that have lasted for a long, long, time.”

Martini says, she always looks forward to attending the ceremonies during the AOCS annual meeting and getting to know the new president. Pamela White’s ceremony is prominent in her memory, since seeing a female president was unique. She and Casimir Akoh went on to become collaborators, so his ceremony sticks in her mind. This year it is Martini’s turn.

“All the Presidents are so approachable and friendly. This is one of the things that I like the most about the AOCS community: Everybody is very approachable and friendly, no matter what their role is within the AOCS organization,” she says.

“With the support of the Governing Board I would like to continue growing AOCS by increasing the number of members and by understanding what the society can do to better serve our members. Our members are so diverse: from industry to academia, longtime professionals and young students, from interests in edible fats to proteins, biodiesel, and processing. It is hard to meet everybody’s expectations, but we are working very hard on it.”



“WITH THE SUPPORT OF THE GOVERNING BOARD I WOULD LIKE TO CONTINUE GROWING AOCS BY INCREASING THE NUMBER OF MEMBERS AND BY UNDERSTANDING WHAT THE SOCIETY CAN DO TO BETTER SERVE OUR MEMBERS.”

Silvana Martini

Sunflower oil

and the conflict in Ukraine

Rebecca Guenard

Russia amassed troops along the Ukrainian border in January disrupting economic activity across Western Europe, the Middle East, and South Asia. As a result, prices for a range of goods have fluctuated depending on whether greater conflict in the region provoked buyers to look elsewhere for supplies or they decided to stockpile them. The turmoil has buyers of vegetable oils particularly rattled.

- Two-thirds of the world's sunflower production occurs in a region currently engaged in conflict.
- The increased presence of Russian troops at Ukraine's boarder has already disrupted the export of goods from the Black Sea region.
- Further conflict between the two countries will undoubtedly result in edible oil importers in the region seeking other sources.

"If the Russia-Ukraine tension escalates, then sunflower oil will go through the roof," said Gnanasekar Thiagarajan, head of trading and hedging strategies at Kaleesuwari Intercontinental, in an interview with Bloomberg. In fact, it will push up prices for all edible oils, he said.

Sunflower is the third largest oilseed crop in the world after soybean and rapeseed (<https://doi.org/10.1051/ocl/2020028>). The popularity of sunflowers comes from its versatility as an oil, seed, and livestock feed. A global focus on improving health along with sunflower's reputation as a beneficial snack, has lead some experts to label it as one of the world's most essential crops.

According to one recent news source, Russia and Ukraine produce almost 80% of the world's sunflower oil, for sale largely in China and India. Last year, India bought 1.89 million tons of the crude sunflower cooking oil and three-quarters of it shipped from Ukrainian ports (<https://tinyurl.com/2p8dcwcn>).

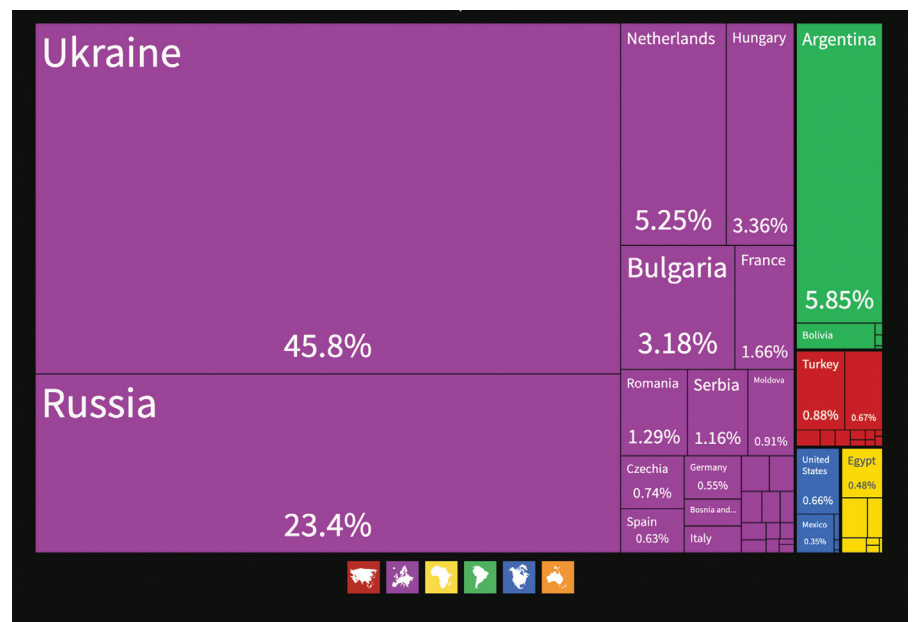


FIG. 1. Crude sunflower seed exports from Europe. Source: oec.world.



BREEDING TRENDS

Wild sunflowers were first used as food by Native Americans in the eastern United States. They were eventually domesticated in the 16th century and spread throughout Europe. However, the sunflower did not succeed as a crop until it reached Russia where it was quickly adapted to produce more oil (<https://tinyurl.com/m9mydeyn>). In 1912, a scientist named Vasily Stepanovich Pustovoit conducted field research at the then recently established All-Russia Research Institute of Oil Crops (VNIIMK) where he focused on breeding sunflower as an oil seed crop (<https://en.vniimk.ru/about/>).

The crop continues to be a mainstay in this area of the world with new varieties established specifically for both oil and non-oil uses. In particular, a growing market demand for confection sunflower (Table 1) has led to dedicated breeding programs like the one at the Institute of Field and Vegetable Crops (IFVCNS) in Serbia. By contrast, in the US, high oil content of oilseed sunflower has always been the major breeding objec-

tive and breeding for non-oilseed production ranges from only 10–25% of total production (<http://www.usda.gov/nass>).

A recent article by Jiujuan Feng at the Institute of Sunflower Technology in Bayannur, China, states that the non-oil sunflower seed type has an oil content of 35% or less and protein content of 25–30%. Oilseed sunflower has an oil content of 50–55%, and relatively low protein content at 16–19%. Sunflower oil's high polyunsaturated linoleic fatty acid concentration and low linolenic acid content has led to it gaining a reputation as a healthy oil product (<https://doi.org/10.1051/ocl/2022004>).

SUNFLOWER OIL TRADE

Ukraine is currently one of the world's main producers of sunflower seed and sunflower by-products, producing 24% of global sunflower seed. The country ranks second, after Russia, in sunflower planted areas with 21% of total world sunflower planted area. Compared to other crops, Ukrainian farmers especially value sunflower because their seed products are

TABLE 1. Areas dedicated to confection sunflower planting in the major producing countries as a result of increased focus on this market. Source: Feng, 2022.

Country	All types (M ha)	Confection type (ha × 10000)	Percentage of confection type (%)	References
Russia	8.50	100.00 ²	12	Demurin (2018)
China	0.59	56.00	95	Zhang (2020)
Ukraine	6.40	19.00	3–5	Hladni and Miladinović (2019)
Turkey	0.78	9.82	12	Tan and Kaya (2019)
USA	0.56	6.27	11	USDA and NASS (2018)
Argentina	1.86	3.00	2	<u>Castaño (2018)</u>
Serbia	0.22	1.15	5–10	Terzić <i>et al.</i> (2017); Hladni and Miladinović (2019)
Spain	0.70	0.70	1	Estimated

relatively inexpensive to produce while holding high value as export commodities.

“Before this tension between Russia and Ukraine, we would have stock [of sunflower oil] in hand for 75 days. Now we have increased it to 100 days. As things stand today, we have stocks till March end. We are hoping that the Russia-Ukraine issue will be sorted out before the stock comes to an end,” said Angshu Mallick, managing director of Adani Wilmar in New Delhi, India, to *The Economic Times* (<https://tinyurl.com/bddydxwk>).

A potential supply shortage has prompted some fast-moving consumer goods companies in the region to stockpile sunflower oil, ensuring they could meet consumer demand for the first quarter of 2022.

In January, Pradeep Chowdhry, managing director for Gemini Edibles & Fats in Telangana, India, told *Bloomberg* “We have covered ourselves till April as far as sunflower oil is concerned. The major problem right now is that ships are not being able to move as the sea route is completely frozen. If the tension escalates, we are not sure whether sunflower oil will at all come or not. In that case, the supply side will dry up soon.”

Buyers in India are particularly concerned because of growing consumer interest in sunflower oil in the country. Import records show that although the majority of edible oil shipped to India is still palm and soybean, more sunflower oil is being imported each year (<https://seaofindia.com>). In 2022, sunflower oil demand in India is expected to rise to 2.5 million tons.

ADDITIONAL ECONOMIC WOES

Of course, edible oils are not the only commodity causing concern. The Europe Union imports nearly 40% of its natural gas from Russia (<https://tinyurl.com/mphr8km4>). Like other countries around the world, these European nations use natural gas in place of petroleum-derived sources to heat homes and generate electricity while in search of options with even lower environmental impact.

Some analysts fear there is too much dependance on Russian for energy across Europe. Germany currently gets half of its natural gas through a pipeline in the Baltic Sea known as Nord Stream. Russia has just spent \$11 billion to complete Nord Stream 2, a second pipeline that was built to bypass the existing network that runs through Ukraine. When it opens, Ukraine will lose revenue from transit fees that are crucial to its economy. Increased reliance on Russia for energy has many world leaders concerned about a simultaneous increase in a tolerance of Vladimir Putin’s threats to invade Ukraine.

In recent years, Russia has pushed up its natural gas prices, resulting in some countries already seeking secondary sources. Liquefied natural gas (LNG)—a product cooled to 127 degrees Celsius below freezing for shipping—is becoming an option for countries trying to limit their supply of natural gas from Russian. Imports of LNG have been increasing across Europe since the beginning of 2022 (<https://tinyurl.com/5xd9jpd>).

Most experts believe Russia has invested too much in future oil and gas contracts, and depends too heavily on current exports to risk its economic security with a war in Europe. However, the

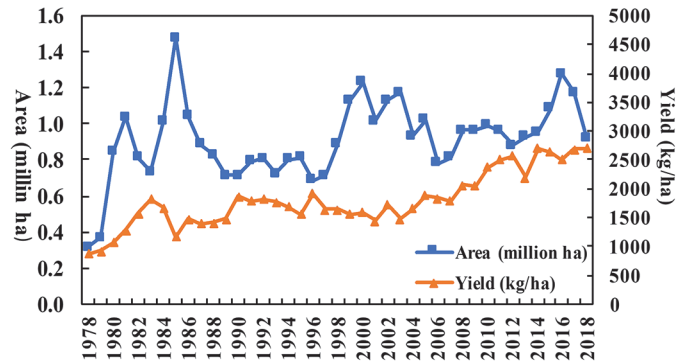


FIG. 2. Growing consumer interest in sunflower confectionary in China has led to an increase in acreage of the crop there.

Source: Feng, 2022.

past few months have shown that Putin does not need to advance into Ukrainian territory to affect global markets.

A fear of disruptions to port activity resulted in buyers dropping out of the market on goods shipped from the Black Sea in search of more secure purchase agreements. Russia and Ukraine export 30% of the world’s wheat and 20% of its corn (<https://tinyurl.com/bdcu6hz2>). As a result, Ukrainian wheat trading companies report difficulty securing shipping sales past the first quarter of the year and prices swing with the ups and downs of news on the conflict. Although business is slower than usual, traders are cautiously proceeding to do business with the two countries while eyeing other sources for grains and vegetable oil.

Indian buyers indicate they are looking to Argentina to import sunflower oil if an escalation in tension eliminates Black Sea supply lines. However, a drought in South America has resulted in a smaller crop of grains and oil seeds this year. If fighting does break out, increased demand for the lower than usual crop production will likely drive up import costs at a time when inflation is already a burden to consumers worldwide.

As of press time, a parade of world leaders have visited Putin, imploring he choose diplomatic resolutions over hostile measures. The United States has sent thousands of troops to Poland to assist with evacuations on Ukraine’s eastern border. Germany has stopped the certification of the Nord Stream 2 natural gas pipeline. Western leaders are imposing sanctions on Russia for entering separatist territories in eastern Ukraine. No one is certain what will happen next.

Rebecca Guenard is the editor-in-chief of INFORM at AOCS. She can be contacted at rebecca.guenard@aoacs.org.

CONTINUE THE CONVERSATION

Since going to press, loss of sunflower oil supplies from the Black Sea after a Russian invasion have prompted India to buy more palm oil from Indonesia, driving up prices. Go to [inform|connect](#) to continue the conversation where *INFORM* left off.



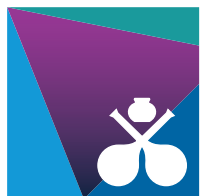
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Global PFAS regulations

Geraint Roberts

Environmental groups like Greenpeace first started campaigning against polyfluoroalkyl substances (PFAS) ten years ago. The Helsingør and Madrid Statements – expressing concern about the market shift from long-chain to short-chain and polymerized PFAS – were signed by hundreds of scientists in 2014. Four years later the Zurich Statement, again published by eminent scientists, called for PFAS to be controlled in groups rather than individually and urged that ‘non-essential uses’ should be gradually phased out. This call was echoed in 2019 by the European Council of Ministers and was included the following year in the European Union’s chemicals strategy for sustainability.

- Polyfluoroalkyl substances (PFAS) are a group of man-made compounds used in industrial and commercial products known to persist in the environment.
- The compounds are so widespread that regulatory agencies globally are trying to decide how to make sure PFAS are used safely.
- Due to the large variety of compounds, regulations are complicated.

PFAS are used in a huge variety of products and industrial applications, including: polymerization aids in fluoropolymers production, surfactants in firefighting foams, anti-mist agents in chromium plating, as well as water-and oil repellency in textiles, leather, food contact materials, and cosmetics. They are also used in the production of components for semiconductors and medical devices, as co-formulant in plant protection products, biocides, feed additives, pharmaceuticals, and in paints and printing inks.

In fact, there are more than 4,700 per- and polyfluoroalkyl substances (PFAS). Their properties and uses vary considerably with scientists expressing greater concern about long-chain PFAS than short-chain varieties or fluoropolymers.

WHAT ARE THE RISKS OF PFAS EXPOSURE?

Although relatively few PFAS have been studied in depth so far, the European Environment Agency (EEA) says most are considered to be toxic and persistent, or highly persistent. Health effects, it says, can include:

- thyroid disease
- effects on reproduction and fertility
- immunotoxicity
- liver damage
- kidney and testicular cancer

The European Food Safety Authority (EFSA) has warned that the long-chain PFAS chemicals perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS) are linked to reduced antibody response to vaccination, including Covid-19 jabs. Persistent, and in some cases mobile, PFAS have contaminated drinking water and are found in human bodies, where some can bioaccumulate.

Regulatory agencies face the challenge of assessing and managing such a vast number of compounds in myriad applications. Regulation of PFAS individually, or even in small groups, would be impracticable.

Take bisphenols, for example, which are largely used to make epoxy resins and polycarbonate. The most well-known is the substance of very high concern (SVHC), bisphenol A (BPA). However, around a dozen others are registered under the European Commission’s program known as REACH (Registration, Evaluation, Authorization and Restriction of Chemicals), including the BPA substitutes bisphenol



S and bisphenol F. Because of the risk of regrettable substitution of BPA, the German authorities are preparing a restriction proposal that will encompass the whole group.

Another similar-sized group of substances of concern is low molecular weight phthalates. Sixteen of them are on the REACH candidate list because of their reprotoxic properties. With the EU chemicals strategy for sustainability promising that future restrictions will take a grouping approach, these are a prime candidate for such action.

PFAS as a whole would represent a group around 300 times the size of either of these examples. How are regulators considering grouping these compounds?

REGULATORY TRENDS

The last few years have seen a growing number of governments pass legislation to regulate PFAS and several trends are emerging.

Rather than targeting one or two PFAS chemicals, such as PFOA or PFOS, most are taking a grouping approach and either addressing all PFAS or sizeable groups of them. Examples of regulations taking this approach—strongly opposed by PFAS

manufacturers and industry bodies—include the EU, Denmark, Canada, and US states like California, Vermont and Maine.

Fluorochemical refrigerants are grouped together and regulated under the United Nations Montreal Protocol, because the substances have the potential to deplete the ozone layer, or contribute to global warming. The grouping includes around

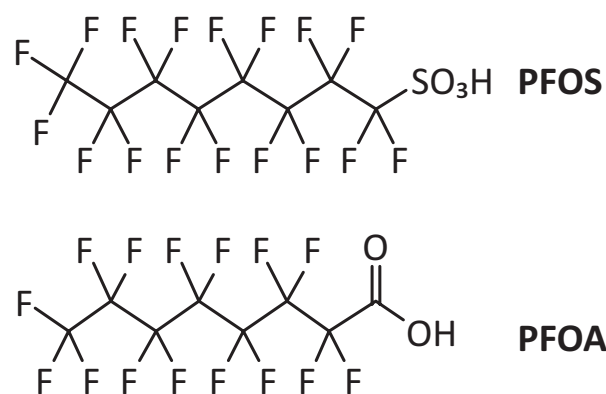


FIG. 1. Structures of PFOS and PFOA.

TABLE 1. A list of long and short chain PFAS the EPA is monitoring as ground water contaminants. Source: awwa.org

PFAS monitored	Source
LONG-CHAIN	
Perfluorooctanoic acid (PFOA)	Nonstick surfaces
Perfluorooctane sulfonate (PFOS)	Fabric protection, Firefighting foam
SHORT-CHAIN	
Perfluorohexan sulfonic acid (PFHxS)	Firefighting foam
Perfluorohexanoic acid (PFHxA)	Degradation product of PFHxS
Perfluorobutyrate acid (PFBA)	Photographic film

120 substances or blends on the market, of which just a quarter have a low global warming potential according to the protocol's definition.

But few governments plan to take a broad approach and address all uses of the substances. An important exception is a proposal to restrict PFAS under EU REACH, which is currently being jointly developed by Denmark, Germany, the Netherlands, Norway and Sweden. This is seeking information on as many uses as possible and is likely to ban all PFAS across the board except for those deemed 'essential'.

Another exception, which could have a big impact in the long term, is the law recently passed by Maine that will eventually bar the sale of new products containing intentionally added PFAS, including in components, unless the substance's use is deemed 'unavoidable'. The phase-out will begin with carpets, rugs and fabric treatments on January 1, 2023. It will then continue with uses most likely to cause pollution and extend to all non-essential uses by January 1, 2030.

The Maine Bill says the state's Department of Environmental Protection "can by Rule identify products by category or use that may not be sold, offered for sale or distributed for sale in this state if they contain intentionally added PFAS." The American Chemistry Council (ACC) says it will affect every major industry in the state, including forest products, healthcare, textiles, electronics, and construction. The Safer States coalition of environmental health groups told Chemical Watch it expects other states to follow in Maine's footsteps either next year, or in the coming years.

Maine is way ahead of federal lawmakers. The United States Congress has not passed legislation restricting the use of most PFAS in all products. The 2020 National Defense Authorization Act added a one-time disclosure requirement to the US Toxic Substance Control Act (TSCA) for PFAS produced and imported since January 1, 2011. The US EPA is pushing ahead—in the face of fierce opposition from industry groups—with a Rule that will require detailed reporting by chemical companies and downstream suppliers of products on the production, use and presence of PFAS chemicals. However, the Biden administration seems reluctant to back broad restrictions and a federal bill banning new PFAS uses that passed the House of Representatives last summer faces a tough battle in the Senate.

Most US states, meanwhile, are targeting uses one or two at a time. Analysis of Chemical Watch's US Bill Tracker shows that since 2018, some 30 bills restricting the use of PFAS in products have been passed by 19 states (other bills have introduced reporting testing or awareness raising measures, but not bans on uses). Most of these bills restrict the use of PFAS-containing firefighting foams (FFFs), usually prohibiting them for testing and training purposes, and half a dozen target their use on food packaging. Aside from these, and in addition to Maine's broad approach, California is addressing use in cosmetics and some children's products, while Vermont is banning PFAS from carpets, rugs, and ski waxes (a significant use in such a snowy state), as well as FFFs and food packaging. Washington State, meanwhile, is finalizing a PFAS chemical action plan that may include the introduction of state

rules that reduce PFAS exposure from carpet and rugs, stain and water resistance treatments, and leather and textile furnishings.

Many more bills addressing uses of PFAS are currently under discussion or coming up for votes in state legislative committees. Together with those already passed, the high level of state activity, and the lack of federal action to restrict uses makes PFAS a classic example of how the revised federal TSCA has so far failed to reduce the amount of state level chemical legislation as industry hoped it would.

So far then, it is the firefighting foam and food packaging sectors that have come under the most pressure from regulation to find alternatives to PFAS, while many clothing brands, especially those specializing in outdoor gear, are trying to phase out the chemicals because of pressure from the public and environmental groups.

DATA GAPS FOR USES

Are there other uses which both legislators and NGOs have not addressed? Preliminary research in Europe seems to suggest there are.

As part of their work to prepare a proposed EU REACH restriction on PFAS, the five national authorities involved included 16 summary reports in their second "stakeholder consultation and call for information," issued in July 2021. Each report looks at a particular sector or group of uses and includes figures on PFAS production, use and exposure where such information is available. Officials are at pains to stress that the information and the numbers are preliminary and that not all PFAS have the same properties or potency. Some of the figures are worst case estimates, others are mid-range. As things stand, regulators are faced with many big data gaps. It is



FIG. 2. Sources of PFAS.

therefore very difficult at this stage to assess which sectors or uses present the greatest health or environmental risks.

FOOD INDUSTRY USES

What is striking is that some of the uses have not yet been targeted by regulators for restrictions and others seem to have escaped attention completely. For example, the use of fluoropolymers is widespread in the oil and gas industry in equipment, pipelines, cables, transport, and storage. PFAS surfactants are used in drilling operations as foaming agents, while PFAS-based tracers are used to map oil and gas fields and as anti-foaming agents in production processes. Similar uses are assumed to exist in mining operations but there is very little information available.

Another example is fluorinated lubricants, which are used by a host of industries, according to another of the summary reports. Based on an earlier call for evidence, stakeholder consultation and literature review, the report says they are used by food producers on the chains and bearings found in ovens and as a lubrication additive on the inside coating of metal food and beverages containers. Other PFAS uses in the food industry are included in the summary report for food contact materials (FCMs) and packaging, and include the use of polytetrafluoroethylene (PTFE) or polyvinylidene fluoride (PVDF) as a non-stick coating on conveyor belts. PFAS are also used, it says, for coating and recoating industrial ovenware and for seals, gaskets, tubing, pipes, valves, conveyor belts, funnels, and filter membranes. Although some US states and countries such as Denmark are targeting PFAS in food packaging, these other food contact applications have so far escaped the attention of regulators and campaign groups.

In fact, PFAS-containing lubricants are used by most heavy industries and manufacturing. Uses include, in aircraft engines and hydraulic systems, in many applications related to automotive vehicle production, the nuclear power sector, wind turbines, semiconductor manufacturing and plastics processing. Fluoropolymers such as PTFE are used in an equally wide range of products, either in the products themselves or as processing aids.

BATTLE LINES DRAWN

With so many uses, it is clear there is a lot at stake for PFAS producers. Contrary to the joint Madrid, Zurich and Helsingør Statements, the ACC and its fluorochemical sector groups say that only long-chain PFAS have adverse health or environmental effects. In 2019, for example, the FluoroCouncil told Washington State's Department of Ecology that measures should only address long-chain PFAS and their salts, and that short-chain PFAS "are not bioaccumulative, are not carcinogenic, and generally exhibit low toxicity." As fluoropolymers are not defined as long-chain, it says, they too should be ignored.

Last year, the FluoroCouncil split into two groups that will focus on defending the markets for fluoropolymers and short-chain PFAS. The Performance Fluoropolymer Partnership says fluoropolymers should be regarded as 'polymers of low con-

cern' and should not fall under forthcoming EU proposals to regulate polymers of concern. It is also countering claims by an international group of scientists, including some from the US EPA and the US National Institute of Environmental Health Sciences (NIEHS) that fluoropolymers should be limited to essential uses unless manufacturers and users can eliminate PFAS emissions from the production and end disposal parts of their lifecycle. Key uses are in the manufacture and performance of medical devices, cell phones and laptops, telecommunications infrastructure and advanced transportation and aerospace applications. The second industry group, the Alliance for Telomer Chemistry Stewardship, promotes short-chain (C6) fluorotelomers, which are used in firefighting foams, clothing, upholstery, and coatings.

These are the future battlegrounds. Long-chain PFAS, like low molecular weight phthalates before them, have been jet-tisoned by producers so they can focus on defending what they believe can be defended – in this case short-chain PFAS and fluoropolymers – from what they say are inaccurate and unwarranted claims of adverse effects. Their level of success will determine which substances are still available ten years from now.

Geraint Roberts is a consulting editor for Chemical Watch.

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Notice of Annual Business Meeting



AOCs members will convene for the AOCs annual business meeting on Monday, May 2, 2022, 7:15–7:45 a.m. CDT (Chicago USA; UTC-5) live in the Centennial Ballroom Foyer of the Hyatt Regency Atlanta and online. In addition to conducting routine business of the Society, attending members will receive an update on the state of the Society, meet the 2022–2023 Governing Board, and gain insight on our future plans. The Governing Board will be present to answer questions from members.

Held in conjunction with the

2022 AOCs Annual Meeting & Expo May 1–4

annualmeeting.aocs.org

Chemist's guilty verdict raises questions about the intersection of academia and law

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

Alexa Tascher

As the first academic researcher prosecuted under the Department of Justice's China Initiative to be found guilty by a jury, Lieber finds himself a symbol of the economic rivalry between the US and China over false statements and tax offenses.

On December 21, 2021, Harvard chemistry professor Charles M. Lieber was found guilty on all counts, including two charges of false statements, two charges of filing a false tax return, and two charges of failure to file a report of foreign bank and financial accounts (<https://tinyurl.com/ykjs2c26>). Lieber was prosecuted under the China Initiative, an effort started in 2018 by the United States Department of Justice (DOJ) ostensibly to protect the country from Chinese economic espionage and national security threats. Experts in international relations claim negative effects for the US science sector from overzealous prosecution of intellectual property (IP) theft, while scientists themselves question the efficacy of the initiative.

The case against Lieber begins in 2011, with an email from a Wuhan University of Technology (WUT) professor concerning a Contract for Strategic Scientist's Appointment. In November of that year, Lieber agreed to sign the Strategic Scientist Agreement, which required him to make "strategic, visionary and creative research proposals" and "supervise young teachers or receive them as visiting scholars," among other similar duties, in the name of WUT. The contract was valid for five years, and Lieber was to be paid \$50,000 per month with travel costs covered.

Five months later, in April of 2012, Lieber's contact at WUT reached out again—this time with an invitation to China's Thousand Talents Plan. Lieber's selection in the program entailed multiple tempting awards: a \$50,000 per month salary and \$158,000 for living expenses, plus \$800,000 in research funding. That June, Lieber was sent a three-year contract, written both in English and Chinese and titled "Employment Contract of 'One Thousand Talent' High Level Foreign (sic) Expert." According to this contract, Lieber would "publish high-level articles in the renowned and important international academic journals in the name of Wuhan University of Technology," assemble a research team, and "guide 1-2 distinguished young scholars and 3-4 doctoral students" in publishing journal articles. Lieber was also to spend at least nine months per year at WUT.

The last contract Charles Lieber signed with WUT, which showed up in email records in January 2013, was a five-year agreement to carry out nanowire research as a collaboration between Harvard and WUT that used the Harvard name. Lieber signed this contract without consulting any Harvard officials, and his authority to give away the Harvard name to this initiative was questionable.

As an aside, nanowires are made of metal compounds and can increase the conductivity of solid-state polymer electrolytes. They do not have the fire hazard status of the traditional liquid electrolytes found in lithium-ion batteries. Research in this field has the potential to be lucrative if nanowires could improve the batteries used in electric vehicles (<https://tinyurl.com/47txauxv>).

Harvard learned of the collaboration with WUT in 2015 and confronted Lieber, who allegedly said that WUT had been using the Harvard name and logo without his consent. The chemistry professor was questioned again in April 2018 by the Department of Defense (DoD); he told investigators that he "wasn't sure" how China categorized him. Later that year, in November, the National Institute of Health (NIH) inquired



Harvard chemist Charles Lieber who was the first scientist convicted under the US Department of Justice's China Initiative.

(Kris Snibbe/Harvard Public Affairs & Communications)

THE MIT REVIEW FOUND THAT ONLY A QUARTER OF PEOPLE AND INSTITUTIONS CHARGED UNDER THE CHINA INITIATIVE WERE CONVICTED, AND MANY CASES FAIL TO EVEN SHOW AN OBVIOUS CONNECTION TO NATIONAL SECURITY OR TRADE SECRET THEFT.

Harvard about Lieber's suspected relationship with WUT and the Thousand Talents Plan.

In an interview conducted by Harvard to respond to NIH, Lieber claimed that he "had no formal association with WUT" after 2012 and that WUT "falsely exaggerated" his involvement with them. (Researchers who receive funding from NIH are required to disclose significant funding from other sources, so that they are not paid twice for the same work.)

The false statements to the DoD and NIH were included in Lieber's charges, as well as lies on tax returns about the money he received from WUT and his failure to disclose a bank account in China.

Since its establishment, the DOJ's China Initiative has been the subject of much discussion and criticism. It was launched under former president Donald J. Trump and attorney general Jeff Sessions to detect and prosecute national security threats in the form of IP theft and economic espionage, in which trade secrets are transferred with intent to benefit a foreign government. Since proving economic espionage can be difficult, DOJ investigators have focused on research-security and tax-fraud cases at universities.

According to the MIT Technology Review, the China Initiative "now appears to be an umbrella term for cases with almost any connection to China, whether they involve state-sponsored hackers, smugglers, or, increasingly, academics accused of failing to disclose all ties to China on grant-related forms" (<https://tinyurl.com/2fw2xh3n>). Although the threat of Chinese intellectual property theft isn't imagined, the China Initiative has been accused of being inefficient and even counterproductive.

The MIT review found that only a quarter of people and institutions charged under the China Initiative were convicted, and many cases fail to even show an obvious connection to national security or trade secret theft. Just 19 of 77 cases included charges of violating the Economic Espionage Act (EEA). Of those 19, eight specifically charged economic espionage, while the others alleged only theft of trade secrets.

In a joint report by the University of Arizona and the Committee of 100, a leadership organization of Chinese Americans in business, government, academia, and the arts, a survey of 1,949 American scientists of Chinese and non-Chinese descent was conducted to understand the impact of the China Initiative on the broader scientific community (<https://tinyurl.com/2x6dfkr7>). Both Chinese and non-Chinese scientists overwhelmingly agreed that limiting collaboration with China will have a negative impact on academia (95.9% and 92.2%, respectively). However, the report found a reluctance, particularly among Chinese scientists, to collaborate internationally with China-based scholars for fears of US investigation. In fact, 40.6% of Chinese researchers based in the US had limited their communication with collaborators in China over the past three years before the survey was conducted.

Another case prosecuted under the China Initiative—that of Gang Chen, a researcher at the Massachusetts Institute of Technology—further exhibits the potential effect of the Initiative on academia. In a New York Times interview, Chen explained that even though neither he nor his colleagues saw parallels between their own activities and Lieber's cover-ups, he was still targeted (<https://tinyurl.com/2p945r3e>). Chen was accused of hiding links to China on grant applications; the charges were dismissed in January 2022 after a year of prosecution.

In a letter in support of Chen, nearly 170 MIT faculty expressed that the criminal complaint against him "represents a deep misunderstanding of how research is conducted or funded at a place like MIT" (<https://tinyurl.com/3np2sh72>). Standard practices, they write, are reframed as sinister collusion. The threat of investigation and prosecution can dissuade scientists from forming beneficial international collaborations, and in the case of Chen, slow and stop existing research efforts.

"Law enforcement does not understand what is considered a normal research practice in academia, open research collaboration, and some of the funding disclosure issues," says Emily Weinstein, of the Centre for Security and Emerging Technology at Georgetown University, in an article for Chemical and Engineering News (<https://tinyurl.com/6mh-kh9t3>). "But academia does not understand why law enforcement is so concerned about this."

Politicians and government officials concerned with Chinese IP theft speak of world-scale competition, where China and the US battle to have the government and economic system “picked by other nations to organize their societies,” in the words of Bill Priestap, the former assistant director of the FBI (<https://tinyurl.com/2nnuf95y>). However, many scientists see international scientific collaboration through a decidedly apolitical lens first. Holden Thorp, a chemistry professor at Washington University in St. Louis, writes of the China Initiative that “most of the people they have gone after have been people doing honest and important scientific collaborations...No country can do it by itself, and there are a lot of great scientists in China that we need to collaborate with” (<https://tinyurl.com/3dwmtmw2>).

The New York Times reported in February that the US Justice Department has spent months evaluating the China Initiative program and plans to announce changes. The forthcoming changes will likely include a new name for the program and a shift of cases involving undisclosed financial interactions with China to civil court. The Justice Department would only be involved in more serious crimes, like espionage and trade-secret theft (<https://tinyurl.com/msbc8f6c>).

More than 2,000 federal investigation cases are currently open in the US that involve Chinese efforts to steal information and technology. The head of the FBI stated that no other country poses a greater threat to US innovation and economic security. However, critics point out that other countries have

AT THE END OF FEBRUARY, THE US JUSTICE DEPARTMENT ANNOUNCED THAT AFTER MONTHS OF EVALUATING THE PROGRAM THE CHINA INITIATIVE WOULD EFFECTIVELY BE TERMINATED.

used researchers in the US to obtain valuable information. The name, China Initiative, therefore, does not convey the extent of the problem.

Whatever changes may come, the program is seen as a success by some officials. Universities implemented training and updated compliance programs to better educate employees on the issue of receiving foreign money and to better account for any they receive. In addition, funding agencies have strengthened their disclosure requirements for grants. These changes now deter academics from getting involved with bad actors in foreign governments, some officials believe.

Where does all this leave us in the case of Charles Lieber? In his own words, he “wasn’t completely transparent by any stretch of the imagination”; he was “scared of being arrested” (<https://tinyurl.com/47epdbkh>). A date has not been set for Lieber’s sentencing, but the effect has certainly been felt in the scientific community following the prosecution of such a prominent figure.

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Chemicals management in Asia: what to expect in 2022

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

David Macfarlane and Ellen Daliday

CHINA

Last year was a busy one for the regulation of chemicals in China. On January 1, 2021, the Ministry of Ecology and Environment (MEE)'s much anticipated revised legislation for new chemicals—MEE Order 12—was enforced. Companies must continue to implement post-registration management measures for new chemicals following an increase in inspections carried out by authorities last year, which is expected to continue in 2022.

In October 2021, the MEE unveiled its draft action plan for managing new pollutants—a subject that is expected to continue to be high on the agenda this year, as it will drive the evolution of the Chinese chemical regulatory system.

The draft action plan—expected to be finalized early this year—lays out the MEE's plans for chemical substance management. This includes new regulations, guidelines, restrictions and bans on "priority" chemicals by 2025.

Key developments

- China's draft action plan for managing new pollutants expected to be finalized early in 2022.
- Numerous additional requirements relating to the new overarching cosmetics law—the Cosmetics Supervision and Administration Regulation (CSAR)—take effect during 2022.
- Companies operating in Japan have until May 25, 2022, to comply with standards on chemical classification, labelling and SDSs in line with the GHS sixth revised edition.
- Grace periods for existing biocidal substances under South Korea's consumer chemical products and biocides safety Act (K-BPR) will end in December 2022.
- At the time this was written, an update on India's Chemicals (Management and Safety) (CMS) Rules 20XX was expected in early 2022.

The MEE also proposes the assessment of five to ten priority substances a year and will publish its assessment plan, including the substances it proposes to assess, before the end of this year. The action plan is expected to affect multiple industries.

As part of the action plan, the MEE will continue working towards finalizing a new regulation for the environmental risk control of toxic and hazardous substances—originally called Erac—during 2022. This will become the country's overarching chemical framework, covering both new and existing substances.

Under the draft action plan, the MEE published guidelines for the screening of priority assessment chemical substances (Pacs) in the last week of December, which entered into force on January 1, 2022. A draft of the guidelines was published in May 2021. The MEE also plans to publish the first list of Pacs and the new technical guidelines for hazard and exposure assessment in 2022. Industry needs to pay attention to this list because the government will conduct environmental risk assessments on the substances, which may subsequently lead to restrictions or bans.

In September 2021, China's National Registration Centre of Chemicals (NRCC) upgraded its integrated information platform for hazardous chemicals to support quick response (QR) code generation for each substance or mixture registered for use in China. This is expected to become a mandatory requirement for hazardous chemical labels, packaging and containers.

Cosmetics

The new overarching cosmetics law, the Cosmetics Supervision and Administration Regulation (CSAR), came into force on January 1, 2021. As additional requirements take effect, 2022 will be another busy year for companies that place cosmetic products on the Chinese market.

The following measures, published in 2021 to support the implementation of the CSAR, will apply this year:

- Measures for the Supervision and Administration of Cosmetics Production and Business Operation (in force since January 1, 2022)
- Administrative Measures for registering and filing cosmetics (in force since January 1, 2022)
- Administrative Measures on Cosmetics Labelling (in force from May 1, 2022)

Since January 1, companies that file or register cosmetic products have been required to submit the safety information of functional ingredients, such as preservatives and sunscreen agents to the National Medical Products Administration (NMPA). They must provide a product safety assessment report prepared in accordance with the product safety technical guideline (2021).

For cosmetic products registered or filed before May 1, 2021, applicants must update their registrations or filing documents, and update product classification codes in accordance with the new rules on classification, by May 1, 2022.

Under the Cosmetic Efficacy Claim Assessment Guidelines, companies must evaluate the claims made on labels, and upload the summary of data supporting those claims to the NMPA website by the following dates:

- January 1, 2022—for new cosmetic registrations or filings
- May 1, 2023—for cosmetic products registered or filed before 1 May 2021
- May 1, 2022—for cosmetic products registered or filed between 1 May 2021 and January 1, 2022

Children's cosmetic products

China's new Regulations on the Supervision and Administration of Children's Cosmetics entered into force on January 1, 2022. Starting from May 1, 2022, new cosmetic products intended for children under 12 years old placed on the Chinese market must bear a special mark accompanied by a warning statement "shall be used under adult guidance". For children's cosmetics already registered or filed, existing product labels must be updated before May 1, 2023.

The sale of existing stock of cosmetic products containing microplastics will be prohibited from December 31, 2022.

Food contact materials

In November, 2021, the Chinese National Health Commission (NHC) sought public comments on the second draft of a proposed national food contact material (FCM) standard for adhesives, as well as revisions to existing standards for rubber and plastic used in FCMs. The latter standards were expected to be finalized and enter into force in 2022. However, delegates at Chemical Watch's November 24 conference on FCM regulations across Asia Pacific and Eurasia heard that the adhesives standard may not be published until the end of 2022 or early 2023.

Dr Zhu Lei from the China National Centre for Food Safety Risk Assessment (CFSA) explained that the publication of the final standard is dependent on the quantity and complexity of comments received. She also noted that the CFSA expects to provide industry with a year transition period (most standards provide six months).

China key dates

- Measures for the Supervision and Administration of Cosmetics Production and Business Operation (in force since January 1, 2022)
- Administrative Measures for registering and filing cosmetics (in force since January 1, 2022)
- Administrative Measures on Cosmetics Labelling (in force from May 1, 2022)
- From May 1, 2022, new cosmetic products intended for children under 12 years old placed on the Chinese market must bear a special mark accompanied by a warning statement "shall be used under adult guidance"
- The sale of existing stock of cosmetic products containing microplastics will be prohibited from December 31, 2022

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TAIWAN

On November 23, Taiwan's EPA legally amended the Regulation on new and existing chemical substances registration. This officially extended the deadline for standard registration of the first batch of 106 priority existing chemicals (Pecs) until December 31, 2024, regardless of tonnage. This is a year longer than initially proposed in May 2021.

The discussion of deadline extensions began as early as April 2020, when industry raised concerns over the ability to complete registration in the midst of the Covid-19 pandemic.

Under standard Pecs registration, companies are required to submit data for nine items to the authorities, with items eight and nine (hazard and exposure assessments) taking the longest to prepare.

Companies can submit the first seven information items along with plans for hazard and exposure assessments and receive a "completion code" for their Pecs registration. The assessment reports can then be submitted at a "later date".

The US Environmental Protection Agency (EPA) is expected to put together a separate review team for these assessment reports. However, experts believe the agency might not announce a general due date for submission because it could designate different dates for different substances, or even decide that it does not require the reports for certain substances.

With concerns about the ambiguous review times and lack of standardized review criteria, experts are urging companies to complete registrations as soon as possible, regardless of the deadline extension.

Because the EPA is focusing on completion of the first batch of Pecs, it does not plan to publish any subsequent batches in the next few years.

Chemicals of concern

In August, the EPA added hydrofluoric acid and ammonium nitrate to its List of Concerned Chemical Substances (CCSs).

The addition of nitrous oxide in November 2020, brought the total to three CCSs.

Companies are required to record operational volumes on a daily basis and report this information monthly to the competent authorities. Manufacturing, import, sales, use and storage activities must be approved by the EPA. The agency is expected to add more substances to the list in 2022.

Taiwan key dates

- December 31, 2024—all standard registrations of Pecs must be completed by this date regardless of tonnage.

- For chemicals of concern, manufacturing, import, sales, use and storage activities must be approved by the EPA (by August 1, 2022, for ammonium nitrate; and by February 1, 2023, for hydrofluoric acid).
- The requirement that businesses record operational volumes on a daily basis and report this information monthly to the competent authorities has been in effect since February 1, 2022, for hydrofluoric acid.

JAPAN

Industry will need to keep a close eye on whether the Industrial Safety and Health Act (Isha) is going to be amended to require mandatory safety data sheets (SDSs) and label-

ling for all chemical substances classified as hazardous under the UN Globally Harmonised System (GHS) of classification and labelling of chemicals. Isha is the main law that implements the GHS, obliging companies in Japan to provide SDSs and labels.

In July 2021, the Ministry of Health, Labour and Welfare (MHLW) published a study group report, which proposes developing mandatory chemical risk management measures based on the sixth revised edition of the GHS.

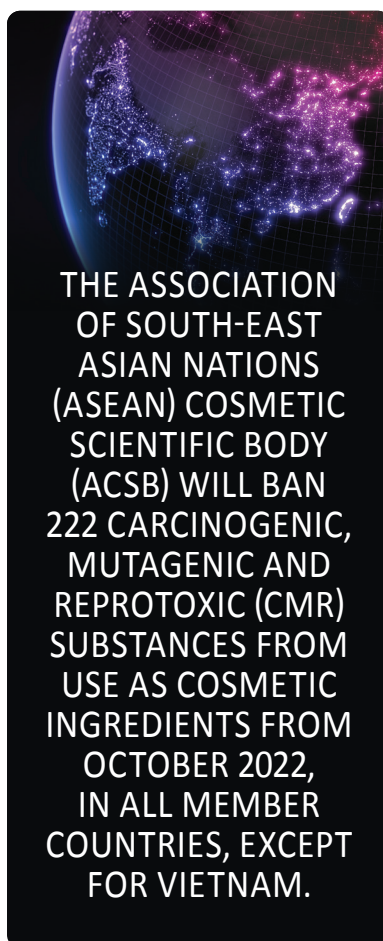
It proposes that the number of substances required to issue SDSs will be expanded to approximately 2,900. For the first three years, from financial year 2021 to financial year 2023, the ministry will include 1,800 substances for mandatory SDS and GHS-based labelling, and the remaining will be implemented in the subsequent years.

Currently, about 700 substances a year are subject to mandatory SDS document and labelling requirements.

Under the proposed measures, the ministry would also set exposure threshold limits for about 150 GHS classified substances in financial year (FY) 2022, and from FY 2023 onwards, in the region of 200 substances per year.

In addition, the report recommends measures to strengthen the transmission of hazard information, workplace safety mandatory measures and proposes exploring the feasibility of setting up a national certification scheme for chemical substance specialists.

Separately, companies have until May 24, 2022, to comply with the Ministry of Economy, Trade and Industry (Meti) and MHLW's 2019 jointly released standards on chemical classification and labelling and SDSs in line with the GHS sixth revised edition. These are JIS Z 7252 (chemical classification for GHS labelling; and JIS Z 7253 (hazard communication for GHS labelling and SDS). Until then, 2014's JIS Z 7252 and



2012's JIS Z 7253 can be used for compliance. These older standards align with the GHS fourth revised edition.

Japan key dates

- May 24, 2022—deadline for compliance with JIS Z 7252 (chemical classification for GHS labelling; and JIS Z 7253 (hazard communication for GHS labelling and SDS)
- FY 2022—exposure threshold limits to be set for about 150 GHS classified substances

SOUTH KOREA

Grace periods for existing biocidal substances such as disinfectants, algicides, rodenticides, insecticides and repellents under South Korea's consumer chemical products and biocides safety Act (K-BPR) will end on December 31, 2022. What this means is that manufacturers or importers of existing biocidal active substances must submit their dossiers and secure approval before the deadline. This timeline is very tight, as government reviews also take months. Companies should watch out for this K-BPR deadline being extended as many companies could struggle to meet the deadline.

Under K-BPR, manufacturers or importers of existing active substances used in biocidal products or biocidal treated articles in circulation before January 1, 2019, must meet an approval submission deadline. If either deadline is not met, the MoE will remove the substance from the list of those subject to a grace period and it will be banned from manufacture, import or sale.

South Korea's revised Cosmetics Act came into force on February 18, 2022. The new Act banned the sale of cosmetics and cosmetic ingredients tested on animals in the country unless they meet the requirements of certain exemptions (i.e., ingredients requiring animal testing under K-REACH and high risky ingredients such as preservatives and colorants).

However, the ban does not affect exports to or imports from countries that require animal testing under their laws. The Act also extends the definition of relevant businesses to include sellers of "customized cosmetics" and includes a reduction in the requirements for the labelling of solid soap packaging.

The country will also take a centralized approach to risk management for products applied to the body via the Act on Risk Assessment of Products for the Human Body, which entered into force on January 28, 2022. It covers the assessment of chemical, biological and physical risk factors for products "applicable" to the human body. This includes those that are ingested, administered, come into contact with the body, or are inhaled.

South Korea key dates

- February 18, 2022—the revised Cosmetics Act entered into force
- December 31, 2022—end of grace periods for existing biocidal substances such as disinfectants, algicides, rodenticides, insecticides and repellents under the K-BPR

INDIA

Chemical Watch understands that an update on India's Chemicals (Management and Safety) (CMS) Rules 20XX is expected in early 2022. After more than a decade in development, the overarching chemicals management law – based on the registration of priority chemicals – will regulate chemicals currently in use and those transported into, or manufactured in, India. It will affect local and foreign companies, with most regulatory compliance requirements applying within 18 months of coming into force.

Another initiative likely to impact industry is last year's Draft Report on Implementation of Circular Economy in Toxic and Hazardous Industrial Waste, which aims to regulate and ensure the environmentally sound management of hazardous waste. This is under review at the moment. The government also proposed a multi-disciplinary approach action plan, which is aimed to provide holistic and integrated methods to effectively promote a circular economy in toxic and hazardous waste management. Both are expected to be finalized in 2022.

Additionally, the Bureau of Indian Standards (BIS) consulted on and introduced numerous mandatory standards for individual chemicals and groups of substances in 2021, more of which are likely to follow this year.

India key dates

- 1H 2022—update expected on long-awaited CMS Rules
- FY 2022—final circular economy initiatives to be published
- 1H 2022—more mandatory standards to be introduced for individual chemicals and groups of substances

EXPECTED ACTIONS BY ASEAN AND ITS MEMBER STATES IN 2022

- The Association of South-East Asian Nations (Asean) Cosmetic Scientific Body (ACSB) will ban 222 carcinogenic, mutagenic and reprotoxic (CMR) substances from use as cosmetic ingredients from October 2022, in all member countries, except for Vietnam.
- Indonesia to roll out its Halal labelling requirement for more products.
- Malaysia to revise its list of prohibited carcinogenic substances under the Occupational Safety And Health (Prohibition of use of substance) Order 1999 and review classifications for new GHS substances.
- The Philippines to issue guidance on the registration requirements for household and urban hazardous substances.
- Singapore to move from GHS 4 to GHS 6 or 7.
- Thailand to revise requirements relating to its Hazardous Substances Act.
- Vietnam to complete its national chemical inventory.

David Macfarlane and Ellen Daliday are with the Chemical Watch Asia desk.

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Meet Selvi Seçil Şahin

Member Spotlight is a slice of life that helps AOCS members get to know each other on a more personal level.



Selvi Seçil Şahin, who loves to sightsee, at the Galata Tower in Istanbul.

PROFESSIONAL

What's a typical day like for you?

I believe that starting a day well will affect the rest of that day. For me, that means having had enough sleep and sharing a nice breakfast with my family. Since I am used to being organized, I plan in advance. I prefer to finish my work (preparing for my next course of study as a Ph.D. candidate) early in the morning and then devote my time to a quality book or a fun science fiction series.

Flash back to when you were 10 years old. What did you want to be when you grew up?

At that age, I wanted to be an artist. It could have been as a violinist, as a painter, or as a fashion designer.

Why did you decide to do the work you plan to do?

I completed a master's degree in food engineering in 2021 and was then honored with a scholarship from the Republic

Fast facts

Name	Selvi Seçil Şahin
Joined AOCS	2021
Education	M.Sc. in food engineering, Ankara University (Ankara, Turkey)
Current AOCS role	Student e-poster presenter, 2021 AOCS Annual Meeting & Expo

of Turkey for my Ph.D. work, which began in February 2022 at the University of Leeds (U.K.) Department of Food Science and Nutrition. Working in academia has always been my dream. I have always enjoyed learning new information as well as being in the laboratory, presenting an idea, witnessing the stages of this idea being tested, and getting good, concrete results.

Is there an achievement or contribution you are most proud of? Why?

I presented my master's thesis as an e-poster at the 2021 AOCS Annual Meeting & Expo. This presentation was my first experience of such a significant platform. I am proud to have placed first in the AOCS Student E-poster Pitch Competition, for which I won \$200.

PERSONAL

How do you relax after a hard day of work?

After a hard day I really need to chat and spend time with my close friends in nature.

What is the most impressive thing you know how to do?

I can analyze and get to know people very easily. When I meet someone new, I can sense what kind of person they are from the first conversation, and my guesses about someone are usually correct. I believe this has made my life easier because I can decide in a very short time whether a person will be around in my future or not.

What skill would you like to master?

Playing the violin has been a dream since I was little. I would love to be very successful in this.

What are some small things that make your day better?

Life is too short to watch bad movies, to chat with people with bad senses of humor, or to eat bad food. Eating a great meal and laughing at a clever joke are the little things that make my day.

PATENTS

Recombinant algal microorganisms having increased lipid production, and methods of making and using the same

Moellering, E.R., *et al.*, Synthetic Genomics, Inc., US11046979, June 29, 2021

The present invention provides a mutant algal microorganism that has a mutation that causes attenuated expression of TrifuncB and/or TrifuncA and as a result produces more lipids than a control algal microorganism. The mutant algal microorganism can further include a mutation in a gene encoding a peroxisomal beta-oxidation pathway protein, such as an ACO1 or PXA1 gene, or a glyoxylate pathway protein, such as an ICL1 gene, that results in attenuated expression and further increased lipid production. Furthermore, provided herein are methods of producing lipids using the mutant algal microorganisms and methods of making the mutant microorganisms.

Chocolate-like food containing highly unsaturated fatty acid

Fujita, T., *et al.*, Fuji Oil Holdings Inc., US11051530, July 6, 2021

The present invention relates to a chocolate-like food containing a highly unsaturated fatty acid-containing fat or oil, and the objective of the present invention is to provide such a chocolate-like food that is suppressed in change in the flavor over time. The present invention is able to suppress change in the flavor over time of a chocolate-like food containing a highly unsaturated fatty acid-containing fat or oil by adjusting the pH thereof to a value within a predetermined range. It is preferable to use a highly unsaturated fatty acid-containing fat or oil which has been subjected to antioxidation treatment. It is preferable that the antioxidation treatment is carried out by dispersing water phases, in each of which a predetermined amount of a water-soluble antioxidant is dissolved, in the highly unsaturated fatty acid-containing fat or oil such that the water phases have particle diameters of 300 nm or less.

Method of obtaining olive oil and extracts from olives

Mateo Anson, N., Isanatur Spain S.L., US11052123, July 6, 2021

A method comprising the stages of: olive input, separation of the stone from the olive skin and pulp, with the removal of the whole stone; electric pulsing of the olive paste generated in the previous stage, process of dehydration of the pulsed olive paste up to a humidity of less than 30% in a continuous vacuum drying machine and subsequent separation of the oil by centrifugation of the olive oil, followed by dehydration of the degreased pulp up to a humidity of less than 10%; and lastly, application of supercritical fluids

(CO₂ with or without modifier) to the degreased and dehydrated pulp, under agitation, pressure, temperature and time conditions, obtaining olive extracts and olive flour. The generation of waste, consumption of water, use of highly toxic solvents and loss of the sensory quality of the oil is avoided, the yields improved and the necessary times reduced.

Colored surfactant composition

Constantine, M., *et al.*, Cosmetic Warriors Ltd., US11052036, July 6, 2021

A colored surfactant composition includes (i) an anhydrous surfactant; (ii) a vegetable oil, a vegetable butter or mixture thereof; and (iii) an oil dispersible water insoluble coloring.

Olefinic ester compositions and their use in stimulating hydrocarbon production from a subterranean formation

Ngantung, F., *et al.*, Elevance Renewable Sciences, Inc. and Wilmar Trading Pte Ltd., US11053430

Compositions for stimulating hydrocarbon production from a subterranean formation are generally disclosed. In some embodiments, such compositions include olefinic ester compounds. In some embodiments, the olefinic ester compounds are derived from a natural oil or a natural oil derivative, for example, by catalytic olefin metathesis. Uses of such compounds, such as in oil- and gas-production methods are also generally disclosed.

Solvent composition and process for removal of asphalt and other contaminant materials

Matza, S.D., *et al.*, United Laboratories International, LLC, US11053464, July 6, 2021

A method and composition for removing contaminant material from industrial equipment are disclosed herein. The method includes providing a solvent composition having methyl soyate, N-methylpyrrolidinone, an additional solvent, and a cationic surfactant. The method also includes contacting the contaminant material with the solvent composition and allowing the solvent composition to react with the contaminant material such that at least a portion of the contaminant material is no longer attached to the industrial equipment.

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



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Silvana Martini, Utah State University, Utah, USA

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Reviewer etiquette: Maintaining manners during peer review

The goal of a reviewer is to support and strengthen the paper in progress. A well executed peer review improves scientific quality, verifies the originality of the reported research, and most importantly helps advance a researcher's career. Several academic websites highlight the importance of the peer review process by providing guidelines and resources. In this article, we provide five key tips on how to share effective feedback to improve manuscript quality.

Peer review is a crucial part of the publication process, ensuring manuscript and journal quality. As an invited referee, you are professionally able to provide constructive criticism to improve the work of a peer. The reviewer's role is to provide written feedback, in the form of commentary to the author and editor, prior to the manuscript's publication.

- **Be kind:** The manuscript is a draft that the author seeks helpful feedback on, thus requiring a fair appraisal. Frame your criticism positively, empower the author to improve their writing
- **Give concrete advice:** Be specific with your feedback. Backup your comments and opinions with evidence, examples, and suggestions for improvement.
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- **Complete the review on time:** When you accept an invitation to review stay organized and stick to the stipulated deadlines.

Peer review involves two parts—reading and evaluating the reported research, followed by communicating your

assessment to the author. Here is some step-by-step advice for completing the process.

When you receive an invitation to peer review, you should be sent a copy of the paper's abstract to help you decide whether you wish to do the review. Try to respond to invitations promptly—it will prevent delays. It is also important at this stage to declare any potential Conflict of Interest.

The structure of the review report varies between journals. Some follow an informal structure, while others have a more formal approach. Whether specifically required by the reporting format or not, you should expect to compile comments to authors and possibly confidential ones to editors only.

THE FIRST READ-THROUGH

The first read-through is a skim-read. Try to bear in mind the following questions—they'll help you form your overall impression:

- What is the main question addressed by the research? Is it relevant and interesting?
- How original is the topic? What does it add compared with other published material?
- Is the paper well-written? Is the text clear and easy to read?
- Are the conclusions consistent? Do they address the main question posed?
- Does the author have a substantial case to disagree significantly with the current academic consensus? If not, what would be required to make their case credible?
- Do the paper's tables and figures aid understanding or are they superfluous?

Spotting potential major flaws

Flagging major problems early on can save time. Editors say, "Specific recommendations for remedying flaws are VERY welcome."

Examples of possibly major flaws include:

- Drawing a conclusion that is contradicted by the author's own data
- The use of a discredited method
- Ignoring a process that is known to have a strong influence on the area under study

Reviewing with Empathy: 4 guiding principles for being a considerate reviewer

BE CRITICAL, BUT CONSTRUCTIVE

- Focus on improvement: Criticism is always more beneficial when it comes with suggestions for improvement.
- Be considerate: Don't let your anonymity tempt you into being derogatory; never include anything that you wouldn't be prepared to discuss with the author face-to-face.



MEET THE DEADLINES

- Be realistic about how long it'll take to do the job properly.
- Put time aside accordingly. Add it to your diary, and stick to it like you would any other commitment.
- Keep the editor informed. Of course, unforeseen and unavoidable things do come up. If that happens, communicate them to your editor as soon as possible.



MAINTAIN ANONYMITY

- Confidentiality regarding the paper you're reviewing is a must.
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*In single or double blind journals the reviewer is anonymous during the review process. In journals using Open Review the identity of both authors and reviewers are known throughout.

AVOID BIAS

- Research is a small world, so if you have any conflicts of interest make them known as soon as they become apparent.



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Check that the methodology in the experimental design is sound—if not, this is likely to be a major flaw. Confirm the researchers have used proper sampling, control experiments, and systematic data analysis.

Look at data tables, figures or images first. If there are critical flaws in this, it is very likely the manuscript will need to be rejected. Such issues include:

- Insufficient data
- Unclear data tables
- Contradictory data that either are not self-consistent or disagree with the conclusions
- Confirmatory data that adds little, if anything, to current understanding

If you find a major problem, note your reasoning and clear supporting evidence (including citations).

Rejection after the first reading

Even if you are coming to the opinion that an article has serious flaws, make sure you read the whole paper. This is very important because you may find some really positive aspects that can be communicated to the author. This could help them with future submissions. A full read-through will also make sure that any initial concerns are indeed correct and fair. After all, you need the context of the whole paper before deciding to reject.

THE SECOND READ-THROUGH

Once the paper has passed your first read and you have decided the article is publishable in principle, one purpose of the second, detailed read-through is to help prepare the manuscript for publication. Of course, you may still decide to reject it following a second reading.

The benchmark for acceptance is whether the manuscript makes a useful contribution to the knowledge base or understanding of the subject matter. It need not be fully complete research—it may be an interim paper. The detailed read-through should take no more than an hour for the moderately experienced reviewer.

"Offer clear suggestions for how the authors can address the concerns raised. In other words, if you're going to raise a problem, provide a solution." (Jonathon Halbesleben, Editor of Journal of Occupational and Organizational Psychology)

As you're reading through the manuscript for a second time, you'll need to keep in mind the argument's construction, the clarity of the language and content.

With regard to the argument's construction, you should identify:

- Any places where the meaning is unclear or ambiguous
- Any factual errors
- Any invalid arguments

HOW TO STRUCTURE YOUR REPORT

Your review should ultimately help the author improve their article. So be polite, honest and clear. You should also try to be objective and constructive, not subjective and destructive.

If there is a formal report format, remember to follow it. This will often comprise a range of questions followed by com-

ment sections. Try to answer all the questions. They are there because the editor felt that they are important. If you're following an informal report format you could structure your report in three sections: summary, major issues, minor issues.

Summary

- Give positive feedback first
- Briefly summarize what the paper is about and what the findings are
- Try to put the findings of the paper into the context of the existing literature
- Indicate the significance of the work and if it is novel or mainly confirmatory
- Indicate the work's strengths, its quality and completeness
- State any major flaws or weaknesses and note any special considerations. For example, if previously held theories are being overlooked

Major Issues

- Are there any major flaws? State what they are and their impact is on the paper
- Has similar work already been published without the authors acknowledging this?
- Are the authors presenting findings that challenge current thinking? Is the evidence they present strong enough

to prove their case? Have they cited all the relevant work that would contradict their thinking and addressed it appropriately?

- If major revisions are required, try to indicate clearly what they are
- Are there any major presentational problems? Are figures & tables, language and manuscript structure all clear enough for you to accurately assess the work?
- Are there any ethical issues? If you are unsure it may be better to disclose these in the confidential comments section

Minor Issues

- Are there places where meaning is ambiguous? How can this be corrected?
- Are the correct references cited? If not, which should be cited instead/also? Are citations excessive, limited, or biased?
- Are there any factual, numerical or unit errors? If so, what are they?
- Are all tables and figures appropriate, sufficient, and correctly labelled? If not, say which are not

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H&N Health and Nutrition	IOP Industrial Oil Products
PRO Processing	PCP Protein and Co-Products
S&D Surfactants and Detergents	

Review Articles

IOP Camelina seed harvesting, storing, pretreating, and processing to recover oil

Veljković, V. B., *et al.*, *Industrial Crops and Prod.* 178, 2022, <https://doi.org/10.1016/j.indcrop.2022.114539>

Camelina [*Camelina sativa* (L.) Crantz] is cultivated worldwide as a rotational oilseed crop under a range of agronomic and environmental conditions. In recent years, interest in camelina has increased due to its short vegetation season, modest agricultural and environmental requirements for cultivation, high seed and biomass (straw) yield, high seed oil content, high polyunsaturated fatty acids content in the oil, and multiple uses. This paper is an overview of the initial steps of any camelina-based production process, such as plant cultivation and harvesting, seed pretreatment, and oil recovery. The main features of the camelina plant and seed are shortly described. The prominent issues of harvesting, cleaning, drying, storing, and pretreating of camelina seed are discussed. The main part of the paper is focused on oil recovery from the pretreated seed. The traits of various camelina oil recovery methods are stressed. The physicochemical properties and composition of camelina oil, with an emphasis on fatty acid profile and bioactive substances (tocopherols, vitamins, polyphenols, sterols, glucosinolates, etc.) contents, are considered. The traditional, actual, and prospective uses of camelina seed, oil, meal, and straw are briefly overviewed. Based on the fatty acid profile of the oil, the bioactive constituents of the meal, and the lignocellulosic content of straw, the camelina plant can be utilized in the biofuels, food, feed, and pharmaceutical industries. Future valorization of camelina should be based on full exploitation of its whole biomass in a biorefinery as it will give the high-added-value to its oil, meal, and straw.

EAT **LOQ** Circular economy and secondary raw materials from fruits as sustainable source for recovery and reuse.

Pierpaolo, S., *et al.*, *Trends Food Sci. Technol.*, 2022, <https://doi.org/10.1016/j.tifs.2022.02.003>

The agro-food sector has become especially aware of the problem of disposal and/or reuse of waste, which is better defined as “secondary raw materials” (SRM). The SRM of agro-food origin have an important value quantified in molecular and functional compounds. We have reviewed many documents concerning food wastes and their re-evaluation as SRM in the agro-food industrial chain. In this work, we gathered scientific literature from the last 60 years regarding not only this concept but also the actual SRM composition of food and which among those can be obtained in compliance with the principle of a circular economy. Initially, our goal was to research and highlight SRMs derived from the processing and conservation of fruit. The results showed the current state of both SRM production and their possible and current use. The data revealed that the main sectors in which SRM are actually employed are chemical, pharmaceutical, food and nutraceutical ones. We also found that the amount of discarded parts overall represents 50% for all fruit families. In a systematic way, the gaps that the current system shows in the aspects of the valorisation of the SRM have been highlighted. The wide diversity of uses for SRMs obtained from food have emerged a common factor and a guiding thread for the evaluation of these by products. Their reutilization has been highlighted considering different families of fruit plants and the SRMs produced within.

IOP Multifaceted applications of microalgal biomass valorization to enriched biorenewables, a review of futuristic biorefinery paradigm

Mohammed R., *et al.*, *Bioresour. Technol.* 17: 100972, 2022, <https://doi.org/10.1016/j.biteb.2022.100972>

Microalgal biorefineries pave a significant impact in addressing current global challenges in the energy, environment and health care sectors. In such context, our current review focuses on the providing an ideal solution of a futuristic biorefinery-based model which favours production of biofuels and biorenewables employing various biomass improvement strategies. For instance, the combinatorial impacts of using wastewater and carbon dioxide utilization by microalgae have led towards sustainable and economically feasible biorefineries. Despite rapid advancements in algal bioprocess technologies, there is still a scope for improvement in the cell biomass productivities which will simultaneously improve the biofuels and biorenewables yields. In conclusion, this comprehensive review pinpoints the relevance of algal biomass valorization involving cost analysis which will lead towards a sustainable biorefinery paradigm with multifaceted applications.

EAT LOQ Current applications of citrus fruit processing waste: A scientific outlook

Shweta, S., *et al.*, *App Food Res* 2, 100050, 2022, <https://doi.org/10.1016/j.afres.2022.100050>

Citrus fruits fall in the category of those commercially grown fruits that constitute an excellent repository of phytochemicals and biologically active compounds, with health-promoting properties. Processing of fruit results in generation of large amounts of waste, which are fed to animals or disposed of, increasing the burden on the environment. However, due to its richness in valuable compounds, citrus fruit waste viz. peels (flavedo and albedo), seeds, and pomace are considered potent bio-resource materials for various uses in the food and non-food sectors. The inherent bioactive compounds present in citrus waste can be used as food additive, encapsulant, nanoparticle, prebiotic, pectin source, essential oil, polyphenol, carotenoid, or dietary fiber. It can also be used as a natural ingredient for cosmetics, medicines, packaging materials, and synthetic fuels. Use as bio-absorbents, biofertilizers, biodiesel, biogas, and bioethanol are some other non-food applications of citrus waste. Irrespective, citrus waste is considered as an ecological risk, alongside other types of waste. Considering this risk, some strategies have recently been developed to reduce its adverse effects. This review on the same lines covers all possible effective and economical ways of valorization of citrus waste in the food and non-food sectors.

Original Articles

IOP Hydrotreated vegetable oil as enabler for high-efficient and ultra-low emission vehicles in the view of 2030 targets

Di Blasio, G., *et al.*, *Fuel*, 310 B, 2022, <https://doi.org/10.1016/j.fuel.2021.122206>

Studies consider the influence of biofuels on the decarbonization of the transport system not negligible. The employment of fossil fuels with an even higher degree of renewable biofuel content, produced with a mature technology process, such as the Hydrotreated Vegetable Oils (HVO), are expected to increase. The research community expects valuable research results to exploit the HVO characteristics in ultra-low emission vehicles equipped with internal combustion engines. In this context, new findings in setting combustion control parameters through proper experimental design are carried out on a modern internal combustion engine architecture. An advanced injection system capable of precise close-coupled multiple injections per cycle was utilized. Steady-state engine operating conditions were selected for this experimental study. Combustion, efficiency, and engine-out emissions indicators with HVO fuel are compared with standard diesel. For assessing the difference in combustion stages, a second derivative method data analysis was performed. It is found that in comparison to diesel fuel, HVO significantly reduces regulated engine-out emissions at the same effi-

ciency and EU 6c NOx emissions targets. To this aim, a specific set of engine control parameters were adopted. The PM decreased up to 10 %, corresponding to 0.18 g/kWh, while the CO₂ reduced by about 7–8% in the range of 0.2–0.5 g/kWh. The decrease of the total PN ranges between 10 and 55%, depending on the control strategy and test point, and the particle distribution shifts towards smaller particle sizes. Outstanding improvements of the NOx-soot trade-off are verified, which in turn demonstrates the capability to operate the engine at post-EU6 NOx conditions without performance and comfort penalties. Engine-out CO and HC emission reductions are confirmed.

EAT Non-conventional techniques for the extraction of antioxidant compounds and lycopene from industrial tomato pomace (*Solanum lycopersicum* L.) using spouted bed drying as a pre-treatment

Paulo S. N. C., *et al.*, *Food Chem*, 13, 100237, 2022, <https://doi.org/10.1016/j.fochx.2022.100237>

This study aimed to use the non-conventional microwave-assisted extraction (MAE) and pressurized liquid extraction (PLE) techniques for recovering bioactive compounds from tomato pomace, a valuable agro-industrial waste. The raw material was previously dried using a spouted bed dryer and then submitted to extraction with green solvents. A response surface methodology (RSM) performed the optimization of MAE and PLE. Next, the yield and the antioxidant activity results were maximized, and the lycopene content of the optimum MAE and PLE extracts was assessed by high-performance liquid chromatography (HPLC). Additionally, a fraction of raw material was oven dried as a comparison. The PLE extract exhibited the highest antioxidant activity, whereas the MAE extract showed the highest lycopene content (59.66 µg lycopene/g extract), which represents a 66.93% lycopene recovery compared to a standard technique with acetone. The remarkable results show that the non-conventional drying and extraction techniques were effective in valorizing this neglected material.

IOP Catalytic methanotreating of vegetable oil: A pathway to second-generation biodiesel

Li, Y., *et al.*, *Fuel*, 311, 2022, <https://doi.org/10.1016/j.fuel.2021.122504>

Vegetable oil is one of the most commonly used feedstocks for the production of biodiesel, while the first-generation biodiesel suffers from the disadvantages of considerable instability and corrosivity. Developing second-generation biodiesel is momentous for the sustainable development of global energy, which overcomes the shortcomings of first-generation biodiesel. The methanotreating of vegetable oil is a potential new route for the production of second-generation biodiesel, which is comprehensively investigated in this study. Throughout the screening of the catalysts, Ga-Ce/TS-1



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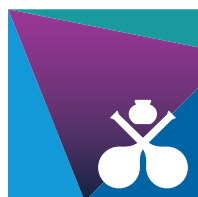


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demonstrates the best overall performances in this methane-incorporated process, leading to 84.23 % of liquid yield, 0.95 % of methane conversion, 72.8 % of oxygen content reduction, and 71% of light hydrocarbon distillates yield. The participation of methane promotes deoxygenation performance, optimizes the composition of paraffinic and olefinic hydrocarbons, as well as suppresses coke formation. The catalytic methanotreating of vegetable oil is confirmed to be a promising pathway to second-generation biodiesel.

EAT LOQ Integration of membrane processes for the recovery and separation of polyphenols from winery and olive mill wastes using green solvent-based processing

Tapia-Quirós, P., *et al.*, *J of Environ Manage*, 307, 114555, 2022, <https://doi.org/10.1016/j.jenvman.2022.114555>

Winery and olive mill industries generate large amounts of wastes causing important environmental problems. The main aim of this work is the evaluation of different membrane separation processes like microfiltration, ultrafiltration, nanofiltration, and reverse osmosis for the recovery of polyphenols from winery and olive mill wastes in aqueous solutions. Membrane processes were tested separately in a closed-loop system, and by an integration in a concentration mode sequential design (open-loop). Feed flow rate was varied from 1 to 10 mL min⁻¹, and permeate samples were taken in order to measure the polyphenols concentration. The separation and concentration efficiency were evaluated in terms of total polyphenol content, and by polyphenols families (hydroxybenzoic acids (HB), hydroxycinnamic acids (HC), and flavonoids (F)), using high performance liquid chromatography. Results showed that MF and UF membranes removed suspended solids and colloids from the extracts. NF was useful for polyphenols separation (HB rejections were lower than for HC and F: HB rejections of 50 and 63% for lees filters and olive pomace extracts, respectively), and RO membranes were able to concentrate polyphenols streams (86 and 95% rejection from lees filters and olive pomace, respectively). Membranes sequential designs for lees filters and olive pomace extracts, using a selective membrane train composed by UF, NF and RO membranes, were able to obtain polyphenol rich streams and high-quality water streams for reuse purposes.

EAT Multiple phase transitions and microstructural rearrangements shape milk fat crystal networks

Arita-Merinoa, N., *et al.*, *J Colloid and Interface Sci*, 607, 1050, 2022, <https://doi.org/10.1016/j.jcis.2021.09.071>

Hypothesis: The rheology of milk fat, which is strongly related to its functionality, reflects multiscale structural transitions in the colloidal network formed by crystallizing triacylglycerols. Experiments: To relate rheology to structure, early stages of milk fat crystallization at 15–22°C were studied combining different techniques; XRD and microscopy to study structural changes,

NMR to quantify the different structures, and rheology to evaluate their effect on macroscopic properties. Findings: Network strength increased with the synchronized formation of micro- and nanostructures. A rheological response was only obtained when these structures became visibly connected on a microscale, and internal transitional changes could be detected with rheology. On the nanoscale, transitions were linked to the formation of specific crystal polymorphs. We quantified the formation of polymorphs commonly found in milk fat (-2 and -2) and of two less commonly obtained polymorphs: -2 and -2. For the first time, the formation of these polymorphs was quantified and related to the composition of fat. Besides providing insights into the complex phase behavior of milk fat, this study shows that the structural transitions involved can be characterized and quantified by combining XRD with NMR and be detected at an early stage using rheology and microscopy.

H&N IOP Effects of different processing methods on the lipid composition of hazelnut oil: A lipidomics analysis

Sun, J., *et al.*, *Food Sci Human Wellness*, 11, 427-435, 2022, <https://doi.org/10.1016/j.fshw.2021.11.024>

Although hazelnut oil is rich in nutrients, its quality is greatly affected by how it is processed. However, no studies to date have comprehensively analyzed the lipid composition of hazelnut oil using different processing methods. Here, we conducted a lipidomics analysis using UPLC-QTOF-MS to characterize the lipid composition of cold-pressed hazelnut oil (CPO), ultrasonic-assisted hexane hazelnut oil (UHO) and enzyme-assisted aqueous hazelnut oil (EAO). A total of 10 subclasses of 98 lipids were identified, including 35 glycerolipids (GLs), 56 glycerophospholipids (GPs) and 7 sphingolipids (SPs). The total lipid and GL content were the highest in CPO, GP content was the highest in UHO and the ceramide content in SPs was most abundant in EAO. Multivariate statistical analysis showed that the lipid profiles of hazelnut oil prepared with different processing methods varied. Twelve significantly different lipids (TAG 54:3, TAG 52:2, TAG 54:4, TAG 54:2, TAG 52:3, TAG 54:5, DAG 36:2, DAG 36:4, DAG 36:3, PC 36:2, PA 36:2 and PE 36:3) were identified, and these lipids could potentially be used as biomarkers to distinguish between hazelnut oil subjected to different processing methods. Our results provide useful information for hazelnut oil applications and new insight into the effects of edible oil processing.

EAT PRO H&N Potential benefits of structured lipids in bulk compound chocolate: Insights on bioavailability and effect on serum lipids

Ledesma, R., *et al.*, *Food Chem*, 375, 131824, 2022, <https://doi.org/10.1016/j.foodchem.2021.131824>

The bioavailability impact of serum lipids in compound chocolate products based on structured lipids was studied. Compound chocolate products containing fat with and without structured lip-

ids were digested in vitro under simulated gastrointestinal lipolysis conditions and were studied in vivo in healthy C57BL/6J mice. The in vitro digestion results show that products containing structured lipids, milk compound chocolate filling and white compound coating, significantly reduced the release rate of Free Fatty Acids (FFA) and improved the caloric reduction between 12.49% and 13.71% compared to products without structured lipids, suggesting that FFA were not absorbed. Animal feeding studies revealed no adverse effects on the compound products intake; in fact, these products reduced total cholesterol, LDL-c, VLDL-c and triacylglycerols. The present work shows the relevance of developing functional compound chocolate as providing a potential healthy initiative through the biological effect of the bioactive ingredients incorporated.

ANA Optical Determination of Solid Fat Content in Fats and Oils: Effects of Wavelength on Estimated Accuracy

Grossi, M., *et al.*, *Euro J Lipid Sci Tech*, 124, 2100071, 2021, <https://doi.org/10.1002/ejlt.202100071>

The melting profile of solid fat content (SFC) is a parameter of primary importance for the food industry since it affects many important product characteristics such as stability, physical appearance, spreadability, and sensation in the mouth. Reference techniques to measure SFC in fats and oils include pulsed nuclear

magnetic resonance (pNMR) and differential scanning calorimetry (DSC), which are reliable and accurate, but require expensive instrumentation and trained personnel. Herein, the accuracy of a recently proposed optical technique to measure SFC is investigated in terms of peak wavelength of incident radiation. A sensor system featuring an array of seven LEDs with peak wavelength in the visible and NIR range is built, and the results compared with data from DSC. All the wavelengths investigated have high accuracy in SFC estimation, especially at 590 (yellow) and 880 nm (NIR).

IOP PRO Lipase and Phospholipase Combination for Biodiesel Production from Crude Soybean Oil

Steinke, G., *et al.*, *BioEnergy Research*, 2022, <https://doi.org/10.1007/s12155-021-10364-3>

Biodiesel (fatty acid methyl esters – FAME) can be produced by enzyme-catalyzed hydroesterification, which is suitable for processing low-cost feedstocks with high content of free fatty acids, phospholipids, and moisture. Thus, this work aimed at synthesizing FAME in a one-step process, performing degumming and hydroesterification of non-degummed soybean oil simultaneously, using enzymes as catalyst. The combinations of soluble lipase Eversa® Transform 2.0 (NS-40116) and two phospholipases (Lecitase® Ultra and Quara® LowP) were evaluated in order to obtain high phosphorus removal and FAME conversion. The acidity and bound



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glycerin contents were monitored during the reactions. By combining 5,000 ppm of NS-40116 and 50 ppm of Quara® LowP, almost 95% of phosphorus was removed and 86.23% of FAME yield was obtained at 45°C, 2 wt% of water, 1.5 methanol equivalents in a 72-h process. The results indicated that combining lipase and phospholipase in a one-step process (degumming and hydroesterification) is a promising alternative for biodiesel production from low-cost feedstocks.

IOP PRO Experimental Analysis of *Sterculia foetida* Biodiesel and Butanol Blends as a Renewable and Eco-friendly Fuel

Devarajan, Y., *Industrial Crops and Products*, 178, 114612, 2022, <https://doi.org/10.1016/j.indcrop.2022.114612>

The current research intended to investigate the performance, emission and combustion characteristics of *Sterculia foetida* biodiesel blending with n-butanol at two different proportions (5% and 10%). The non-edible nature of the *Sterculia foetida* kernel oil favored choosing as feedstock. It comprises more than 70% of sterculic acid, a cyclopropane ring in its chemical structure. The base-catalyzed transesterification process converted *Sterculia foetida* kernel oil into biodiesel. The n-butanol additive was added in 5% & 10% volume as an oxygenated fuel to *S. foetida* / diesel blends for reducing emissions and improving thermal efficiency. Investigations revealed that brake thermal efficiency was improved by adding n-butanol in the blends compared with 20% *S. foetida* biodiesel + 80% Diesel. The emissions such as carbon monoxide, smoke opacity and hydrocarbons have significantly reduced vis-à-vis standard diesel. The oxides of nitrogen (NO_x) and carbon dioxide (CO₂) decreased relative to 20% *S. foetida* biodiesel + 80% Diesel. The analysis in combustion registered an improvement for butanol/diesel/biodiesel blends relative to *S. foetida* biodiesel owing to the innate content of oxygen in Heat Release Rate and In-Cylinder Pressure. Hence the addition of butanol with *S. foetida* biodiesel appears as a good substitute for straight diesel.

IOP PRO PCP Lignin Depolymerization and Biotransformation to Industrially Important Chemicals/Biofuels

Radhika, N.L., *Fuel*, 312, 122935, 2022, <https://doi.org/10.1016/j.fuel.2021.122935>

Lignin is a potential feedstock due to its energy content and its abundant availability from biomass based biorefinery. Among the different fractions of biomass, lignin has been under utilized

due to its hetero aromatic polymeric structure. Development of options for lignin or lignin rich residue valorization can balance the economics of bioethanol based biorefineries. Lignin is also being viewed as alternative to the aromatics and polymer industry, apart from the source of biofuels/bioenergy. In spite of various physico-chemical and other available abiotic methods, biological methods of lignin depolymerization and its transformation to biofuels or value-added products got significance due to their economic and environmentally benign nature. Extensive research has been carried out on the biological methods of lignin depolymerization, considering fungi, enzymes and bacteria. In this review, a comprehensive view on types of lignin and their characteristics, existing methods of lignin depolymerization with a special emphasis on microbial methods and various industrial applications, viz., biofuels, lipids, polyhydroxyalkanoates, vanillin and dicarboxylic acid, etc., were presented. In conclusion, the critical aspects of lignin depolymerization to be considered to increase the product yield and possible future perspectives were also discussed.

IOP PRO PCP A Renewable Lignin-Derived Bio-Oil for Boosting the Oxidation Stability of Biodiesel

Umar, Y., *Renewable Energy*, 182, 867, 2022, <https://doi.org/10.1016/j.renene.2021.10.061>

The valorization of lignin is being increasingly recognized to improve the economics of pulp and paper making mills. In the present study, an integrated lignin–glycerol valorization strategy is introduced with an overarching aim for enhancing the process value chains. LignoBoost kraft lignin was subjected to base-catalyzed depolymerization using glycerol as a co-solvent. The generated bio-oil was used as a renewable additive to biodiesel for enhancing its oxygen stability. The influence of three independent parameters including temperature, time and glycerol amount on lignin depolymerization was investigated. Response surface methodology was applied to design the experiments and to optimize the process for maximizing the yield and antioxidant impact of bio-oil. The results showed that glycerol has a positive qualitative and quantitative impact on the produced bio-oil, where an enhancement in the yield (up to 23.8%) and antioxidant activity (up to 99 min induction period) were achieved using the PetroOxy method (EN16091). The addition of 1 wt% bio-oil to biodiesel has led to an improvement in the oxidation stability over a neat sample of up to ~340%, making it compliant with European standard (EN14214). The proposed process presents a biorefinery paradigm for the integrated utilization of waste cooking oil, lignin and glycerol.

A photograph of a man with dark hair and a beard, wearing a grey sweater, leaning over a young child with blonde curly hair. The child is wearing a blue and white patterned cardigan over a white shirt. They are both looking down at a wooden rolling pin and a bowl of dough on a wooden surface. The background is a blurred kitchen setting.

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