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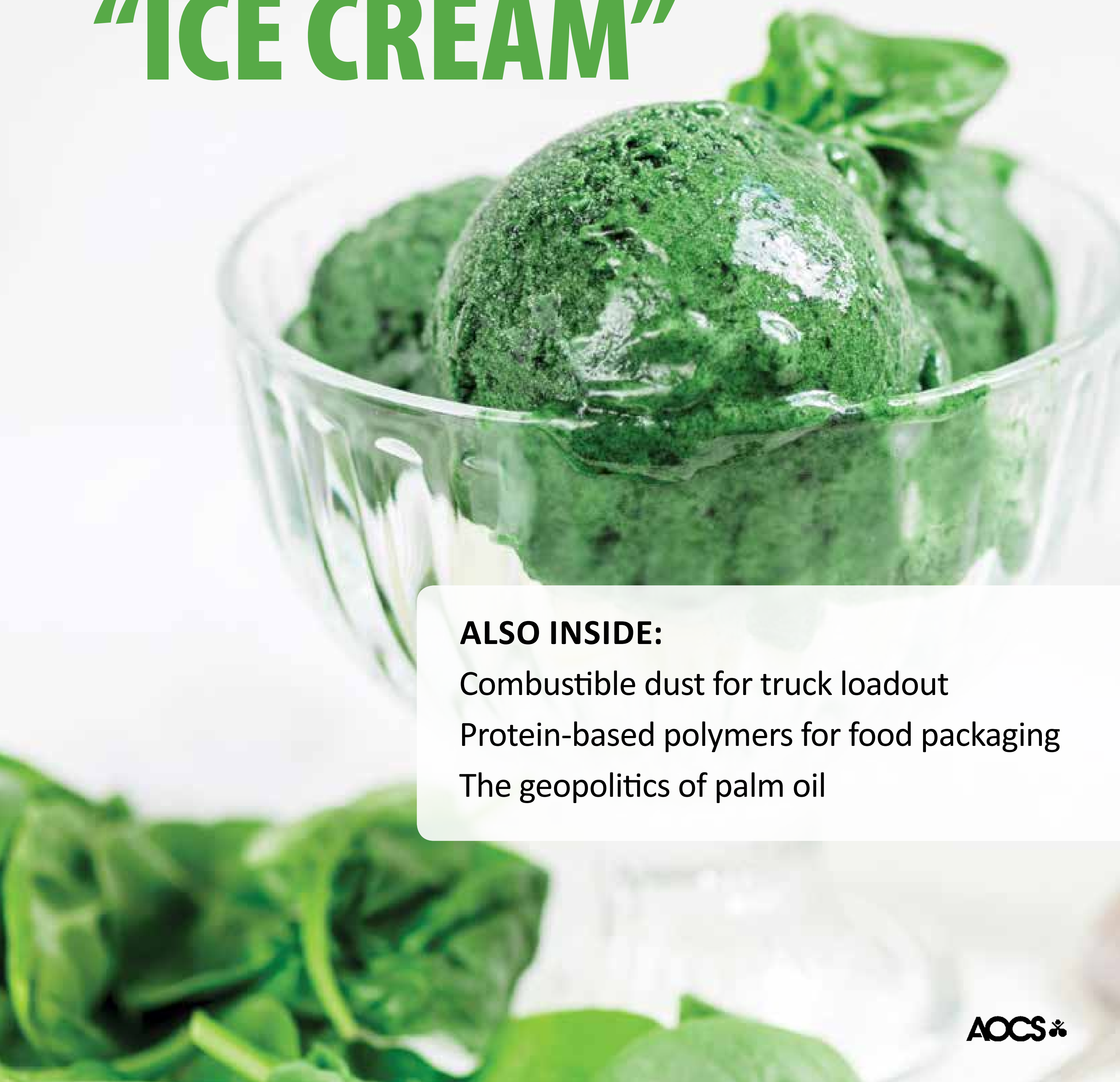
# INFORM

International News on Fats, Oils, and Related Materials

# PLANT-BASED "ICE CREAM"



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# Taking the cream out of ice cream

Rebecca Guenard

Want the ultimate sign that frozen desserts have changed? Spinach ice cream! In addition to the vitamin-rich main ingredient, the spinach-flavored treat has a non-dairy base to attract vegan customers (https://tinyurl.com/spinach-ice-cream). Van Leeuwen Ice Cream, the Brooklyn, New York ice cream shop that served the leafy-flavored scoop this summer, has been selling artisanal frozen desserts for a decade (https://vanleeuwenicecream.com/). They are among a group of producers on the leading edge of a resurgence of alternative ice creams. These frozen treats may still be cold and scooped into a cone, but their formulation is far more complicated than traditional ice cream.

- **Frozen dessert companies are reformulating ice cream to appeal to health and environmentally conscientious consumers.**
- **Replacing milk fat and protein requires completely rethinking the dessert formulations to emulate ice cream's taste and feel.**
- **Current non-dairy formulations are based on empirical tinkering; the product category needs a more scientific investigation of ingredient interactions.**

Plant proteins do not exhibit the same unique properties as milk proteins, and the complexity of milk fat is difficult to duplicate with non-dairy replacements. Removing dairy from frozen desserts inevitably results in a complicated food label as more and more ingredients are needed to produce the taste and texture of traditional ice cream.

"When making non-dairy frozen desserts you have to bring in the technology and the scientific knowledge to balance the amount of sugar, the amount of protein, and the amount of fat," says Robert F. Roberts, head of the food science department at Penn State University in University Park, Pennsylvania, USA. "And then you have to put that together in a way that is going to be stable so you can freeze it."

Despite the formulation obstacles, vegan ice creams are growing in popularity. They are marketed toward a myriad of consumers, like those trying to avoid digestive discomfort or concerned about the environmental strain caused by ice cream, as well as those making the choice to avoid animal by-products for ethical reasons. In addition, some frozen desserts are aiming for a bigger health food market. Alternative ice creams now include nutritional incentives like probiotics and extra protein (https://tinyurl.com/y3unejyf). Manufacturers seem to be considering frozen desserts as a vehicle for supplementing basic nutrition to reduce the risk of certain diseases and health conditions.

Some experts think that alternative ice creams need more research to understand the molecular interactions of the ingredients before they get too established in the market. The formulation for the non-dairy frozen desserts have thus far been determined empirically. In contrast, the science of traditional ice cream is well-known. What can non-dairy ice cream producers take away from the treat humans have enjoyed since antiquity? And what can consumers expect from this rapidly changing product?

## THE PROTEIN PREDICAMENT

Typically, traditional ice cream is composed of the following mixture: fats, proteins, sweeteners, stabilizers, emulsifiers, water, and flavors. As this mixture is whipped, air also gets incorporated. Milk proteins provide important structural functions for blending these ingredients into a

creamy, smooth texture. The proteins (lactose, casein, whey, etc.) stabilize the partial coalescence of the fat phase and maintain small air bubbles. The proteins also enfold water, which gives the product body and texture while preventing ice crystallization. Finally, they add a sweetness to the ice cream, reducing the amount of added sweetener that is needed. In short, dairy is a critical ingredient that cannot be replaced with a single substitute. Multiple components are necessary to make up for all the duties dairy fulfills (Fig. 1).

"The biggest problem I see when I talk to lay people is, they say, 'I just replaced the cow's milk with soymilk and it didn't work,'" Roberts says. "That is because cow's milk and soymilk are not the same thing." He says soymilk, almond milk, and other non-dairy beverages do not contain as much protein, and the proteins they contain function differently. "It certainly doesn't contain any lactose; it doesn't contain the right minerals," he says.

Roberts points out that using the word "milk" to describe almond and soy beverages leads manufacturers and consumers to assume such products function like dairy. "People think they can replace these things one for one and they cannot," he says. "This absolutely does not work."

He says the main reason for this failure is composition. Dairy protein isolates are primarily protein, about 85 or 90 percent. A pea protein flour or a soy protein flour, on the other hand, has roughly 12 percent protein. That means when you

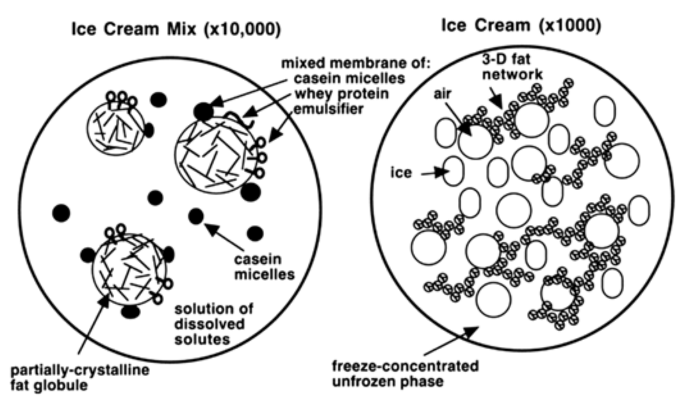


**FIG. 1. Illustration of the interplay between fat, protein, water, and air in dairy-based ice cream.** Source: Goff, Chapter 13 from *Advanced Dairy Chemistry, volume 1B:* proteins, applied aspects, McSweeney and Mahony editors, Springer, New York, 2016.

add these protein isolates to an alternative ice cream formula, you are incorporating a much higher number of unknown ingredients.

According to Roberts, in addition to having lower concentrations of protein than dairy, plant proteins grow inconsistently. The plant's variety, where it is grown and under what conditions, all influence protein production. "We have been studying milk for a long time. There is a couple hundred years

of research data on milk," he says. "We know milk comes from a cow, so biologically there is some variation, but in general milk has a similar composition." Even within a single plant species, he says, there is enough variability that it could affect a frozen dessert formulation. As a result, alternate ice cream producers may find they need to change their formulation when swapping out protein suppliers. Robert's research group plans to study how functional properties change with these inconsistencies in plant protein isolates. It is one of many studies that are needed to better understand these products.

"Not much has been published on the science of plant-based ice creams," says Finn Hjort Christensen of DuPont Nutrition Biosciences in Denmark.

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Christensen is working on emulsifiers for vegan ice creams. Without the stabilizing properties of milk proteins, alternative ice creams rely on emulsifiers to distribute air in small bubbles throughout the product. A traditional ice cream might use egg yolk as the emulsifier, which is not possible with vegan, or even low-fat ice creams. He says emulsifiers are crucial to making these alternative ice creams with vegetable-based proteins. "If you have very poor air incorporation that means that you are trying to force in air and it is not being distributed," says Christensen. "The air bubbles would be really big, and when it comes out of the freezer it looks like Swiss cheese."

Working empirically, he has found that mono- and diglycerides, and acetylated diglycerides work well as emulsifiers for vegan ice creams. However, he admits that he does not understand the interactions between these emulsifiers and plant proteins enough to achieve better air incorporation. Christensen echoes Robert's statement that scientific studies of plant-based frozen desserts are not available yet. "We have been making dairy based ice cream for the last two hundred years, whereas it has only been within the last 5 years that we have seen a growing interest in the plant-based version," he says. Though, with all the large, international companies launching products within this segment of the industry he says he believes a lot of research will be published soon.

## DESSERTS AS HEALTH FOOD

One factor that may push research forward is the rebranding of these desserts as functional foods. Such foods are intended to provide a benefit beyond basic nutrition, like minimizing a consumer's risk for type-2 diabetes. Low-fat or sugar-free options have now evolved into ice cream with prebiotics, probiotics, or higher protein. For some of these formulations, not having cow's milk is an advantage.

One of the first modern-day alternative ice creams to come on the scene, in 2012, was Halo Top, a US company headquartered in Los Angeles, California. Within 5 years, Halo Top became the top-selling pint of ice cream in the United States while also gathering a long list of competitors. Well-established brands like Häagen-Dazs, Magnum, and Ben&Jerry's have developed more healthy options, and start-ups focused on healthy alternatives are regularly cropping up.

The latest is a brand from the Netherlands called Koupe. In an interview with Food Navigator, Koupe founder, Jaco Pieper, said that in addition to having reduced sugar, fat, and calories, his product offers something extra for your health: protein and prebiotic fiber (https://tinyurl.com/y52wpa69). Koupe touts the energy boost its consumers will get from the addition of lean protein and fiber, but it is less and less novel to find these ingredients in snacks and desserts. Even candy bars are being sold with added protein (https://tinyurl.com/yyhm3824). Halo Top has protein- and fiber-containing varieties among their products as well.

A unique approach to providing a healthy treat is allowing the growth of bacteria that benefit the gut. The idea of fermented ice cream mirrors yogurt, which harbors strains like *Lactobacillus acidophilus* and *Bifidobacterium Bifidum* that enhance digestion and overall health. However, probiotic cultures do not grow rapidly in ice cream made from cow's milk. Similarly, not all frozen yogurt has the same probiotic concentration as standard yogurt; if it has any at all.

Research shows that replacing cow's milk with plant products, such as soy or coconut, promotes better probiotic growth (https://doi.org/10.1016/j.lwt.2016.02.056). In a collaboration between the University of Malaya, Lumpur, Malaysia, and King Abdulaziz University in Jeddah, Saudi Arabia, researchers found that the population of *Lactobacillus acidophilus* bacteria increased more than *Bifidobacterium Bifidum* in both soy and coconut milk, but both cultures were higher than in cow's milk. In addition, a mixture of 75% soy milk and 25% coconut milk grew nearly double the amount of these bacteria that grows in cow's milk. The investigators point out that the sugars and amino acids the bacteria need to grow are more abundant in these mediums than in cow's milk.

Alternative ice creams are now suited for a wide range of consumers' dietary needs. A frozen dessert with vegetables, protein, and gut-healthy bacteria evokes less guilt than traditional ice cream. Sustainability studies provide one more reason for consumers to gravitate to dairy-free frozen treats.

## Biotech ice cream

In April 2019, *Inform* reported on biotech companies that were using fermentation as a new way to manufacture proteins (https://tinyurl.com/y2al3h8s). One of these companies, Perfect Day, has released a limited supply of ice cream made from the whey protein they develop without cows.

Perfect Day was founded in San Francisco, California, USA, by two vegans with experience working in the biopharmaceutical sector. They established their company in 2014, with the goal of creating milk proteins through the fermentation practices used by biopharma. In doing so, they fulfilled their vegan belief of avoiding animal byproducts, while still eating foods they enjoy, like cheese, yogurt, and ice cream.

The company has no plans to enter the manufacturing realm itself but will partner with companies who will formulate their proteins into food products (their most notable joint venture was in 2018, with Archer Daniel Midland). However, Perfect Day produced an ice cream for limited release that was only available through their website. The sample pack consisted of three pints of different flavors at a cost of $60 (closer to $100 with shipping). Within hours the company sold out of the one thousand packets of "animal-free" ice cream it made available. (https://www.perfectdayfoods.com/taste-the-magic/).

Those that had the opportunity to try it before it was gone report that they could not tell the difference between Perfect Day and traditional ice cream (https://tinyurl.com/yxe6flgh). Instead of the gritty, wateriness that non-dairy ice cream consumers usually say they experience with alternative ice creams, Perfect Day's ice cream was described as smooth and creamy. Milk proteins, even if they are lab-grown, provide the crucial bridge that combines all the ingredients in the frozen treat.

If this temporary release was a test of consumer acceptance of lab-grown dairy proteins, the ice cream's rapid sell out could be taken as a sign of success.

**Founders Ryan Pandya and Perumal Gandhi eating animal-free ice cream made with Perfect Day protein.** Courtesy of Perfect Day.

## AN ENVIRONMENTAL CONCERN

Adisa Azapagic, a researcher at the University of Manchester in Manchester, U.K., recently coordinated a study of dairy ice cream's effect on the environment. "What we wanted to do was evaluate and estimate the life-cycle environmental impact of ice cream which had not been done previously," she says. Her research team evaluated ice cream production from start to finish. They considered everything from the production of raw materials, to the manufacturing process, to the energy used for refrigeration, to end-of-life packaging, and disposal. They also considered the effect of all the transportation steps in between, and the waste produced across ice cream's entire lifecycle.

Of all the processes she studied, Azapagic found that the production of milk had the biggest impact on the environment. She says the methane produced on dairy farms adds to the greenhouse gases in the environment that contribute to climate change. "Anything that eliminates milk will have a lower environmental impact," she says.

Frozen desserts that eliminate milk, such as sorbets, are one thing, but Azapagic says consumers cannot assume that substituting with plant-based ingredients is more environmentally friendly. Her group's impact study included cocoa cultivation for chocolate flavored ice cream. "Farmers open up new lands and plant new cocoa beans. We call that land use change," says Azapagic. "This is typically associated with high carbon emissions." She says that if there was increased land use associated with cultivating soybean, for example, non-dairy frozen desserts based on soy could have a similar environmental impact as that of dairy ice cream. Without impact studies, it is impossible to claim that alternative ice creams are better or worse for the environment than dairy based.

"I have not seen studies which look at these new types of ice cream and estimate the environmental impact of replacing the milk with some of the alternatives," Azapagic says. "Unless you have captured some numbers, it is dangerous to speculate."



## THE FUTURE OF FROZEN DESERTS

For all the ice cream innovation that has occurred in the past five years, more work remains. For many consumers the flavor and texture of plant-based frozen desserts is still unappealing.

Despite the added protein and fiber that some Halo Top flavors offer, the legumes used as the source for these ingredients reportedly leave a dry taste in the mouth (https://tinyurl.com/y65gctz3). The addition of plant materials and the removal of milk fat makes mouth feel a continued challenge for alternative ice creams. "Milk fat has hundreds of fatty acids in it, with about twenty in abundance" says Roberts. "Most typical vegetable fats only have three or four." The complexity of fatty acids in milk translates into a complex freezing profile that inhibits traditional ice cream from crystalizing at a single temperature, he says. This, in turn, leads to the smooth, creamy feeling in the mouth when it melts. Alternative frozen desserts still face the challenge of feeling watery and icy in the mouth (https://tinyurl.com/y5k9k6n6).

Then there is the obstacle of taste. Roberts says that with dairy formulations manufacturers can make a neutral base that does not impart a flavor. "You can make a white background for people to add their strawberry or vanilla or whatever flavor they want to put into the product, he says. "Folks in the plant-derived industry would like to do the same thing." However, plant products have an inherent taste that formulators must mask to create a neutral base.

"You definitely see more and more of these plant-based products coming on to the market," says Christensen. "If we have found the holy grail yet, with regards to formulation, I don't know. It's still an area where there is not a lot of research on how to improve."

In July 2019, a new kind of dairy-free ice cream hit the market with the potential to displace all the new alternative brands (see "Biotech ice cream," page 9). The ice cream contains milk proteins that were not produced from an animal (https://tinyurl.com/y2qs3q9r). The product is made by Perfect Day, a San Francisco, California company using the fermentation of microflora to produce milk proteins. The proteins function like those in traditional ice cream. If consumers accept this animal-free source, the world of ice cream could change yet again.

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# Effective dust control for grain/meal truck loadout

Matt Williamson

- Truck loading areas for grain or processed meal accumulate combustible dust and must comply with the new combustible dust safety standards implemented by NFPA 652 and enforced by the US Occupational Safety and Health Administration (OSHA).

- The electrical area classification for indoor truck loadout bays can be difficult and expensive to address, since most of these facilities were constructed before these standards were issued.

- Here are some strategies for implementing dust control that will help you satisfy electrical area classification requirements and meet these new standards in the most cost-effective way.

If your facility loads out bulk trucks of grain or processed meal, then you are well-aware of how much dust can cloud up and accumulate around the loadout area, including on floors, rafters, lights, ductwork, and equipment (Fig. 1). This dust is combustible and must be addressed for compliance with the new combustible dust safety standards implemented by NFPA 652 and enforced by the US Occupational Safety and Health Administration (OSHA). The electrical area classification for indoor truck loadout bays is a particular concern, since most of these facilities were constructed prior to the issuance of these standards. Wholesale changes to existing electrical systems is often impractical, or even impossible. What is the most cost-effective way to implement dust control and satisfy electrical area classification requirements to meet these new standards?

## UNDERSTANDING THE RISKS

Bulk loadout facilities for open-top trucks are typically built indoors, or at least under a roof, for weather protection. However, this results in an "open system" where combustible dusts may be allowed to develop into dust clouds at concentration ranges that could lead to explosion. These combustible dust clouds drift and settle throughout the room, including over many potential ignition sources like hot truck exhausts and unrated electrical equipment, with operators and truck drivers often present in the area. This is why many dust explosions and flash fires have been known to occur in truck loadout areas, such as the one at White Farms in Indiana that caused a truck fire and silo collapse. A video of this event went viral in 2017 (https://www.youtube.com/watch?v=BXjwinZEPII).

Having a Dust Hazard Analysis (DHA) completed by individuals with expertise in combustible dust safety is critical to understanding the unique risks associated with each facility and is required by September

FIG. 1. Clouds of combustible dust are created when loading grain or processed meal into a bulk truck.

2020 under NFPA 652 "*Standard on the Fundamentals of Combustible Dusts.*" Whether it is performed internally or by an outside engineering consultant, the DHA will outline the potential hazards and priorities to develop an appropriate dust hazard implementation strategy for each individual site.

## DUST CONTROL STRATEGIES

Once the DHA has been completed, the next step in mitigating the risk in the bulk truck loadout operation is to reduce the development and life span of combustible dust cloud formation by implementing dust control measures. By pulling the dusts away from the loadout area as quickly as possible, the potential for a cloud to drift to an ignition source is greatly reduced. Additionally, this will minimize the hazardous accumulation of dust throughout the area, thus reducing required cleanup efforts.

The difficulty with dust aspiration over open-top bulk trucks is the sheer size of the open area where the bulk material is moving and generating dust. The pick-up velocity across the entire surface of the open area needs to be maintained at 250–500 feet per minute, which requires an enormous amount of air.

One common strategy is to install dust-controlled loading spouts. These consist of stacked cups inside a dust-controlled flexible sleeve, which can raise or lower for each loadout arm. Another option is a dust suppression hopper (Fig. 2, page 14), which returns the dusts back into the bulk stream at the discharge of the loading spout. These work well if the bulk density of the solids is highly consistent, because they must be designed for a specific bulk solid. However, if there is any variation to the bulk density, or if multiple bulk solids share the same loading spout, then dust suppression hoppers will be ineffective in controlling the dusts.

In such a shared loadout system, or when the bulk density is inconsistent, a truck loadout hood is the better option (Fig. 3, page 14). This hood may be indexed up or down as needed, or may be static in position. Flaps are necessary around the edge of the hood to maintain the air velocity; however, they must be cleaned regularly to prevent dust build-up. Hoods for large bulk trucks will require 20–30,000 cfm air with a large dust collector located outside of the loadout building. To cover a full truck, over 20 pick-up points may be needed from the top of the hood. A smaller hood may be designed if the truck is moved to loadout in sections.

## IGNITION SOURCE CONTROL STRATEGIES

The final step in mitigating the dust hazard is to remove or isolate potential ignition sources. One important step in the loadout procedure is to shut off the truck engine while actively loading the truck. Diesel truck exhaust pipes can reach temperatures as high as 649°C, which is more than enough to ignite any combustible dust cloud.

If the minimum ignition energy (MIE) of the dust is below 30 mJ, then personnel must not be allowed to access the pile until the dust has settled. Furthermore, the spouts and hood should be grounded and bonded per NFPA 77.

The biggest cost concern with existing truck loadout buildings is the electrical area classification. The loadout of a combustible material into an open-top truck or container constitutes an "open system" from an electrical classification standpoint. Therefore, a distance of 20 feet (about 6 meters) from the edge of the truck should be rated Class II, Group G, Division 1, with an additional 10 feet (3 meters) of Division 2 beyond that, per the guidelines of NFPA 499. This will likely encompass the entire truck loadout bay.

**FIG. 2. Dust suppression hopper (dustless spout) from Sioux Steel Company**

Upgrading all of the electrical equipment, conduit, wiring, and junction boxes to meet this standard may seem cost prohibitive, but may not be as bad as it seems. Unlike flammable liquids in a Class I environment, Class II dusts require "dust ignition proof" provisions in Division 1 areas and "dust tight" in Division 2, not necessarily explosion proof or intrinsically safe. For some electrical items commonly found in loadout buildings, such as ticket printers and computers, it is best to locate these inside of a separate loadout office inside of the loadout bay. These offices must be equipped with a self-closing door. If dustless or dust-controlled spouts or hoods can prevent the formation of dust clouds altogether, and the area around the trucks is kept clean, it is possible to avoid the Division 1 classification entirely.

As with any regulatory concern, having a qualified engineer survey your existing loadout area and recommend specific upgrades where necessary can prevent major problems in the long run.

*Matt Williamson is a Professional Engineer (PE) with over 30 years of process engineering and project management experience, and a recognized expert on combustible dusts and related regulations. He is the Director of Engineering at ADF Engineering, Inc., based in Miamisburg, Ohio, USA, and can be reached at mwilliamson@adfengineering.com*

**FIG. 3. A loadout hood**

# The significance of advocating one's own research findings with the world

Kinya Tsuchiya

- During the 2019 AOCS Annual Meeting & Expo, Nisshin OilliO Group, Ltd., received the AOCS Corporate Achievement Award "in recognition of excellence and innovation in the research and development of specialized medium-chain triglyceride (MCT) oil food products."
- Japan has the largest percentage of elderly people in the world, and the Japan-based company has developed several unique food products with MCTs that easily convert to energy, are less readily stored as body fat, and turn into ketones to supplement the cerebral glucose metabolism that slows down with age.
- Nisshin OilliO's goal is to develop foods that address health concerns throughout the lifespan, and their patents usually disclose big leaps. Somehow, they have unlocked a secret that allows them to consistently innovate at a higher level than most companies. This article by the General Manager of the R&D Center explains why it's important for young scientists to advocate, make new connections, and share ideas with the world.

Upon receiving the 2019 AOCS Corporate Achievement Award, I thought about the young scientists who work hard every day in the labs of our R&D Center, and was inspired to tell them about the importance of understanding the significance of advocating for one's research findings with the global audience.

It was with great honor and humility that the Nisshin OilliO Group received the Award. We were pleased to have eight team members present to witness this exciting occasion, including some of our younger associates enjoying their first visit to such a conference in the United States. On the plaque that was presented to us at the annual meeting in St. Louis, it says: "In recognition of excellence and innovation in the research and development of specialized medium-chain triglyceride (MCT) oil food products." This special recognition lifted us up into a new level of challenge. Our young scientists' mission now is to live up to the Award; to persevere and progress, with the Award as a symbolic driving force to advocate their research.

## AOCS: A GOOD PLACE TO ADVOCATE

The history of Nisshin OilliO's research advocacy started back in 2004, with the company's participation in AOCS. Dr. Ching T. Hou, Senior Scientist at the National Center for Agricultural Utilization Research–US Department of Agriculture, had a deep understanding and interest in our presentations and encouraged us to continue participating in the Society's meetings. At the time, our company was preparing to take a leap forward into the global business arena. So, this provided added impetus for us to follow Dr. Hou's guidance. For us, 2004 was a year of truly "going global." Since then, we have continued to participate in the AOCS meetings every year, contributing many presentations in the area of enzymatic interesterification technology, the key technology in developing our medium- and long-chain triglyceride (MLCT) cooking oil.

The first time I attended the AOCS meeting I asked a consultant to accompany me. The consultant had worked as a director for a global oils and fats processing company and had participated in myriad international conferences. He was the one who taught me that AOCS has a "science" side and a "business" side. Business meetings are held side-by-side with the scientific meetings, he explained, and scientists, especially corporate scientists, should not hesitate to advocate for their data. It is now my turn to mentor the younger scientists in this approach. Since going global is the ultimate mission, it is a great advantage for our scientists to participate in AOCS, to advocate, make new connections, and share their findings with other participants. It is also important for our scientists to listen carefully and open their minds to findings and new ideas presented by other participants. This advocacy and sharing of ideas will contribute to the growth and development of Nisshin OilliO and ultimately benefit everyone as progress is made in the field overall.

"THE MOST IMPORTANT THING IS: UNDERSTANDING THE SIGNIFICANCE OF ADVOCATING FOR ONE'S RESEARCH FINDINGS WITH THE WORLD." — Kinya Tsuchiya

## A LUCKY ENCOUNTER

In 2017, we decided to exhibit what at the time was our latest innovation of MCT oil—the C10 (capric acid) powder—at the AOCS annual meeting. The powder was still in the development stage, and the only results we had up to that point were from an in-house evaluation. Yet, imagine the sincere pride in the hearts of the scientists who had worked on it. I knew we needed to advocate the discovery, but, at the same time, to get a calm and objective third-party opinion on it. We were very lucky to have a fellow AOCS scientist assess the powder. Through his eyes, we could see many possibilities for introducing it to the world. We also asked others at the meeting to imagine potential uses for C10 powder, and we considered these ideas along with our own to create new foods consistent with our goal to enhance health throughout the lifespan.

## TO ADVOCATE OR NOT TO ADVOCATE: THERE IS NO QUESTION!

To present one's findings at a conference or to publish one's article in a journal is to carve one's name in the world of science and go down in history. It also involves boldly advocating for one's hypotheses, data, and discussions with the world, hoping that there is no mistake in the data, that they are unique, and that it does not sound too arrogant…But why must one advocate? Because it helps us see things that we could not see before—by allowing us to view our own work objectively, through the eyes of others. For example, we may gain insight into the social significance of the data, or find out how consistent the data really is with the business goals of the company. Once advocated, there will be many reactions—some in favor, some against. Nevertheless, it takes careful deliberation and courage to advocate. Taking this approach will encourage not only the personal development of the young scientist but will also benefit the company as a whole, as we move forward with "going global."

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*Kinya Tsuchiya has been an Officer and General Manager of the Central Research Laboratory (R&D Center) of the Nisshin OilliO Group, Ltd., since April 2019. Before that, he headed Nisshin's Medium-Chain Triglyceride (MCT) Strategic Business, where he proposed and created Memorion, an MCT gel product with a purpose of providing the benefits of MCTs to people with various health conditions. Since joining the company in 1988, Kinya's responsibilities have included analyzing the structure-and-composition of triacylglycerol, vitamin E, and phytosterol; evaluating the "crispiness" and "crunchiness" of deep-fried food with a sound-measuring device; and creating the building blocks for the company's palm oil business. He can be contacted at k-tsuchiya@nisshin-oillio.com.*

# Proteins: natural polymers with potential application for food packaging

Sergio de Jesús Calva Estrada, Maribel Jiménez Fernández, and Eugenia Lugo Cervantes

Plastic materials represent almost half of the global packaging market (22.8% of the total market being rigid plastic and 24.85% flexible plastic). The food sector is the main client of the flexible packaging market due to the need to extend food's shelf life. Most of these packaging materials are petroleum-based, and both the depletion of natural petroleum resources and the waste from these undegradable materials have increased environmental concerns.

- **Proteins are natural polymers with potential application in the sustainable development of safe food packaging.**
- **Proteins confer desirable physicochemical, mechanical, stability, and security properties to packaging that is in direct contact with food.**
- **They are also excellent vehicles for various bioactive compounds, making them useful in the development of active packaging.**

One possible solution is to replace petroleum-based plastic packaging with biodegradable material based on renewable natural polymers, better known as "bioplastics." This is an eco-friendly alternative since some bioplastics can be easily degraded by the enzymatic action of different microorganisms. The bioplastics market is projected to exceed $3.4 billion by 2020, with a growth rate of 10.8% per year. Biodegradable protein-based films have gained attention for use in the food-packaging industry due to consumer demands for high-quality foods, use of natural preservatives, and eco-friendly packaging.

Many animal and vegetable proteins have been studied for their potential in packaging due to their relative abundance, good film-formation ability, biodegradability, and nutritive value.

Protein-based films tend to exhibit better gas and aroma barrier properties—as well as better mechanical properties—than those derived from lipids and polysaccharides. Also, due to their amphiphilic nature, they can be carriers for active compounds that preserve the quality and nutritional value of foods and food nutrients.

## PROTEIN SOURCES FOR FILMS

Commercial production of bio-based food packaging requires an abundant supply of natural materials. Agro-industrial by-products are increasingly being revaluated for their potential as waste resources for industrial use, and raw materials for the development of protein-based films can be obtained from sources and by-products of animal and plant origin. Table 1 summarizes some protein sources of films that have been studied and used to develop films with potential application in food packaging, along with their general advantages.

## PROTEIN SOURCES FROM ANIMALS

Gelatin is among the most-studied proteins. Gelatin has been shown to have excellent barrier properties against oxygen and aroma compounds at low or intermediate relative humidity, as well as satisfactory mechanical properties (good mechanical strength and high elasticity). Surimi, a concentrate stabilized with myofibrillar proteins obtained from the muscle of beef, pork, and chicken, can be used to make nutritional and biodegradable films with good mechanical strength. Caseins, which make up the major dairy-protein group, are obtained from milk. This group of proteins can be used to make opaque and water-insoluble films, and their barrier properties are useful for the control of oxygen permeability. Caseins and whey proteins, both by-products of cheese manufacturing, form films that provide an excellent barrier against oxygen and aroma compounds at low or intermediate relative-humidity conditions. Keratin, the major structural protein component of chicken feathers, is a protein source with good film-forming capacity. Egg white, a protein combination constituted mainly by ovalbumin (54%), can be easily processed at low temperatures and produces films with high transparency and elasticity.

## PROTEIN SOURCES FROM PLANTS

Sources of plant origin, such as soy protein, have an attractive film-forming ability. Wheat gluten readily forms films with selective gas-barrier properties and insolubility in water, but such films absorb water when submerged. Zein proteins, which represent the major class of storage pro-

**TABLE 1. Advantages of protein-based films deriving from different sources studied (Adapted from Calva-Estrada, S.J., M. Jiménez-Fernández, and E. Lugo-Cervantes, https://doi.org/10.1007/s12393-019-09189-w, 2019).**

| Protein | Advantage |
|---|---|
| **Animal proteins** | |
| ***Meat Proteins*** | |
| *Gelatin* | • Excellent film-forming capacity<br>• Excellent barrier properties against oxygen and volatile compounds at low or intermediate relative humidity conditions<br>• Good mechanical resistance and high elasticity<br>• Thermo-reversible with a melting point close to body temperature |
| *Myofibrillar protein* | • Good film-forming capacity<br>• Low tensile strength |
| ***Milk Proteins*** | |
| *Caseins* | • Low oxygen permeability<br>• Good mechanical properties<br>• Insoluble in water (but they absorb water) |
| *Whey protein* | • Good film-forming capacity<br>• Excellent barrier against oxygen, volatile compounds, and oil at low or intermediate relative humidity conditions<br>• Low tensile strength |
| *Albumen* | • Easily processed at low temperatures<br>• High transparency and elasticity |
| *Keratin* | • Good film-forming capacity |
| **Plant Proteins** | |
| *Soy protein* | • Good film-forming capacity |
| *Wheat gluten* | • Good film-forming capacity<br>• Selective gas barrier properties<br>• Insoluble in water (but they absorb water) |
| *Corn zein* | • Excellent film-forming capacity<br>• High tensile strength<br>• Low water vapour and oxygen permeability |
| **Others plant proteins** | |
| *Lentil protein*<br>*Peanut protein*<br>*Pea protein*<br>*Mung bean protein*<br>*Triticale protein*<br>*Pumpkin protein*<br>*Faba bean protein*<br>*Sunflower protein*<br>*Bitter vetch protein*<br>*Kidney bean protein*<br>*Red bean protein*<br>*Jatropha protein*<br>*Distiller dried grains protein* | • Good film-forming capacity<br>• Color and semitransparency (can be used for packaging of foods which are sensitive to light) |

**FIG. 1. Some protein films showing good film-forming capacity, color, and semitransparency, characteristics that are useful in packaging foods that are sensitive to light**

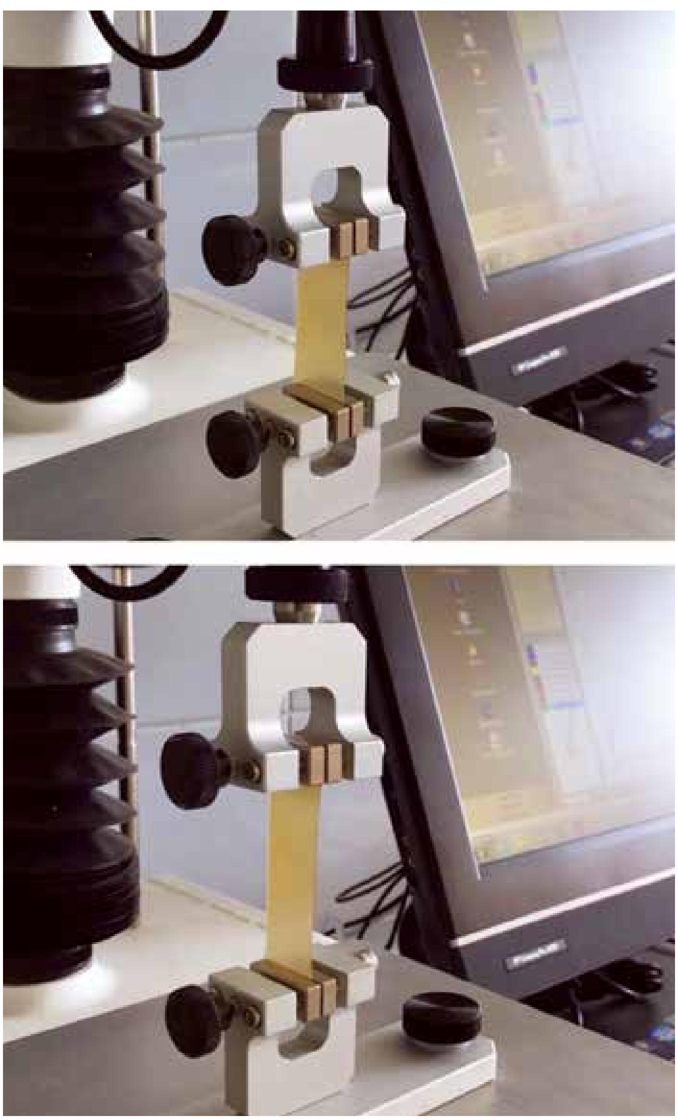

**FIG. 2. Some protein-based films have an elastic structure, an attractive property for food packaging materials**

teins in corn endosperm and are the main residue from the production of corn starch, have an excellent capacity to form films with high strength, glossiness, good moisture, and oxygen barrier properties. Other legume-seed proteins, such as lentil, pea, sesame, bean, triticale, pumpkin oil cake, faba bean, sunflower, and distilled dried grains with soluble protein, represent protein groups that form colored, semitransparent films that would be useful in packaging used to protect foods that are sensitive to light (Fig. 1).

In general, the protein sources previously mentioned have demonstrated great biodegradability and excellent biocompatibility. Among these, gelatin, myofibrillar proteins, whey protein, soy protein, wheat gluten, and zein have characteristics that are the most favorable for use in food-packaging materials (excellent barrier properties against oxygen and aroma compounds and satisfactory mechanical properties), which is why they are the most-studied.

## DEVELOPMENT OF PROTEIN-BASED FILMS

The process used to develop bio-based films is similar to that used in the processing of synthetic plastics. In this process, the native proteins must be denatured through treatments by heat, the addition of acid or base, and/or a solvent. Such treatments extend the protein structure and allow the protein chains in the structure to interact and associate, as it is these interactive forces (by electrostatic interactions, Van der Waals forces, hydrogen bonds, covalent and disulfide bonds) that generate the cohesive and elastic matrix (Fig. 2).

Due to their hydrophilic nature, protein films have higher water-vapor permeability than most synthetic polymers, such as low-density polyethylene (LDPE) and high-density polyethylene (HDPE), and they also exhibit weaker mechanical properties. Currently, different strategies have been applied in the development of protein-based films (Fig. 3).

The use of technological strategies, such as those of plasticization (incorporating small molecules that induce flexibil-

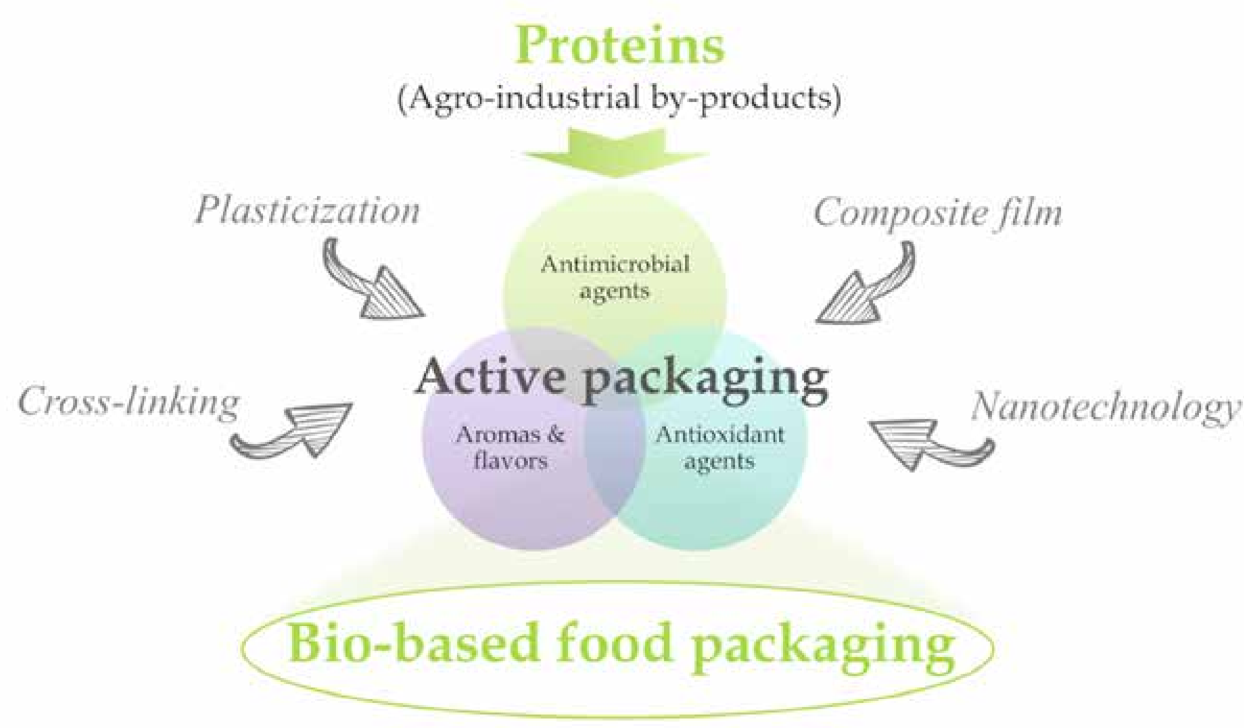


**FIG. 3. Schematic of tools and technologies applied together for the development of active bio-based packaging materials (materials with antioxidant activity; antimicrobial activity; and color, flavor, and aroma enhancers)**

ity, extensibility, and dispensability of the film), cross-linking (formation of stronger intermolecular covalent bonds that reduce polymer mobility), the development of composite films by blending with other polymers, and the application of nanotechnology by the inclusion of different nanostructures (nanoparticles, nanoemulsions, and nanoliposomes), have led to the use of proteins in the development of bio-based active packaging materials with potential application in foods.

## PROTEIN-BASED FILMS AS "ACTIVE PACKAGING"

Active packaging is the major area of research in the food packaging industry, as the active compounds within it play an active role in enhancing the safety and/or the organoleptic attributes of food and prolonging its shelf life. Protein-based films can be carriers for active compounds, such as antioxidants and antimicrobial agents (to preserve the quality of foods), nutrients (to increase nutritional value), substances such as color ingredients (to improve visual attributes), and volatile compounds and spice powders (to improve food aroma and taste). Many compounds obtained from natural sources with antimicrobial and/or antioxidant properties have been extensively studied in protein-based packaging materials. Some natural extracts such as green tea, oolong tea, black tea, and grape-seed extract, as well as essential oils from lemon peel, orange leaves, cinnamon, thyme, clove, oregano, ginger, orange leaves, lavender, marjoram, coriander, garlic, among others, are incorporated into protein-based films to create materials with novel applications in food preservation.

## Further reading

1) Calva-Estrada, S.J., M. Jiménez-Fernández, and E. Lugo-Cervantes. *Food Eng. Rev. 11*: 78, 2019, https://doi.org/10.1007/s12393-019-09189-w.

2) *Edible Films and Coatings for Food Applications* (2009) Huber K.C and Embuscado M.E., eds., Springer, New York, NY. https://doi.org/10.1007/978-0-387-92824-1.

3) Falguera, V., J.P. Quintero, A. Jiménez, J.A. Muñoz, and A. Ibarz, *Trends Food Sci. Technol. 22*: 292–303, 2011, https://doi.org/10.1016/j.tifs.2011.02.004.

4) Balaguer, M.P., G. Lopez-Carballo, R. Catala, R. Gavara, and P. Hernandez-Munoz, *Int. J. Food Microbiol. 166*: 369–377, 2013, https://doi.org/10.1016/j.ijfoodmicro.2013.08.012.

## POTENTIAL APPLICATIONS

Protein-based active packaging has been applied in real food systems and has demonstrated the capacity to extend the shelf life of foodstuffs. Films used to cover meat products (pork meat, poultry, and fish slices) in a polystyrene tray suppress lipid oxidation and the formation of metmyoglobin, the oxidized form of the oxygen-carrying hemeprotein myoglobin, during refrigerated storage. They have also been used in plastic packaging bags for bakery products, such as bread slices, to

**PROTEIN-BASED ACTIVE PACKAGING HAS BEEN APPLIED IN REAL FOOD SYSTEMS AND HAS DEMONSTRATED THE CAPACITY TO EXTEND THE SHELF LIFE OF FOODSTUFFS.**

prevent fungal growth during storage at ~25°C and 50% relative humidity (RH). Another potential application could be lids that actively prevent fungal growth in cheese spread and other products stored under refrigeration. Finally, protein-based edible films may have a potential application in powders for instant solubilization, and in coatings for multiple animal foodstuffs, such as meats, seafood, and cheese, as well as fresh and minimally processed vegetables and fruits.

Although the functional properties of protein-based films are not yet comparable with those of the synthetic films, promising potential methodologies are being developed to enhance their mechanical and barrier properties. More knowledge about practical applications and the effectiveness of protein films in various food products is needed to develop tailored solutions that lead to commercialization of novel protein-based packaging materials.

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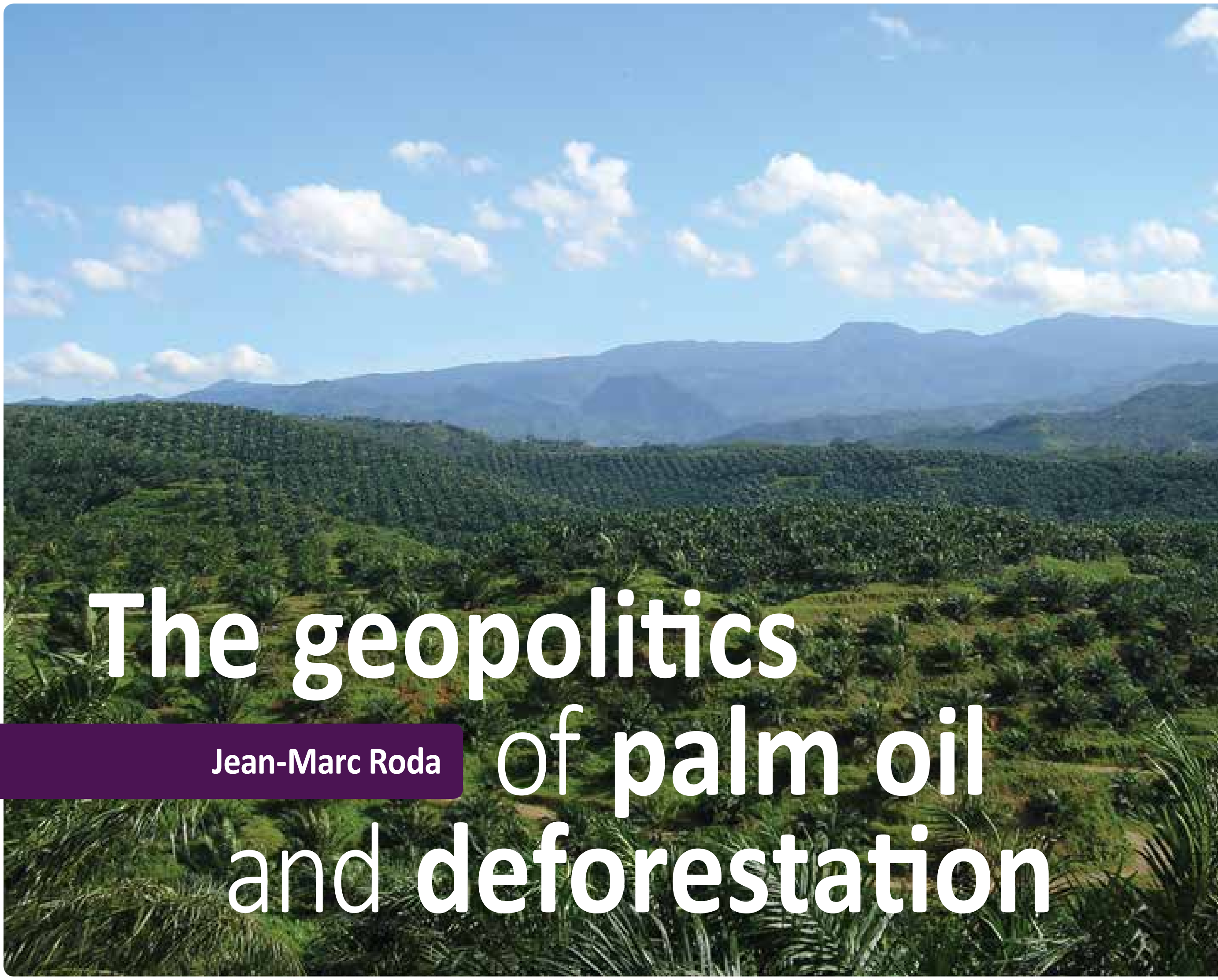
*Maribel Jiménez Fernández, a chemist pharmacist biologist, with a PhD in Food Sciences, is a member of the National System of Researchers, and a reviewer for several international journals. She has directed several research projects, and is a member of the nucleus of professors of the Postgraduate in Food Sciences at the Universidad Veracruzana. She can be contacted at maribjimenez@uv.mx.*

*Eugenia Lugo is a research food technologist and lead scientist at Centro de Investigación y Asistencia en Tecnología y Diseño del Estado de Jalisco (CIATEJ) in Mexico. Her research has focused on bioactive compound extraction, microencapsulation processes, and characterization of plant proteins. She can be contacted at elugo@ciatej.mx*



# The geopolitics of palm oil and deforestation

Jean-Marc Roda

- **Fats consumption increases when poverty decreases and urbanization increases.**
- **At the same time, vegetable fats are progressively replacing animal fats.**
- **This leads to geo-strategic questions: Which vegetable oils will be produced to feed the world, who will sell them, who will control their production, and where will there be enough land to grow them?**

Like other vegetable and animal fats, palm oil follows food-supply trends that have been well-documented since the 18th century. For example, in France, the calorie intake per capita peaked around 1900 and has since been stable.

While the total caloric intake in France has levelled off, the proportion of carbohydrates has constantly decreased while that of fats has risen. The two converged between 1980 and 2000 ((https://tinyurl.com/y3m4x3k5). In other words, once French society provided enough food for all, the average diet progressively increased its share of fats, up to a maximum.

Many countries are still far from achieving the same food abundance that countries like France have, but food security increased in the last six decades worldwide, even in the least-developed countries (Fig 1, page 24).

Since 1950, the FAO has compiled detailed data showing that the same phenomenon occurs everywhere: Intake of food and fats per capita increases, and hunger progressively decreases.

Despite a variety of trajectories across countries, all of them see an increase of fats consumption when poverty decreases and urbanization increases (Fig. 2).

At the same time, another trend has taken place: Vegetable fats are progressively replacing animal fats. For the developed countries, the consumption of animal fats per capita reached its peak in the 1980s and started to decline. Conversely, consumption of vegetable fats continued to rise strongly during that period. While North American and European vegetable-oil consumption is now stable, all the other regions of the world are still far from European levels (Fig. 2).

On average, these regions consume proportionally more vegetable than animal fats. They also have strong population growth, and when they reach the levels of vegetable-oil consumption seen in Europe—perhaps by 2050—the global demand will be around 250 to 350 million metric tons (MMT) per year more than the 170 to 180 MMT consumed currently.

This leads to geo-strategic questions: Which vegetable oils will be produced to feed the world, who will sell them, who will control their production, and where will there be enough land to grow them?

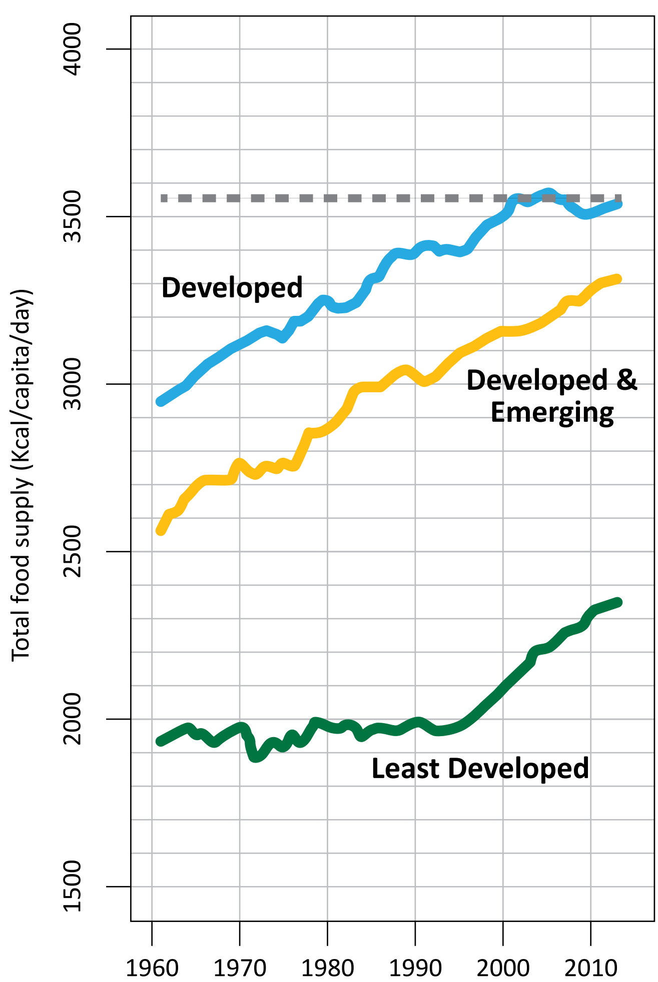



FIG. 1. Total food supply (Kcal per capita per year). J.-M. Roda/FAO/CIRAD/UPM, Author provided

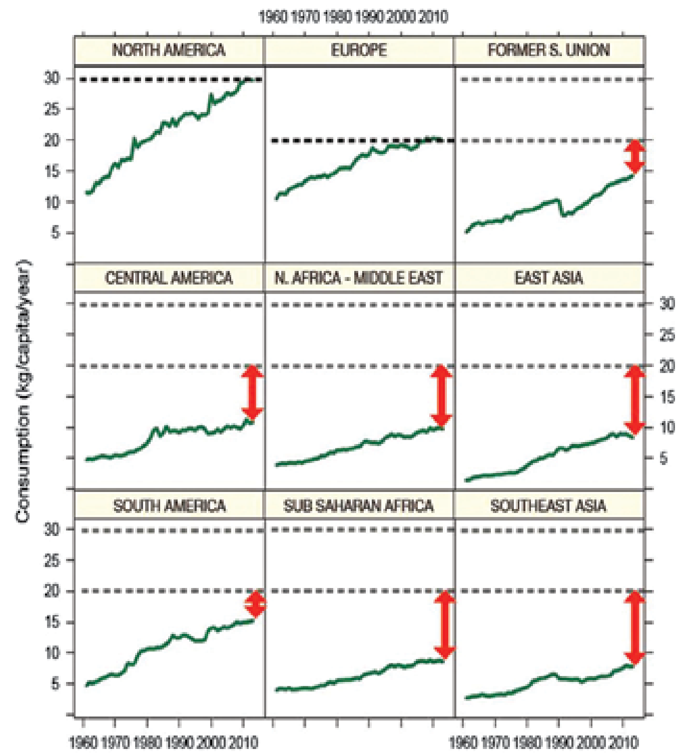



FIG. 2. Vegetable oil consumption. J.-M.Roda/CIRAD/UPM, Creative Commons (CC) BY 4.0

## COMPARATIVE ADVANTAGES OF VEGETABLE OILS

Four major vegetable oils constitute more than 85% of the world consumption (Fig. 3). Sunflowers, rapeseed, and soybeans were originally grown in temperate countries, but a rising share of soybeans is now produced in Brazil, thanks to genetically improved varieties. Oil palms grow only under humid tropical conditions and produce 5 to 8 times more oil per hectare than the other crops.

In other words, soybean, sunflower, and rapeseed demand 5 to 8 times more land than oil palm trees to produce one metric ton (MT) of oil (Fig. 4).

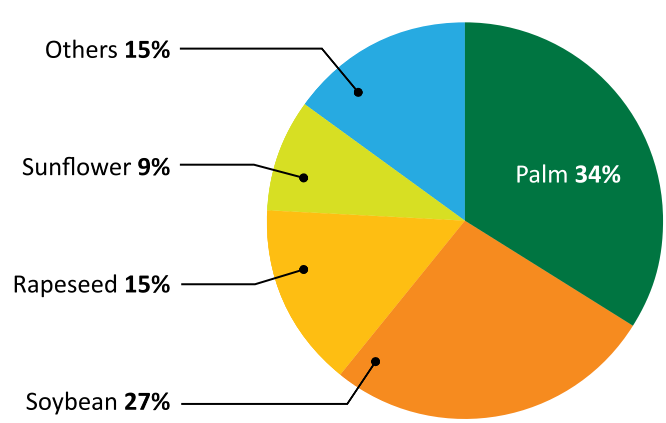



FIG. 3. Vegetable oils consumed worldwide. J.-M. Roda/FAOSTAT

In addition to their exceptional productivity, oil palm trees also demand much less work and production inputs per unit than other oil crops (Fig. 4). Therefore, palm oil is by far the cheapest oil to produce.

Oil palm trees are also one of the most profitable crops for farmers and are thus one of the success stories for fighting rural poverty in tropical countries. In humid Africa, oil palms are one of the last safety nets for the poorest. Indonesia and Malaysia produce more than 80% of the world's palm oil: In both countries palm oil development was and is still responsible for the livelihoods of millions of smallholders.

These major oils also have different characteristics for industrial uses. Palm oil is the only one that is naturally hydrogenated and structurally stable at ambient temperatures. The other oils must be artificially hydrogenated to achieve similar properties, which is costly and produces harmful trans-fatty acids. Still, all oils have their own advantages and drawbacks for human health, with none being better than the others.

Because of the productive advantages of palm oil, its market share has grown steadily over the last decades, and surpassed other vegetable oils (Fig.5). It is now the leading vegetable oil of the world (Fig. 3).

## LAND GRABBING, OR FEEDING THE PLANET?

All the agribusiness corporations are perfectly aware of the properties of the respective oils, and of the world demographic trends. They bet on growing markets, with the rise of the middle class in developing and emerging regions. They especially eye the fastest-growing urban clusters of the world, including China, India, Nigeria, Pakistan, Indonesia, Bangladesh, and the Philippines.

To supply to global markets, agribusiness corporations as well as some governments are racing to secure land by direct acquisition or indirectly through political intervention. Building up "land banks" is the game, and getting the best position to feed the future planet is the stake.

The biggest agribusiness corporations, known as the "ABCDs," are headquartered in western countries and are highly influential around the world. For example, they allegedly control 75% to 90% of the world grain market. Three of the ABCDs have their headquarters in the United States, which not coincidentally has the largest land bank outside its borders—more than 7 million hectares. Smaller but rising agribusiness corporations from Southeast Asia are also in the competition. As a result, Malaysia has the second largest land bank, with more than 3 million hectares.

There is a marked specialization between these multinationals for vegetable oils. The ABCDs directly or indirectly control the production of soybean, rapeseed, and sunflower oil. The smaller Southeast Asia multinationals such as Wilmar, Olam, Sinar Mas, Sime Darby, and others control the production of palm oil. As a result, there is a global competition in the vegetable oil market, with, on one side, the dominating western agribusinesses, and on the other side, the smaller agribusinesses from Southeast Asia who are progressively taking a bigger share of the global pie.

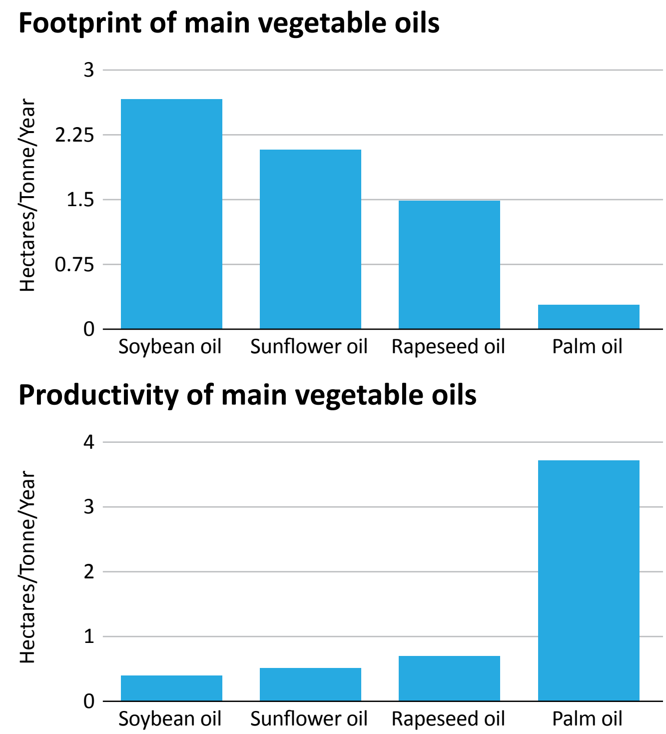



**Fig. 4. Footprint in hectares of main vegetable oils and their productivity per hectare.** J.-M. Roda/CIRAD/UPM, Author provided

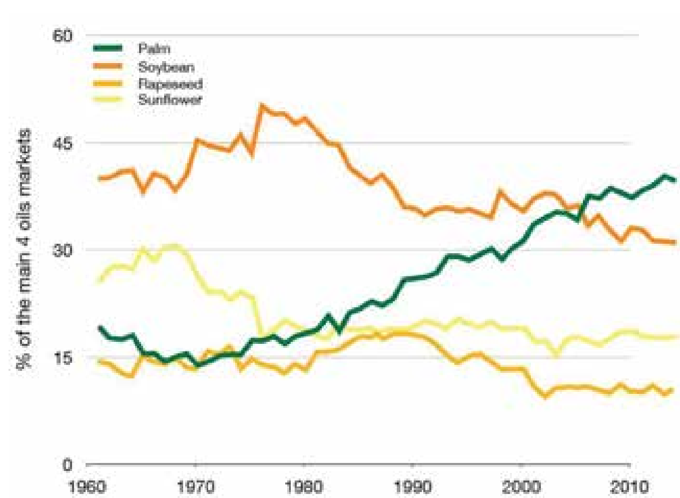



**FIG. 5. Market shares of the main vegetal oils.** J.-M. Roda/CIRAD/UPM, Author provided

## EU AGRICULTURE POLICY AND RAPESEED

The main oil crops of the European Union are rapeseed and sunflower. Rapeseed is dominant, especially in France, Germany, and Poland. Among big producers of biodiesel, France and Germany are the only countries to use rapeseed as main feedstocks. It is much more expensive than palm oil and soybean oil, but rapeseed plays an important role in the agricultural politics of the two countries. In 2003, France and Germany established fiscal policies promoting biodiesel. It immediately boosted European consumption of domes-

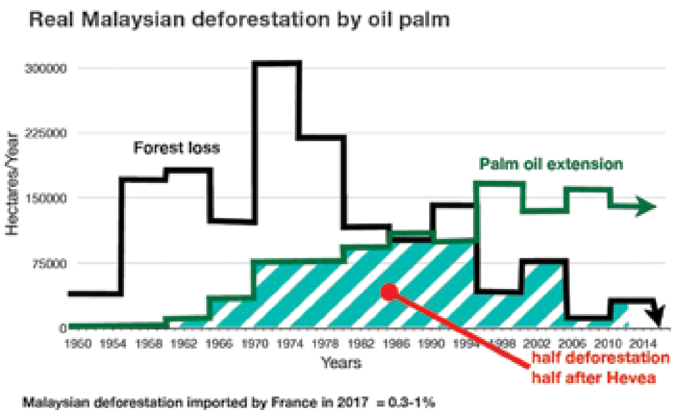



**FIG. 6. Real Malaysian deforestation by oil palm.** J.-M. Roda/CIRAD/UPM, CC BY 4.0

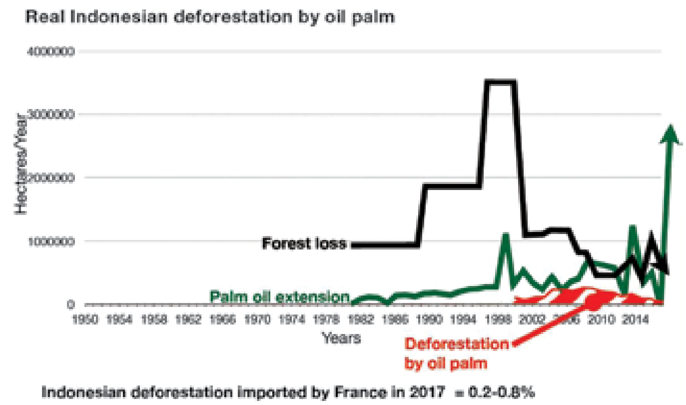



**Fig. 7. Real Indonesian deforestation by oil palm.** Ph. Guizol/CIRAD, CC BY 4.0

tic rapeseed, but it also pushed up imports of palm oil, which increased by 3.1% for every 1% rise in the price of rapeseed oil. After 2008, even though these fiscal tools were ended, industrial consumers continued importing palm oil. Palm oil had become, and remains, a formidable competitor for the European rapeseed oil.

More recently, the United States started a trade war with China which imposed tariffs on US soybeans in 2018. That year, US soybean exports to China dropped by 98%. At the same time, the US trade diplomacy managed to convince Europe to increase its imports of soybean by nearly 250%. Most of the soybean imported into Europe is used for animal feed, producing oil as by-product: it is used as biodiesel at 98%. This added volume of cheap oil for biodiesel is another competition for European rapeseed.

In early 2019, the EU submitted an act targeting vegetable oils that cause indirect land use change (ILUC) risks and deforestation. The technicalities of this act are still debated among experts, but in practice the result will be a ban of palm oil. The main producers of palm oil, Indonesia and Malaysia, were understandably infuriated by this move.

## PALM OIL AND DEFORESTATION

Palm plantations are reputed to be a major factor of deforestation. However, despite such widespread perceptions, palm plantations are responsible for only 3% of global deforestation. In Indonesia and Malaysia, deforestation peaked decades ago, and was already decreasing before palm oil started to take off. Palm plantations mostly replaced other agricultural uses. For example, in Malaysia the major phase of deforestation occurred for the development of rubber estates, before the 1980s. Almost all of the rubber plantations were later replaced by palm plantations.

Some palm plantations were established in lands that were previously forested, but the real share of deforestation caused by palm oil plantations peaked in the 1990s and has decreased consistently since. It is now almost non-existent in Malaysia (below 1%, Fig. 6). In Indonesia, the peak was between 2000 and 2008, and has now decreased to 5% (Fig. 7).

We know that consumers around the world will eventually demand about 250 to 350 MMT per year more vegetable oil than today. Soybean development in Brazil and palm plantation development everywhere else will continue because the main demand is not in the countries having interests in opposing their development. Without palm oil, the future demand for vegetable oils would require cultivation land areas almost as large as the Australian continent.

For the benefit of all, the key is to prevent future deforestation, not to ban palm oil. It is imperative to improve the productivity and sustainability of palm plantations, enabling them to produce more with the same area. The real challenge is to create enough value from both agricultural and forest landscapes, to encourage local societies to keep their forests rather than to convert them into agriculture.

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OIL SEED PREPARATION, EXTRACTION, REFINERY TURNKEY EQUIPMENT & TECHNOLOGY PROVIDER

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With constant R&D on oil seed processing along with our Joint venture partners since 2003 Crown Iron works, USA leader in oil extraction plants and refining plants our company has developed technologies for low cost efficient and automation processing in mechanical and chemical extraction of various oil seeds and oils & fats chemical and physical oil refinery plants throughout the world in more than 60 countries spread over 1000 strong clientele.

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# Biosensors for detecting food pathogens

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

Rebecca Guenard

Summer months are a time when menus expand with new dishes based on produce that ripens during warm temperatures, but it can also mean a greater risk of exposure to pathogens. During the summer of 2019, the US Centers for Disease Control and Prevention in Atlanta, Georgia, reported multistate outbreaks of *Salmonella* associated with papaya and melon (https://tinyurl.com/y45ykxl6). In addition, seemingly innocuous dips and baked goods were tainted by outbreaks of *Salmonella* in tahini and *E. coli* in flour.

Warmer temperatures may also promote the growth of molds and fungi that produce afla- and mycotoxins. These metabolites are known to grown on peanuts, almonds and pistachios, as well as grains, corn and cottonseed used for animal feed where they are introduced up the food chain to humans.

Access to globally distributed products increases exposure to the pathogens they harbor and the potential for illness to spread worldwide. According to the World Health Organization (WHO) 420,000 people die globally from foodborne illness associated with contamination each year, a third of which are children (https://tinyurl.com/y6tdshws). Advances in microbiology and molecular genetics have sped up the process of detecting and identifying foodborne pathogens and reducing their spread, but these methods take days, cutting into the limited shelf-life of produce. What the industry desires is the technology to detect multiple pathogens at once in a matter of hours. Is such a device possible?

"We have always been trying to find a better detection method for these bacteria," says Andrew Gehring, a research chemist for the US of Agriculture (USDA) who specializes in developing analytical methods for detecting foodborne pathogens. Gehring focuses on biosensors, devices that combine a biorecognition element (antibodies, nucleic acids, enzymes, etc.) and a transducer that produces a signal. When an interaction occurs between a pathogen and a biorecognition element, the biosensor indicates a detectable response. Gehring's group has built several prototypes of biosensors intended for microbial analysis by the USDA, Food Safety and Inspection Service (FSIS) at food production facilities during routine tests for drug residues, antibiotics, herbicides, insecticides, hormones and, of course, pathogens. However, the fact that they have been built does not mean they have been used. One consideration is the FSIS's zero tolerance threshold.

The FSIS has a standard procedure to recall the deadliest pathogens, 7 types of Shiga-toxin producing *E. coli* in addition to *Listeria monocytogenes* (https://tinyurl.com/y4uh7l8a). If they find 1 cfu (colony forming unit) in up to 325 grams of food—a mass-to-mass ratio, equivalent to a detection limit of 15 parts per quadrillion—the item is pulled from store shelves. The only reasonable way to determine if such a small amount of a pathogen is present is to enrich a contaminated sample. Inspectors remove food products from production facilities and ship them to field service laboratories. If bacteria is present in the sample it is sufficiently enriched to grow overnight. "The problems with that is it takes time, it's labor intensive, and it costs money," says Gehring. Ideally, inspectors want to test food products onsite, but that poses another problem. "How do you detect something online or near-line in the [establishment]? You cannot do enrichment on the factory floor," he says. "They do not want the risk of growing large numbers of pathogens in the factory."

After a 2009 *Salmonella* outbreak in peanut butter, the US, Food and Drug Administration (FDA) ramped up efforts to trace pathogens faster (https://tinyurl.com/y385d37z). They began sequencing the pathogen's genome and found ways to quickly identify features that distinguished one subtype of bacteria from another to trace the outbreak to its source (https://tinyurl.com/yyzutjbd). However, in a global food supply chain the whole genome sequencing effort required international involvement. In 2012, the FDA launched the GenomeTrakr, a public database of the DNA sequences of food borne pathogens collected from laboratories around the world (https://tinyurl.com/yy2eq284). According to its website, this pathogen identification network consists of government and univer-

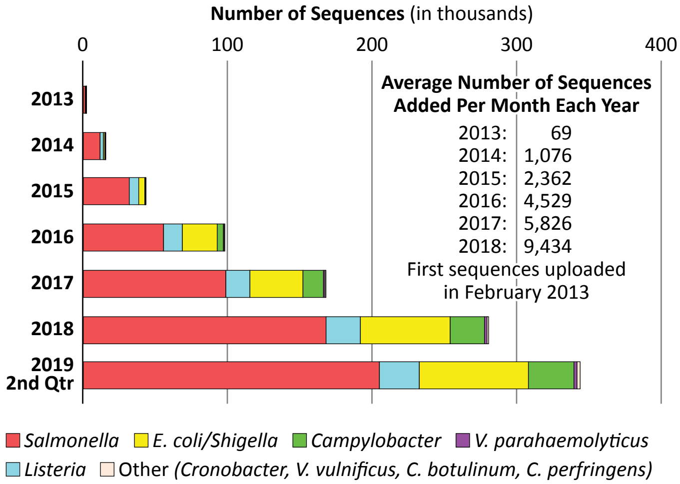



**FIG. 1. The total number of sequences in the GenomeTrakr Database as of the last day of the quarter from February 2013–2018. The average number of sequences added per month during the same time period is also depicted.**

sity labs inside and outside of the United States who upload sequencing data from thousands of different bacteria strains monthly. By referencing this database, a researcher can use a bacteria's unique DNA sequence to surveil the food supply and cut off outbreaks.

The GenomeTrakr has proven to be invaluable in identifying foodborne pathogens related to outbreaks more quickly and stopping their spread. The database has been used on multiple occasions to pinpoint the exact processing plant where a pathogen originated. Despite this, GenomeTrakr can only be used to identify potential sources of contamination once an outbreak begins. Now that the database is fully established, it faces the same time limitation that the zero tolerance standard faces, the week-long process to enrich and detect foodborne pathogens in a lab. Inspectors need a new analytical tool.

"The desire is for a hand-held instrument with high-throughput, extremely fast sampling that can analyze a lot of different samples at one time with great sensitivity yet without cross-contamination. Ultimately what we are trying to do is develop a tool that functions similarly to a *Star Trek* tricorder," says Gehring, referring to a fictious, catch-all tool. While Gehring's team at the USDA is working on such a device, so are a few private companies.

In 2016, Avner Avidan and Yair Moneta established Inspecto in Tel Aviv, Israel, with the intention of producing a portable device that can be used at any point in the supply chain, with little training required (https://inspecto.io/). A year later, they gained the investment dollars necessary to build the device which uses an immunoassay with surface-enhanced Raman detection. The device incorporates disposable capsules specific to certain contaminants. The only analyte mentioned on the company's website is pesticide residues, though in talking to the media about their instrument the company's founders allude to the capability of detecting other compounds by mentioning that the device will address food safety regulations (https://tinyurl.com/y3o4g87r). For now, the Inspecto device is just an idea, and it will take some time before it is brought to market. Another instrument company seems to be closer to selling a new instrument.

LexaGene, a biotech company in Beverly, Massachusetts, USA, developed an automated, table-top instrument for pathogen detection that can be used on site (https://lexagene.com/). The instrument shows enough promise that in June 2019 FSIS invited LexaGene to describe the science behind the technology(https://lexagene.com/fsis-usda-presentation/). During his presentation, Jack Reagan, the company's CEO, claimed that LexaGene's instrument improved the probability of detecting a pathogen while reducing the time needed for analysis.

The instrument works by a flow-through process that enables users to analyze larger sample volumes than are typically measured. The specific DNA of any targeted pathogens present are amplified using polymerase chain reaction (PCR), a technique which only requires one or two copies of a bacteria's DNA for detection. The sample is exposed to 20 different assay solutions to analyze for multiple pathogens at the same time, including *Listeria monocytogenes*, *Salmonella enterica*, and specific types of *E. coli*. The instrument is inexpensive and does not require technical skills to operate. In addition, unlike some genetically based analyzers, the device is capable of distinguishing between both live and dead cells.

In the next year, Reagan says that the company will continue testing its product, and file for the certification and licensing necessary for regulatory purposes. After those are achieved, the instrument will go on the market and food safety specialists can determine if it is the all-in-one device they have been waiting for.

In February 2019, the WHO, the United Nations Food and Agriculture Organization, and the World Trade Organization held the first joint conference to discuss ways to reduce foodborne deaths worldwide. Many of the technological advancements discussed here were presented. Food safety treads ever closer to a reality where contaminated food never leaves a field, or a processing plant, or gets put on a ship. Should these new technologies become commonplace for more prevalent pathogens they could eventually be applied to the testing of aflatoxins in animal feed.

*Olio is produced by* Inform*'s associate editor, Rebecca Guenard. She can be contacted at rebecca.guenard@aocs.org.*

## References

Food Safety Analysis Using Electrochemical Biosensors, Mishra, G.K., *Foods 7*: 141, 2018.

Electrochemical biosensors for *Salmonella*: State of the art and challenges in food safety assessment, Delerue-Matos, C., *Biosensors and Bioelectronics 99*: 667, 2018.

Dual-competitive lateral flow aptasensor for detection of aflatoxin $B_1$ in food and feedstuffs, Chen, A., *et al.*, J. *Hazard. Mater. 344*: 15, 249–257, 2018.

# Canada proposes VOC regulations for certain products

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

Kelly Franklin

The Canadian government is proposing to establish volatile organic compound (VOC) concentration limits for some 130 product types, in an effort aimed at improving ambient air quality.

According to a July 6, 2019 Canada Gazette notice, existing voluntary guidelines recommending VOC concentration limits for certain products have "not been sufficient" for meeting air quality objectives.

VOCs—which contribute to the formation of ground-level ozone and particulate matter (PM2.5), the two main components of smog—are currently being emitted at an estimated 50,000 metric tons a year, it says.

The government is proposing to align its regulations largely with the 2010 version of the California Air Resources Board (Carb) consumer products regulations.

This would involve imposing VOC concentration limits for a variety of products used in commercial or industrial settings, including:

- personal care products;
- automotive and household maintenance products;
- adhesives, adhesive removers, sealants, and caulks; and
- other miscellaneous products, including anti-static products and non-stick cooking sprays.

The proposal includes a few deviations from California's standards due to Canada's colder climate, such as a higher limit for non-chemically curing sealant and caulking products, and the exclusion of windshield washer fluids.

The proposed regulations would prohibit the manufacture and import of products with VOC concentrations in excess of their respective category-specific limits, unless a permit is obtained. The concentration limits and product categories and subcategories are identified in the Schedule to the Proposed Regulations. While the proposed regulations that were pre-published in 2008, included a prohibition on sale, the current proposed regulations would only apply to the manufacture and import of products in order to the reduce administrative burden and impacts on small businesses.

It sets out labelling, reporting, and record-keeping requirements, as well as alternative compliance options.

Manufacturers and/or importers of a regulated product would be required to indicate, on the product container, the date on which the product was manufactured or a code representing that date. The proposed regulations would not include mandatory testing requirements to be conducted by regulated parties to ensure regulated products meet the proposed VOC concentration limits. However, they would be required to keep information regarding regulated products in Canada to ensure that the Department is able to access records and reports, if required.

## ALTERNATIVE COMPLIANCE OPTIONS

The proposed regulations would include a provision for temporary permit applications for products that would be otherwise unable to meet the regulatory requirements for technical or economic reasons. Temporary permits would allow regulated parties to continue manufacturing or importing products if the conditions outlined in the proposed regulations are met, including a plan to show how the products would be brought into compliance. A permit would be valid for a period of up to two years from the date it is issued and could be extended for an additional two years, provided the application is submitted 90 days prior to the expiry of the first period.

### *Permit—Product resulting in lesser VOC emissions*

The proposed regulations would include a provision for a permit allowing products to exceed the VOC concentration limits if, as a result of product design, formulation, delivery, or other factors, the total VOC emissions from that product would be lower than those from a comparable compliant product when used in accordance with the manufacturer's written instructions. It is proposed that the permit would be valid for a period of four years from the date it is issued and could be renewed every four years, provided the application is submitted at least 90 days prior to the expiry of the previous period.

### *VOC Tradeable Unit Credit Program*

The proposed regulations would include a VOC Tradeable Unit Credit Program similar to CARB's Alternative Control Plan Regulation for Consumer Products and Aerosol Coating Products, with certain differences that take into consideration the Canadian context. The program would provide an alternative method for complying with VOC concentration limits by providing a permit that would allow companies to manufacture or import products that exceed concentration limits in the following ways: balancing emissions from products that exceed the concentration limits with credits earned from products that were reformulated to have a VOC concentration lower than the regulatory limits; or by purchasing credits from other companies.

To apply, participate, and maintain a permit in the program, companies would be required to follow the requirements and deadlines as set out by the proposed regulations. Permits under the program would be valid indefinitely if participating companies continue to submit the required annual reports and meet conditions set out by the proposed regulations. Further, regulated parties would be required to submit a report for each calendar year during which they participate in the program.

Canada already has regulations in place governing VOC concentrations in automotive refinishing products and for architectural coatings. In 2005, the government consulted on its intention to regulate emissions from additional products, with a regulatory proposal released in 2008. It made revisions to these in 2013 and had additional engagement with the public at that time.

If finalized, the regulations would apply to manufacturers and importers. They would come into force on January 1 of the year following the two-year anniversary of their adoption, with an extra year for disinfectants to comply.

The government is holding a 75-day consultation on the Volatile Organic Compound Concentration Limits for Certain Products Regulations, ending on September 19, 2019.

*Kelly Franklin is North America editor for* Chemical Watch.

# Argentina 2021 to host the largest olive oil production plant in Latin America

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

Leslie Kleiner

As South America keeps growing in terms of olive oil production, Argentina announced investments in what will be the largest olive oil production plant in Latin America. The company Solfrut broke ground for the plant, which is located in the province of San Juan, one of the olive oil-producing provinces accessible through The Olive Route, in Argentina.

**Q: What infrastructure will the largest olive oil plant in Latin America have?**

With an investment of US$14 million, during the first phase of the investment the plant is expected to have a storage capacity of 4,000 metric tons of oil. Receiving, cleaning, and classification production processes will be addressed during the second phase. Finally, in the third phase, the fractionation methods will be upgraded with larger equipment to make the process more efficient. The expectation is that the 2020 olive grinding process would be done in this new plant, and that when the three phases are complete in the year 2021, the production capacity will be 4,000 metric tons of olive oil. To aid this project, the company has 440 olive trees and 330 vineyards, among other investments in the pistachio business [1].

**Q: What is the portfolio of Solfrut like?**

Solfrut, a company of the PHRONESIS group, has four divisions (agribusiness, oils, wines, and food) and specializes in process integration from raw material to finished product. This is accomplished through the integration of three olive farms, vineyards, cellars, food, and olive oil production. Regarding olive oil, Solfrut produces various olive oils and blends for their brand Oliovita, as well as for other brands sold in Argentinean and South American supermarkets, such as: Carrefour, Walmart, Vea, La Anónima, Libertad, Jumbo (Argentina y Chile), as well as Disco (Uruguay). The variety of flavor profiles (spicy, bitter, fruity) as well as packaging (glass, PET, tin) allows the company to cater to various specifications. However, Solfrut also commercializes bulk oil for internal consumption and for export to the United States, China, Chile, Uruguay, and other countries [2].

**Q: How do olive oils from San Juan compare to others worldwide?**

This year, three different extra virgin olive oils (EVOOs) from San Juan won awards in two international competitions, "CINVE" in Spain, and "Olive Japan" in Tokyo. The company Olivum won a gold medal and four silver medals at the CINVE competition in Spain. Gold was awarded to their Coratina EVOO, and silver to the Arbequina, Blend suave, Blend medio, and Picual varieties. In Tokyo, the company Tupelí was awarded silver for its blends Changlot Real, Coratina, and Arauco, while the company Solfrut also was awarded in the same category for the Changlot variety of Oliovita EVOO.

**Q: Besides olive oil production, do olives bring other businesses to the region?**

Much like tourists organize to see vineyards for Malbec and other wines in Argentina, "La ruta del olivo" (The Olive Route) displays farming through olive oil production in the provinces of Catamarca, La Rioja, San Juan, and Mendoza, where olives are grown. Catamarca is considered the main olive oil production area of the country, with over 30,000 hectares destined to olive production. While traveling through the Olive Route, it is possible to experience the variety in olives and olive oil aroma and flavor that comes from changing geographic locations. Therefore, tourism is an additional business that olive production brings to the area [4].

## References


[1] https://www.diariolaprovinciasj.com/economia/2019/5/8/invertiran-us-14-millones-en-la-construccion-en-san-juan-de-la-planta-de-aceite-de-oliva-mas-grande-de-latinoamerica-109593.html

[2] https://www.solfrut.com.ar/

[3] https://sisanjuan.gob.ar/noticias-produccion-y-desarrollo-economico/item/14068-aceites-de-oliva-sanjuaninos-en-el-podio-mundial

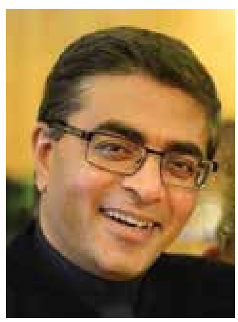
[4] http://turismo.perfil.com/5729-la-ruta-del-olivo-en-todo-su-esplendor/


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

# From division leadership to program development

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

Kaustuv Bhattacharya is a big believer in the AOCS mission, which makes him a particularly effective member of the Annual Meeting Program Committee as vice chair of the Edible Applications Technology Division.



"AOCS is the perfect global platform for me," he says. "My job with DuPont has taken me physically to about 50 countries, and I have worked with people from more than 75 countries. Such global exposure has made me aware of the strength in diversity, the power of inclusion, and the value of listening. AOCS meetings bring all of this together, every year, allowing for attendees to engage in collective discussion of trends, of what's new, and of their views of the current state of the art in fats and oils and related materials."

Bhattacharya emphasizes the importance of learning through listening, whether on the job or within the Society. As a principal application specialist at DuPont Nutrition Biosciences ApS (Braband, Denmark), he is used to believing in the voice of the customer. "If you don't listen, you don't know what they want," he stresses, and extends that advice to his—and others'—participation in AOCS.

"Products are different in every part of the world," he notes, "and yet the technology is the same. By involving professionals from other regions and by balancing participation by those in academia and those in industry, we can learn the most from each other." He sees one of the advantages of AOCS in the mix of academic, industrial, and governmental scientists. "Academics have more explanations, whereas industrial scientists have more observational data," he explains. This broad scope allows those attending the AOCS Annual Meeting & Expo to learn about model systems from academia and "make them fit in the real world."

Bhattacharya brings his passion for inclusion and diversity to his work on program development, noting that the 2019 EAT session chairs represent seven countries from four continents from both academia and industry. "I always try to provide a structured platform for discussion among the session chairs for our conference calls, and we always ended in full agreement."

## Fast facts

| | |
|---|---|
| **Name** | Kaustuv Bhattacharya |
| **Joined AOCS** | 2012 |
| **Education** | M.S., physical chemistry, University of Calcutta, India (1996) |
| **Job title** | Principal Application Specialist, Oils and Fats |
| **Employer** | DuPont Nutrition Biosciences ApS (Braband, Denmark) |
| **Role in AOCS** | Vice Chair, Edible Applications Technology (EAT) Division; Annual Meeting Program Committee; EAT Short Courses |
| **High-fat Indulgence** | Nutella |
| **Fat-related Nickname** | Shortening ("This is self-given since I am short and 100% fat.") |
| **Favorite Social Media** | LinkedIn |
| **Most memorable AOCS experience** | "I had a wonderful half-hour, one-to-one discussion with Len Sidisky in Minneapolis in 2018. We seemed to have the same admiration for what AOCS represents and shared a similar passion for taking AOCS to the next level." |
| **Other involvement** | Edible Applications Technology Division Executive Steering Committee |

He gives high marks to AOCS staff for "making things so easy," and points in particular to Membership Director Janet Brown. Bhattacharya met her in 2017 in Uppsala, Sweden, during the Euro Fed Lipid Congress, where she invited him to run for the 2018–2019 EAT vice chair position. "I had little idea what I was getting into, but I felt that I could trust her instincts about me doing well in that role."

And the rest, as they say, is history.

# PATENTS

## Biocidal biopolymer coatings

Ming, W., *et al.*, Georgia Southern Research and Service Foundation, US10227495, March 12, 2019

Disclosed herein are biopolymer-based biocidal coatings. The coatings have excellent antimicrobial and antifungal properties, and retain their activity over substantially prolonged periods of time.

## Additives for oilfield and industrial applications

Maker, D., *et al.*, Emery Oleochemicals GmbH, US10227545, March 12, 2019

The present invention relates to new ether carboxylic acids as high temperature stable rheology modifier, viscosifier, lubricant, or emulsifier additives in oilfield and industrial applications. In particular, the invention relates to an ether carboxylic acid or a derivative thereof obtainable by reacting a branched polyol alkoxylate with a halogen carboxylic acid or a halogen carboxylic acid derivative. Further aspects of the invention relate to a lubricant composition comprising an ether carboxylic acid of the invention and the use of said ether carboxylic acid.

## Microorganisms having increased lipid productivity

Ajjawi, I., *et al.*, Synthetic Genomics, Inc., US10227619, March 12, 2019

The present invention provides mutant microorganisms that have higher lipid productivity than the wild type microorganisms from which they are derived, and biomass at levels that are within approximately 50% of wild type biomass productivities under nitrogen replete conditions. Particular mutants produce at least twice as much FAME lipid as wild type, while producing at least 75% of the biomass produced by wild type cells under nitrogen replete conditions. Also provided are methods of producing lipid using the mutant strains.

### Protein Highway

In July 2019, AOCS joined a consortium of industry, academia, and government entities from the Protein Highway region of the Canadian Prairies and US Upper Midwest that signed an agreement to strengthen cross-border and regional collaboration in research, business development and innovation within the rapidly developing alternative protein sector. Learn more at https://tinyurl.com/y6akvns3.

## Liposomal composition comprising a sterol-modified lipid and a purified mycobacterial lipid cell wall component and its use in the diagnosis of tuberculosis

Baumeister, C., *et al.*, University of Pretoria, US10228371, March 12, 2019

A liposomal composition comprising a sterol-modified lipid and a purified mycobacterial lipid cell wall component or analog or derivative thereof is described. The composition is useful as a lipid antigen-presenting vehicle for the detection of lipid antigen specific biomarker antibodies in antibody containing biological samples in the diagnosis of active tuberculosis. The purified lipid cell wall component is typically a purified mycolic acid or a mixture of mycolic acids from a mycobacterium that produces mycolic acids. The sterol-modified lipid is typically a phospholipid.

## Methods for targeting membrane steroid transporters

Yamanaka, N., *et al.*, University of California, US10228380, March 12, 2019

Described herein are methods of identifying compounds that can modulate the transport of a steroid hormone across a phospholipid membrane. Also described herein are methods of identifying compounds that can affect the transcriptional activity of a steroid hormone nuclear receptor.

## Method for producing fat and oil composition

Saito, K., *et al.*, Kao Corp., US10231468, March 19, 2019

Provided is a production method which can produce, with a high yield, a fat or oil composition containing a diacylglycerol at a high content and having a favorable external appearance at room temperature. Specifically, provided is a production method for a refined fat or oil composition, comprising the following steps (1) and (2): (1) a step of adding a polyglycerin fatty acid ester having an average polymerization degree of glycerin being 20 or more to a fat or oil composition containing 50 mass % or more of diacylglycerol, followed by cooling; and (2) a step of separating a crystal precipitated in the step (1) from a liquid portion.

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

# AOCS Laboratory Proficiency Program 2018-2019 Award Winners

## Aflatoxin in Corn Meal

**First Place**
Patricia Sanchez
SGS Argentina
Buenos Aires, CF C1430DNN
Argentina

**Honorable Mention**
George Holt
Delight Products Co.
Springfield, TN 37122 USA

## Aflatoxin in Corn Meal Test Kit

**First Place**
Cindy McCormick
Office of the Texas State Chemist
College Station, TX 77843

**Honorable Mention**
JLA Analytical Team
JLA USA
Edenton, NC 27932
Gordon Thomas
New Jersey Feed Lab
Ewing, NJ 08638 USA

## Aflatoxin in Peanut Paste

**First Place**
Kayla Castleberry
JLA DeLeon
DeLeon, TX 76444

**Honorable Mention**
Marisel Corelli
JLA Argentina SA
General Cabrera, CD X5809 BAS
Argentina
Polly Liu
SGS-CSTC Standard Technical
Services Co.
Qingdao SD China

## Aflatoxin in Peanut Paste Test Kit

**First Place**
Blakely Analytical Lab
JLAI
Blakely, GA 39823 USA

**Honorable Mention**
Fran Fletcher
IEH Douglas
Douglas, GA 31535 USA
Sylvester Analytical Team
JLA Sylvester
Sylvester, GA 31791 USA
Judy Thomas
JLA Brownfield
Brownfield, TX 79316 USA

## Aflatoxin in Pistachio and Almond

**First Place**
Alina Hernandez
IEH Labs and Consulting Group
Fresno, CA 09372 USA

**Honorable Mention**
Aflatoxin Department
IEH-JL Analytical
Modesto, CA 95358 USA
Saul Agular
JLA Arbuckle
Williams, CA 95987 USA

## Cholesterol

**First Place**
Dixie Moorman
Minnesota Valley Testing Lab
New Ulm, MN 56073 USA

**Honorable Mention**
Angie Johnson
Keyleaf
Saskatoon, SK S7N 2R4 Canada

## DDGS from Corn Meal

**First Place**
Anders Thomsen
Eurofins Nutrition Analysis Center
Des Moines, IA 50321 USA

**Honorable Mention**
Mumtaz Haider
Amspec LLC
Pasadena, TX 77503 USA

## Edible Fat

**First Place**
Wade Chase
AGP
Hastings, NE 68901 USA

**Honorable Mention**
Konni Shipman
AGP
Hastings, NE 68901 USA
Felicia Melendez
AGP
Hastings, NE 68901 USA
Travis Patterson
AGP
Hastings, NE 68901 USA
Jennifer Duffy
AGP
Hastings, NE 68901 USA

## Feed Microscopy

**First Place**
Sirithon Tubsangtong
Central Analysis Laboratory
Bangkok 10500 Thailand

**2nd Place**
Michael Olivarez
Office of the Texas State Chemist
College Station , TX 77843 USA

**3rd Place**
Jim Selkirk
Wisconsin Department of Agriculture
Madison, WI 53718 USA

## Fish Meal

**First Place**
Benjaporn Chatchoochaikul
Betagro Public Company
Sanutprakarn 10130 Thailand

**Honorable Mention**
Pete Cartwright
New Jersey Feed Lab, Inc.
Ewing, NJ 08638 USA

## Gas Chromagraphy

**First Place**
Shirley Elliott
Darling Analytical Laboratories
Ankeny, IA 50021 USA

**Honorable Mention**
Hujar Musa
Malaysian Palm Oil Board (AOTD)
Selangor 43000 Malaysia
Heather Compton
Stratas Foods
Quincy, IL 62305
Stephan Sansone
New Jersey Feed Lab
Ewing, NJ 08638 USA
Oilseed Lab
Canadian Grain Commission
Winnipeg, MB R3C 3G8 Canada
Brendan Lautenbach
IOI Loders Croklaan
Channahon, IL 60410 USA
Rudy Fulawka
BASF
Saskatoon SK S7K 3J9 Canada
Joy Thompson
Bakels Edible Oils (NZ) Ltd.
Mt. Maunganui, Tauranga 3116 New Zealand

## GOED Nutraceutical Oils

**First Place**
QC Laboratory
Eric Le Naour
Helene Jehanno
Polaris
Fouesnant 29940 France

**Honorable Mention**
Lara Bjorgvinsdottir
Lysi HF
Reykjavik 101 Iceland
Mulgrave Laboratory
DSM Nutritional Products
Mulgrave, NS B0E 2G0 Canada
Maike Timm-Heinrich
BASF AF
Ballerup DK-2750 Denmark

## Marine Oil

**First Place**
Otelia Robertson
Omega Protein Inc.
Reedville, VA 22539 USA

**Honorable Mention**
Paul Thionville, Andre Thionville, Kristopher Williams
Thionville Labs Inc.
New Orleans, LA 70123 USA
Melissa Thrift
Omega Protein, Inc
Reedville, VA 22539 USA

## Marine Oil Fatty Acid Profile

**First Place**
QC laboratory
Eric Le Naour
Helene Jehanno
Polaris
Fouesnant 29940 France
**Honorable Mention**
Pete Cartwright
New Jersey Feed Lab, Inc.
Ewing, NJ 08638 USA
James Dick
University of Stirling
Stirling, Scotland FK9 4LA UK
Courtney Rethwisch
Select Supplements
Vista, CA 92081 USA

## NIOP Fats and Oils

**First Place**
Melanie Greer
Dallas Group of America
Jeffersonville, IN 47130 USA
**Honorable Mention**
Mumtaz Haider
Amspec LLC
Pasadena, TX 77503 USA

## Nutritional Labeling

**First Place**
Thomas Mawhinney
University of Missouri
Columbia, MO 65211 USA
**Honorable Mention**
Jocelyn Alfieri
Silliker Canada Co.
Markham, ON L3R 5V5 Canada

## Oilseed Meal

**First Place (tie)**
Tuyen Mai
Intertek Agri/Food Service
New Orleans, LA 70122 USA
Lidieth Solara Carranza
INOLASA
Barranca, Punterenas 6651-1000
Costa Rica
**Honorable Mention**
Jennie Stewart, Brad Beavers
Carolina Analytical
Bear Creek, NC 27207 USA
Edgar Tenent
K-Testing Lab, Inc.
Memphis, TN 38116 USA
Jim Bell
Barrow Agee Labs, Inc.
Memphis, TN 38116 USA
Amanda Self
Barrow Agee Labs, Inc.
Memphis, TN 38116 USA

## Olive Oil Part A

**First Place (tie)**
Gwendolyn Truong
Sunset Olive Oil
Montebello, CA 90640 USA
Alex Vargo
Pompeian Inc.
Baltimore, MD 21224 USA

## Olive Oil Part B

**First Place**
Alex Vargo
Pompeian Inc.
Baltimore, MD 21224 USA
**Honorable Mention**
Vera Chen
Catania Oils, Inc.
Ayer, MA 01432 USA
Ryan Drazenovic
Pompeian
Baltimore, MD 21224 USA

## Olive Oil Part C

**First Place**
Vera Chen
Catania Oils, Inc.
Ayer, MA 01432 USA
**Honorable Mention**
Zhennian Huang
Catania Oils, Inc.
Ayer, MA 01432 USA
Valentina Cardone
Chemiservice Srl
Monopoli, BA 70043 Italy

## Palm Oil

**First Place**
Mohamed Fathi Nazir
IFFCO Egypt
Suez 204 Egypt
**Honorable Mention**
Ricardo Arevalo Bravo
Grupo Industrial Numar SA
Barrio Cuba, San Jose Costa Rica
Kah Soon NG
PGEO Edible Oils Sdn Bhd
Pasir Guidang, Johor 81700
Malaysia
Puthiha Adam Moskam
Bunge Loders Croklaan Oils Sdn Bnd
Pasir Gudang, Johor 81700 Malaysia

## Peanut

**First Place**
JLA Analytical Team
JLA USA
Edenton, NC 2932 USA
**Honorable Mention**
Fran Fletcher
IEH Douglas
Douglas, GA 31535 USA

## Phosphorus in Oil

**First Place**
Maria Lina Dionisio
Sovena Oilseeds
Almada 2801-801 Portugal
**Honorable Mention**
Amy Watson
Riceland Foods Inc.
Stuttgart, AR USA

## Solid Fat Content by NMR

**First Place**
Joseph Maher
Barry Callebaut USA
Pennsauken, NJ 08110 USA
**Honorable Mention**
Rosalin Manalang
AAK USA
Richmond, CA 94804 USA

## Soybean Oil

**First Place**
Renato Ramos
Admiral Testing Services
Luling, LA 70070 USA
**Honorable Mention**
Molly Harris
Owensboro Grain Edible Oils
Owensboro, KY 42301 USA

## Soybeans

**First Place**
Joao Peixoto
Ceno Consultants Enterprises
Gonzales, LA 70737 USA
**Honorable Mention**
Sara Esquivel Candia
CAIASA
Asuncion, 1892 Paraguay
Mumtaz Haider
Ampec LLC
Pasadena, TX 77503 USA

## Specialty Oils

**First Place**
Heather Dahl
Pacific Coast Canola
Warden, WA 98857 USA
**Honorable Mention**
Imprang Chutiyanawat
Ligand Scientific Ltd.
Nonthaburi 1100 Thailand
Erik Madden
Exact Scientific Services, Inc.
Ferndale, WA 98248 USA

## Tallow and Grease

**First Place**
Adalberto Coronado
National Beef Packing Co.
Liberal, KS 67901 USA
**Honorable Mention**
Jean Francois Harvey
Sanimax ACI, Inc.
Charny, QC G6X 3R4 Canada
Francois Leveille
Sanimax San, Inc.
Montreal, QC H1C 1G2 Canada
Kester Emefiena
Amspec LLC
Pasadena, TX 77503 USA

## Trace Metals in Oil

**First Place**
Heather Dahl
Pacific Coast Canola
Warden, WA 98857 USA
**Honorable Mention**
Jose Adolfo Juarez Chavez
Proteinas Naturales SA de CV
Guadalupe, Nuevo Leon 67130
Mexico
Jillian Kriger
Louis Dreyfus Co.
Yorkton SK S3N 3X3 Canada

## trans Fatty Acid Content

**First Place**
Hajar Musa
Malaysian Palm Oil Board (AOTD)
Selangor 43000 Malaysia
**Honorable Mention**
Piyanut  Boriboonwiggai
Thai Vegetable Oil Public Co.
Pathom 73120 Thailand
Tiam Huat Goh
PT Musim Mas
Medan, North Sumatra 20371
Indonesia
Jocelyn Alfieri
Silliker Canada Co.
Markham, ON L3R 5V5 Canada

## Unground Soybean Meal

**First Place**
Jennie Stewart, Brad Beavers
Carolina Analytical LLC
Bear Creek, NC 27207 USA
**Honorable Mention**
Augustin Rodriguez Arguello
Proteinas Naturales SA De CV
Guadalupe, NL 67130 Mexico
Paul Thionville, Andre Thionville,
Kristopher Williams
Thionville Labs, LLC
New Orleans LA 70123 USA
John Reuther
Eurofins Central Analytical Labs
New Orleans, LA 70122 USA
Frank Hahn
Hahn Laboratories
Columbia, SC 29201 USA
Lisa Marlow
Pilgrim's Corp.
Gainesville, GA 30501 USA

## Vegetable Oil for Color Only

**First Place**
QA Department
Richardson Oilseed Ltd.
Lethbridge AB T1H 6P5 Canada

# Key metrics continue to increase for all three AOCS journals

For the second year in a row, Wiley and AOCS Press are excited to announced that *JAOCS, Lipids*, and *JSD* have all increased their impact factors (Table 1). In addition, in the area of Applied Chemistry, *JAOCS* and *JSD* improved from Quartile 3 (Q3) to Quartile 2 (Q2). The journal editorial teams continue to work to improve quality while also striving to improve the author experience. In some situations, these top-cited papers needed additional work and, as the result of rigorous reviews, were published and now show up on the top-cited list.

"THIS DEMONSTRATES WHY I DON'T GIVE UP ON SOME AUTHORS AT LIPIDS IF THE DATA IS REASONABLE. WE WILL WORK EXTRA HARD THROUGH THE PEER-REVIEW PROCESS TO HELP MAKE IT THE BEST POSSIBLE." — Eric J. Murphy, *Lipids* Editor-in-Chief

We congratulate the following authors and member authors (names of authors who are 2019 AOCS members appear in color) for their top-cited articles, which were cited in 2018 and published in 2016 and 2017. As an AOCS member, be sure to log in at aocs.org and visit My Account to read these articles or any article ever published in *JAOCS, Lipids*, and *JSD*.

## *JOURNAL OF THE AMERICAN OIL CHEMISTS' SOCIETY*

**Chemical characterization of six microalgae with potential utility for food application**
Matos, Angelo Paggi; Feller, Rafael; Siegel Moecke, Elisa Helena; de Oliveira, Jose Vladimir; Furigo Junior, Agenor; Derner, Roberto Bianchini; Sant'Anna, Ernani Sebastiao
http://dx.doi.org/10.1007/s11746-016-2849-y

**TABLE 1. Impact factors of AOCS Journals in 2017 and 2018**

| Journal | Impact Factor | 2017 | 2018 |
|---|---|---|---|
| *JAOCS* | 2-year | 1.601 | 1.720 |
| *LIPIDS* | 2-year | 1.936 | 2.144 |
| *JSD* | 2-year | 1.454 | 1.672 |

**A Review on frying: procedure, fat, deterioration progress and health hazards**
Hosseini, Hamed; Ghorbani, Mohammad; Meshginfar, Nasim; Mahoonak, Alireza Sadeghi
http://dx.doi.org/10.1007/s11746-016-2791

**Sustainable synthetic approaches for the preparation of plant oil-based thermosets**
Llevot, Audrey
http://dx.doi.org/10.1007/s11746-016-2932-4

**Fingerprinting krill oil by P-31, H-1 and C-13 NMR spectroscopies**
Burri, Lena; **Hoem, Nils**; Monakhova, Yulia B.; **Diehl, Bernd W. K.**
http://dx.doi.org/10.1007/s11746-016-2836-3

**H-1-NMR characterization of epoxides derived from polyunsaturated fatty acids**
Xia, Wei; **Budge, Suzanne M.**; Lumsden, Mike D.
http://dx.doi.org/10.1007/s11746-016-2800-2

**Catalysts for fatty alcohol production from renewable resources**
**Thakur, Deepak S.;** Kundu, Arunabha
http://dx.doi.org/10.1007/s11746-016-2902-x

**Discrimination of olive oil by cultivar, geographical origin and quality using potentiometric electronic tongue fingerprints**
Souayah, Fatma; Rodrigues, Nuno; Veloso, Ana C. A.; Dias, Luis G.; Pereira, Jose A.; Oueslati, Souheib; Peres, Antonio M.
http://dx.doi.org/10.1007/s11746-017-3051-6

**Phenolic profile of peanut by-products: antioxidant potential and inhibition of alpha-glucosidase and lipase activities**
de Camargo, Adriano Costa; Bismara Regitano-d'Arce, Marisa Aparecida; **Shahidi, Fereidoon**
http://dx.doi.org/10.1007/s11746-017-2996-9

**Effect of roasting on physicochemical properties of wild almonds (*Amygdalus scoparia*)**
Hojjati, Mohammad; Lipan, Leontina; Carbonell-Barrachina, Angel A.
http://dx.doi.org/10.1007/s11746-016-2868-8

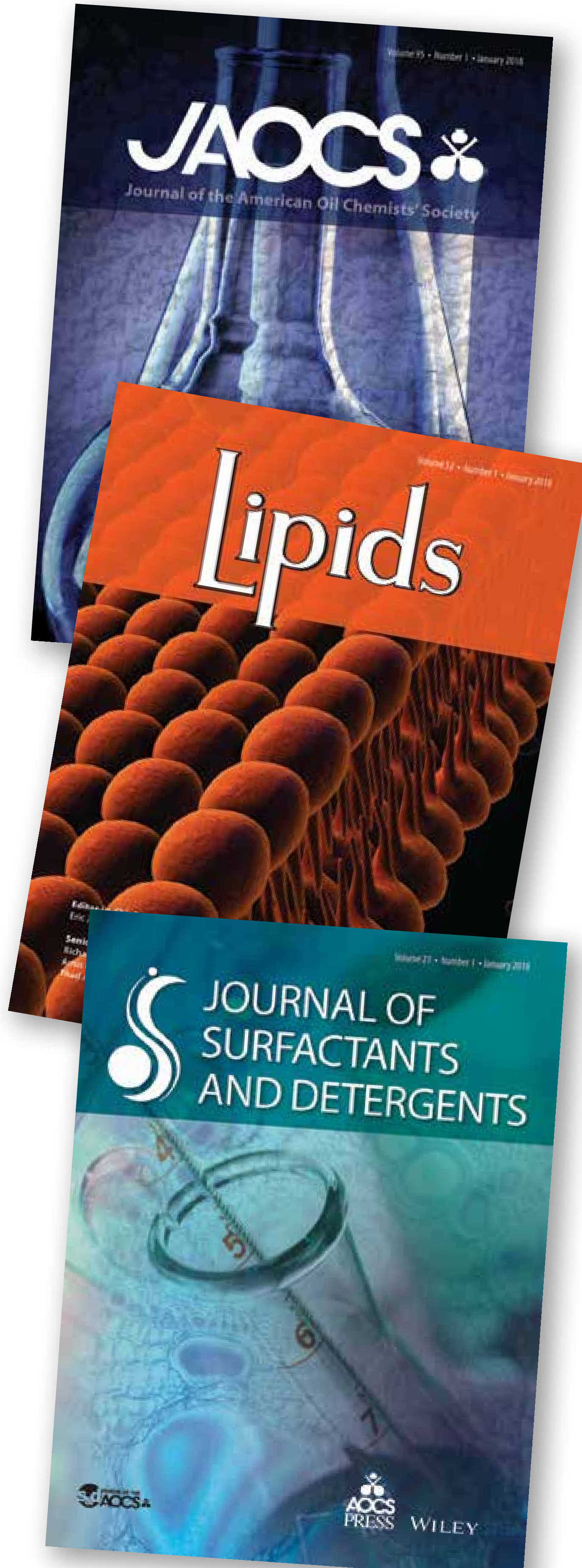
**Biological implications of lipid oxidation products**
Vieira, Samantha A.; **Zhang, Guodong**; **Decker, Eric A.**
http://dx.doi.org/10.1007/s11746-017-2958-2

## *LIPIDS*

**Current evidence supporting the link between dietary fatty acids and cardiovascular disease**
Hammad, Shatha; Pu, Shuaihua; Jones, Peter J.
http://dx.doi.org/10.1007/s11745-015-4113-x

**Intake of up to 3 eggs/day increases HDL cholesterol and plasma choline while plasma trimethylamine-n-oxide is unchanged in a healthy population**
DiMarco, Diana M.; Missimer, Amanda; Murillo, Ana Gabriela; Lemos, Bruno S.; Malysheva, Olga V.; Caudill, Marie A.; Blesso, Christopher N.; Fernandez, Maria Luz
http://dx.doi.org/10.1007/s11745-017-4230-9

**Low n-6/n-3 PUFA ratio improves lipid metabolism, inflammation, oxidative stress and endothelial function in rats using plant oils as n-3 fatty acid source**
Yang, Li Gang; Song, Zhi Xiu; Yin, Hong; Wang, Yan Yan; Shu, Guo Fang; Lu, Hui Xia; Wang, Shao Kang; Sun, Gui Ju
http://dx.doi.org/10.1007/s11745-015-4091-z



**Short-term high-fat diet induces obesity-enhancing changes in mouse gut microbiota that are partially reversed by cessation of the high fat diet**
Shang, Yue; Khafipour, Ehsan; Derakhshani, Hooman; Sarna, Lindsei K.; Woo, Connie W.; Siow, Yaw L.; Karmin, O.
http://dx.doi.org/10.1007/s11745-017-4253-2

**Uncoupling EPA and DHA in fish nutrition: dietary demand is limited in atlantic salmon and effectively met by DHA alone**
Emery, James A.; Norambuena, Fernando; Trushenski, Jesse; Turchini, Giovanni M.
http://dx.doi.org/10.1007/s11745-016-4136-y

**Fatty acid binding protein-1 (FABP1) and the human FABP1 T94A variant: roles in the endocannabinoid system and dyslipidemias**
**Schroeder, Friedhelm**; McIntosh, Avery L.; Martin, Gregory G.; Huang, Huan; Landrock, Danilo; Chung, Sarah; Landrock, Kerstin K.; Dangott, Lawrence J.; **Li, Shengrong**; Kaczocha, Martin; **Murphy, Eric J.**; Atshaves, Barbara P.; Kier, Ann B.
http://dx.doi.org/10.1007/s11745-016-4155-8

**Replacement of marine fish oil with de novo omega-3 oils from transgenic *Camelina sativa* in feeds for gilthead sea bream (*Sparus aurata* L.)**
Betancor, Monica B.; Sprague, M.; Montero, D.; Usher, S.; Sayanova, O.; Campbell, P. J.; Napier, J. A.; Caballero, M. J.; Izquierdo, M.; Tocher, D. R.
http://dx.doi.org/10.1007/s11745-016-4191-4

**Non-conjugated cis/trans 18:2 in beef fat are mainly delta-9 desaturation products of trans-18:1 isomers**
Vahmani, P.; Rolland, D. C.; Gzyl, K. E.; Dugan, M. E. R.
http://dx.doi.org/10.1007/s11745-016-4207-0

**Dietary fatty acid composition modulates obesity and interacts with obesity-related genes**
Hammad, Shatha S.; Jones, Peter J.
http://dx.doi.org/10.1007/s11745-017-4291-9

**Female mice are resistant to fabp1 gene ablation-induced alterations in brain endocannabinoid levels**
Martin, Gregory G.; Chung, Sarah; Landrock, Danilo; Landrock, Kerstin K.; Dangott, Lawrence J.; Peng, Xiaoxue; Kaczocha, Martin; **Murphy, Eric J.**; Kier, Ann B.; **Schroeder, Friedhelm**
http://dx.doi.org/10.1007/s11745-016-4175-4

## *JOURNAL OF SURFACTANTS AND DETERGENTS*

**A Review of Gemini surfactants: potential application in enhanced oil recovery**
Kamal, Muhammad Shahzad
http://dx.doi.org/10.1007/s11743-015-1776-5

**Effect of alkanediyl-alpha,omega-type cationic dimeric (Gemini) surfactants on the reaction rate of ninhydrin with [Cu(II)-Gly-Tyr](+) complex**
Kumar, Dileep; Neo, Kian-Eang; Rub, Malik Abdul
http://dx.doi.org/10.1007/s11743-015-1754-y

**Surface parameters and biological activity of n-(3-(dimethyl benzyl ammonio) propyl) alkanamide chloride cationic surfactants**
Shaban, Samy M.; Aiad, Ismail; Ismail, Abdallah R.
http://dx.doi.org/10.1007/s11743-016-1795-x

**Synthesis, characterization, surface and biological activity of diquaternary cationic surfactants containing ester linkage**
Migahed, M. A.; Negm, N. A.; Shaban, M. M.; Ali, T. A.; Fadda, A. A.
http://dx.doi.org/10.1007/s11743-015-1749-8

**Bio-/environment-friendly cationic Gemini surfactant as novel corrosion inhibitor for mild steel in 1 M HCl solution**
Mobin, Mohammad; Aslam, Ruby; Zehra, Saman; Ahmad, Musheer
http://dx.doi.org/10.1007/s11743-016-1904-x

**Surface tension and adsorption studies by drop profile analysis tensiometry**
Kairaliyeva, T.; Aksenenko, E. V.; Mucic, N.; Makievski, A. V.; Fainerman, V. B.; Miller, Reinhard
http://dx.doi.org/10.1007/s11743-017-2016-y

**Synthesis, characterization and exploratory application of anionic surfactant fatty acid methyl ester sulfonate from waste cooking oil**
Jin, Yueming; Tian, Senlin; Guo, Jiali; Ren, Xiao; Li, Xinyan; Gao, Shumei
http://dx.doi.org/10.1007/s11743-016-1813-z

**Improvement in the safety of use of hand dishwashing liquids through the addition of hydrophobic plant extracts**
Wasilewski, Tomasz; Seweryn, Artur; Krajewski, Maciej
http://dx.doi.org/10.1007/s11743-016-1868-x

**Modulation of aggregation behaviour of anionic surfactant in the presence of aqueous quaternary ammonium salts**
Chauhan, S.; Kaur, Maninder
http://dx.doi.org/10.1007/s11743-017-1949-5

**Amido-amine-based cationic gemini surfactants: thermal and interfacial properties and interactions with cationic polyacrylamide**
Hussain, S. M. Shakil; Kamal, Muhammad Shahzad; Sultan, Abdullah S.
http://dx.doi.org/10.1007/s11743-016-1896-6

# EXTRACTS & DISTILLATES

The full version of all AOCS journal articles are available online to members at www.aocs.org/journal. This column builds on that member benefit by primarily highlighting articles from other journals.

| | |
|---|---|
| ANA Analytical | BIO Biotechnology |
| EAT Edible Applications | LOQ Lipid Oxidation and Quality |
| H&N Health and Nutrition | IOP Industrial Oil Products |
| PRO Processing | S&D Surfactants and Detergents |

## ANA Tutorial on lipidomics

JianingWang, *et. al.*, *Analytica Chimica Acta 1061*: 28–41, July 2019, https://doi.org/10.1016/j.aca.2019.01.043.

The mainstream of lipidomics involves mass spectrometry-based, systematic, and large-scale studies of the structure, composition, and quantity of lipids in biological systems such as organs, cells, and body fluids. As increasingly more researchers in broad fields are beginning to pay attention to and actively learn about the lipidomic technology, some introduction on the topic is needed to help the newcomers to better understand the field. In this tutorial, co-authors from University of Texas seek to introduce the basic knowledge about lipidomics and to provide readers with some core ideas and the most important approaches for studying the field.

## ANA H&N The unique protein composition of honey revealed by comprehensive proteomic analysis: allergens, venom-like proteins, antibacterial properties, royal jelly proteins, serine proteases, and their inhibitors

Erban, T., *et al.*, *J. Nat. Prod. 82*: 1217–1226, 2019, https://doi.org/10.1021/acs.jnatprod.8b00968.

Honey is a widely used natural product that delivers some therapeutic benefits, but its chemical composition is not well-understood. The analytical technology described in this study moves us closer toward an understanding of the science behind the claims. The same methodology could be applied to additional naturals like milk.

Honey is a unique natural product produced by European honeybees. Due to its high economic value, honey is considered to be well-characterized chemically, and is often discovered to be adulterated. The results of this in-depth proteomic study of 13 honeys shows that our knowledge of honey protein composition, which is of high medical and pharmaceutical importance, is incomplete. We identified a number of proteins that are important for an understanding of honey properties and merit additional pharmaceutical research. Our major result is an expanded understanding of the proteins underlying honey's antimicrobial properties, such as hymenoptaecin and defensin-1, glucose dehydrogenase isoforms, venom allergens and other venom-like proteins, serine proteases and serine protease inhibitors, and a series of royal jelly proteins. In addition, we performed quantitative comparisons of all the proteins previously known or newly identified. The honey proteins, determined using label-free nLC-MS/MS in which the same protein quantity was analyzed in one series, were found in relatively similar proportions, although eucalyptus honey differed most widely from the remaining honeys. Overall, the proteome analysis indicated that honeybees supply proteins to honey in a relatively stable ratio within each proteome, but total protein quantity can differ by approximately an order of magnitude in different honeys.

## ANA H&N A systematic cheminformatics analysis of functional groups occurring in natural products

Ertl, P. and T. Schuhmann, *J. Nat. Prod. 82*: 5, 1258–1263, 2019, https://doi.org/10.1021/acs.jnatprod.8b01022.

A comparative knowledge of functional groups from natural products is expected to open a new paradigm of drug design and discovery.

The two most striking features distinguishing natural products from synthetic molecules are their characteristic scaffolds and unique functional groups (FGs). In this study we systematically investigate the distribution of FGs in natural products from a cheminformatics perspective by comparing FG frequencies in natural products with those found in average synthetic molecules. We thereby aim for the identification of FGs that are characteristic for molecules produced by living organisms. In our analysis we also include information about the natural origins of the structures investigated, allowing us to link the occurrence of specific FGs to the individual producing species. Our findings have the potential for being applied in a medicinal chemistry context concerning the synthesis of natural product-like libraries and natural product-inspired fragment collections. The results may be used also to support compound derivatization strategies and the design of "non-natural" natural products.

## EAT The gastrointestinal behavior of emulsifiers used to formulate excipient emulsions impacts the bioavailability of beta-carotene from spinach

Yuan, X, *et. al.*, *Food Chem. 278*: 811–819, April 2019, https://doi.org/10.1016/j.foodchem.2018.11.135.

Authors from the University of Massachusetts Amherst and the South China Agricultural University studied the impact of the type of emulsifier used to formulate excipient emulsions on the degradation (D*) and bioaccessibility (B*) of beta-carotene in spinach, using a simulated gastrointestinal tract (GIT). Emulsions stabilized by sodium caseinate (SC) were more prone to droplet aggregation than those stabilized by either Tween 20 or octenyl succinic anhydride (OSA)-modified starch. The fraction of beta-carotene available for absorption (D* x B*) was also affected by emulsifier type: SC (12.0%) > Tween 20 (5.0%) approximate to OSA stabilized (2.6%) ($p < 0.05$). This effect was mainly attributed to differences in the digestive characteristics of the emulsifiers, which affected the transfer efficiency of beta-carotene from the plant tissues to the lipid phase, lipid digestion, and mixed micelle formation. These results show the importance of selecting an appropriate emulsifier when designing excipient emulsions to enhance the bioavailability of nutraceuticals in fruits and vegetables.

## H&N Resveratrol-loaded lipid nanocarriers are internalized by endocytosis in yeast

Barbosa, C., *et al.*, *J. Nat. Prod. 82*: 1240–1249, 2019, https://doi.org/10.1021/acs.jnatprod.8b01003.

Different positive pharmacological effects have been attributed to the natural product resveratrol (RSV), including antioxidant, anti-aging, and cancer chemo-preventive properties. However, its low bioavailability and rapid metabolic degradation has led to the suspicion that many of the biological activities of this compound observed *in vitro* may not be attainable in humans. To improve its bioavailability and pharmacokinetic profile, attempts have been made to encapsulate RSV into lipid-based nanocarrier systems. Here, the dioctadecyldimethylammonium bromide (DODAB):monoolein (MO) liposomal system (1:2) loaded with RSV revealed appropriate characteristics for drug release purposes: reduced size for cellular uptake, stability up to 80 days, positive surface charge, and a controlled biphasic release of RSV from the lipid nanocarriers over a period of almost 50 h at pH 5.0 and 7.4. Moreover, the encapsulation efficiency of the nanocarrier ranged from 70% to 92% and its RSV loading capacity from 9% to 14%, when [RSV] was between 100 and 200 micrometers. The partition coefficient (Kp) of RSV between lipid and aqueous phase was log Kp = 3.37 ± 0.10, suggesting moderate to high lipophilicity of this natural compound and reinforcing the lipid nanocarriers' suitability for RSV incorporation. The thermodynamic parameters of RSV partitioning in the lipid nanocarriers at 37°C reflected the spontaneity of the process and the establishment of hydrophobic interactions. The cellular uptake mechanism of the RSV-loaded nanocarriers labeled with the lipophilic fluorescent probe 1,6-diphenyl-1,3,5-hexatriene (DPH) was studied in the eukaryotic model system *Saccharomyces cerevisiae*. Thirty minutes after incubation, yeast cells readily internalized nanocarriers and the spots of blue fluorescence of DPH clustered around the central vacuole in lipid droplets colocalized with the green fluorescence of the lipophilic endocytosis probe FM1-43. Subsequent studies with the endocytosis defective yeast deletion mutant and with the endocytosis inhibitor methyl-beta-cyclodextrin supported the involvement of an endocytic pathway. This novel nanotechnology approach opens good perspectives for medical applications.

## H&N LOQ Investigation of lipid-derived formation of decadien-1-amine, 2-pentylpyridine, and acrylamide in potato chips fried in repeatedly used sunflower oil

Karademir, Y., *et al.*, *Food Res. Int. 121*: 919–925, 2019, https://doi.org/10.1016/j.foodres.2019.01.020.

This study aimed to investigate lipid derived formations of decadien-1-amine, 2-pentylpyridine, and acrylamide in potato chips during frying. 2,4-Decadienal, a lipid-derived carbonyl, was monitored in repeatedly used sunflower oil at different thermoxidation levels (0, 6, 12, 18, 24 h at 180°C), and in the resulting potato chips. Formations of decadien-1-amine and 2-pentylpyridine were shown for the first time in potato chips. Frying oil had the highest concentration of 2,4-decadienal after thermal oxidation at 180°C for 6 h. Expectedly, potato chips fried in this oil contained the highest concentration of 2,4-decadienal (29 mg/kg). There was a positive correlation (r2=0.73) between the concentrations of 2,4-decadienal and decadien-1-amine (relative concentration as peak area) formed in potato chips fried in repeatedly used sunflower oil. No 2-pentylpyridine was detected in potato chips fried in unoxidized oil, whereas its concentration ranged between 91 and 154 microgram/kg in potato chips fried in oxidized oil. Acrylamide concentration of potato chips ranged between 525 microgram/kg (fried in oxidized oil, 12 h) and 722 microgram/kg (fried in unoxidized oil). A negative correlation (r2=0.70) was observed between the concentrations of 2,4-decadienal and acrylamide in potato chips. The results suggest that reactions of lipid derived carbonyls should be taken into account to understand better the modifications of amino acids in fried products.

## H&N LOQ Acrylamide: a review about its toxic effects in the light of Developmental Origin of Health and Disease (DOHaD) concept

Matoso, V., *Food Chem. 283*: 422–430, 2019, https://doi.org/10.1016/j.foodchem.2019.01.054.

The endocrine system is highly sensitive to endocrine-disrupting chemicals (EDC) which interfere with metabolism, growth, and reproduction throughout different periods of life, especially in the embryonic and pubertal stages, in which gene reprogramming may be associated with impaired development and control of tissues/organs even in adulthood. Acrylamide is considered a potential EDC and its main source comes from fried, baked, and roasted foods that are widely consumed by children, teenagers, and adults around the world. This review aimed to present some aspects regarding the acrylamide formation, its toxicokinetics, the occurrence of acrylamide in foods, the recent findings about its effects on different systems, and the consequences for human health. The challenges to characterize the molecular mechanisms triggered by acrylamide and to establish safe levels of consumption and/or exposure are also discussed in the present review.

## H&N LOQ EAT Innovative non-thermal technologies affecting potato tuber and fried potato quality

Dourado, C., *et al.*, *Trends Food Sci. Technol. 88*: 274–289, 2019, https://doi.org/10.1016/j.tifs.2019.03.015.

Since frying is the most common technique used in potato processing, fried potato is the most important processed potato product. Some food characteristics provided by the frying process are considered desirable, but others are harmful to human health. Thereby, the main challenge is to reduce the formation of the undesirable characteristics, without compromising sensorial attributes. In this review, the origin, economic importance, morphology, and composition of potato tubers are presented. Factors affecting potato tuber quality for human consumption and further processing are addressed, with a focus on the frying process, including the textural, chemical, and nutritional changes induced by frying, and the main characteristics affecting the quality of fried potato products. A brief overview of novel emerging non-thermal technologies and their effects on potato tuber and fried potato quality is provided. Irradiation, cold plasma, ultrasound, pulsed electric fields, and high-pressure processing are innovative non-thermal technologies with potential as frying pre-treatments, improving time and energy for slicing, cooking, and creating improved and healthier fried potatoes. Further studies are needed to better understand the subjacent biochemical mechanisms.

## H&N LOQ A quanti-qualitative study of a phenolic extract as a natural antioxidant in the frying processes

Sordini, B., *et al.*, *Food Chem. 279*: 426–434, 2019, https://doi.org/10.1016/j.foodchem.2018.12.029.

The aim of this work was to evaluate the effects of a phenolic extract from olive-mill wastewater on the stabilization of refined olive oil and on French fry quality during the frying process. Frozen, pre-fried potatoes were fried at 180°C for 8 min in refined olive oil enriched by different concentrations of a phenolic extract, while oil enriched by a common synthetic antioxidant (butylated hydroxytoluene) was used for comparison. The whole frying process took six hours. The phenolic extract was revealed as a very promising oil stabilizing agent during frying, playing an important role (dose-dependent) in preserving the antioxidants both in oil and in food, in reducing the formation of unwanted compounds (acrolein and hexanal), and in contrasting acrylamide production. These results clearly show that phenolic extract can be used as a source of natural antioxidants to replace (or avoid) synthetic additives in foods or beverages.

## H&N LOQ Phenolic compounds in beer inhibit formation of polycyclic aromatic hydrocarbons from charcoal-grilled chicken wings

Wang, C., *et al.*, *Food Chem. 294*: 578–586, 2019, https://doi.org/10.1016/j.foodchem.2019.05.094.

The effect of various beer marinades on formation of polycyclic aromatic hydrocarbons (PAHs) in charcoal-grilled chicken wings (CWs) and the active ingredients in beer contributing to inhibition of PAH formation were studied. The 1,1-diphenyl-2-picrylhydrazyl (DPPH) scavenging activity and total phenolic content (TPC) of six beers were evaluated. LC-MS analysis indicated a total of 32 phenolic compounds, among which we screened 11 to verify the inhibition of select PAH production. The total stable free radicals and selected PAH content of charcoal-grilled CWs were assayed, revealing a positive correlation. Heineken exhibited the highest phenol content and excellent performance in TPC (393.86 mg gallic acid equivalents (GAE)/L), ability to scavenge free radicals (27.0%), and the most effective inhibition of PAH8 formation (67%). Our study supplies a theoretical foundation for using edible materials rich in phenolic compounds as potential natural inhibitors of PAHs formed during the cooking process.

## S&D Modelling the kinetics of stain removal from knitted cotton fabrics in a commercial Front Loader Washing Machine (FLWM)

Bueno, L, *et. al. Chem. Eng. Sci. 200*: 176–185, June 2019, https://doi.org/10.1016/j.ces.2019.02.008.

Authors from University of Birmingham, UK; Repsol YPF, Spain; Procter & Gamble Ltd., UK; and University of Nottingham, UK, investigate the kinetics of stain removal from knitted cotton textiles during the washing process in a Front Loader Washing Machine (FLWM). Their mechanistic model takes into consideration the dual porosity of the textiles by allowing two different regions where the soil is located (inter-yarn and intra-yarn porosity). They suggest that for the washing cycle the detergent formulation can be designed to optimize the washing performance while reducing energy consumption and fabric damage.

## S&D Microrheological study of ternary surfactant-biosurfactant mixtures

Xu, L. and S. Amin, *Int. J. Cosmetic Sci.*, May 2019, https://doi.org/10.1111/ics.12541.

The combination of sodium laureth sulfate (SLES) and cocamidopropyl betaine (CAPB) is one of the most frequently utilized surfactant system bases for personal cleansing products. However, due to consumers' increasing awareness on product sustainability, microbial-produced biosurfactants are increasingly gaining the interest of the personal care industry as potential alternatives for traditional petroleum-derived and chemically synthesized surfactants. The co-authors of this paper from Manhattan College, Riverdale, New York, USA, used traditional mechanical rheometery and diffusing wave spectroscopy (DWS) to understand the rheological impact of rhamnolipids biosurfactant (mono/dirhamnolipids mixture, CCB) on a common personal care mixed surfactants system: anionic sodium laureth sulfate (SLES) and zwitterionic cocamidopropyl betaine (CAPB). The ternary biosurfactant/surfactants mixtures were evaluated at three different formulation conditions. The experimental results can provide a formulation guideline when applying rhamnolipids in cosmetics and personal care products.

## S&D Two-membrane air fresheners for continuous non-energized perfume delivery

Gui MinShi, *et al. J. Membr. Sci. 581*: 114–122, July 2019, https://doi.org/10.1016/j.memsci.2019.03.032.

Authors from the National University of Singapore and Procter & Gamble in Singapore have developed two-membrane air fresheners for continuous non-energized air freshener perfume delivery with significantly superior delivery consistency over a conventional membrane air freshener. In this study, a model perfume is used to investigate the conventional air freshener as functions of temperature and air velocity. The release rate of the conventional air freshener varies greatly from its initial use to its end-of-life under a fixed ambient condition. To regulate the evaporation rates of the volatile compounds, the new air freshener consists of an inner membrane and an outer membrane. The outer membrane is used as the regulation membrane to create a vapor reservoir between the inner wet membrane and the outer membrane so that the vapor generated from the inner membrane can be regulated. Comparing the conventional air freshener to the new air freshener, the outer membrane impregnated with polyethylene glycol (PEG) shows significantly better consistency of perfume delivery rates under different air velocities and temperatures. In addition, a model has been employed to predict the perfume release from the conventional air freshener. The perfume release from the newly developed air fresheners is regulated by vapor transport through the outer membrane which may be predicted through the Knudsen flow or solution diffusion model.

## S&D Encapsulation of colorants by natural polymers for food applications

de Boer, F.Y., *et. al.*, *Color. Technol. 135*: 83–194, June 2019, https://doi.org/10.1111/cote.12393.

Authors from the University of Utrecht and Unilever Research Labs in the Netherlands report new ways to use natural colorants in food products. Product appearance is an important factor for consumers when determining the quality of a product, and color is one of the most important factors which contribute to product appearance. Currently, the safety and consumer acceptance of some colorants used in food products, such as titanium dioxide and some synthetic colorants, are under discussion. Therefore, new ways to use natural colorants as alternatives to these suspect colorants for future applications are being investigated. A promising method for increasing the applicability of the often-sensitive natural colorants

is the encapsulation of these colorants in colloidal particles by natural polymers such as carbohydrates, lipids, and proteins. In recent years, micro- and nano-encapsulation have increasingly been used for various purposes concerning several food properties such as color, flavor, and micronutrient content. This technique results in improved stability for the often-sensitive natural colorants and presents the possibility of entrapping water-insoluble colorants for improved use in an aqueous system. This paper reviews the main methods that are used for encapsulation by natural polymers, discusses the different types thereof that are used for encapsulation of colorants, and provides a short overview of natural colorants successfully encapsulated in these natural polymers.

## S&D Improving environmental risk assessments of chemicals: steps toward evidence-based ecotoxicology

Martin, O.V., *et. al.*, *Environ. Int. 128*: 210–217, July 2019, https://doi.org/10.1016/j.envint.2019.04.053

The 36 coauthors of this paper include most of the major players in the personal and home care and chemicals industries, in addition to academic institutions from around the world. This paper reports on discussion that took place at a Society of Environmental Toxicology and Chemistry (SETAC) Pellston Workshop titled "Improving the usability of ecotoxicology in regulatory decision-making." The authors discuss regulatory decisions related to chemical substances: pre-market authorizations, setting of health-based reference values and environmental quality standards, and prioritizing for future testing and management measures. Opinions on how the use of ecotoxicological and toxicological evidence should be operationalized in regulatory practice can differ considerably. Although all regulatory decision-making based on science has some degree of empirical support, the authors argue here that evidence-based ecotoxicology goes further by systematically collating, classifying, and integrating evidence by its epistemological strength, commonly referred to as the weight of evidence. The term evidence-based ecotoxicology was selected to mirror developments in medical and clinical practice that are commonly referred to as "evidenced-based medicine." The group presents recommendations based on their own experiences of performing and scrutinizing risk assessments for chemicals within the European, North American, Pacific, and Asian regulatory frameworks.

## S&D Spontaneous formation of multilamellar vesicles from aqueous micellar solutions of sodium linear alkylbenzene sulfonate (NaLAS)

Khodaparast, S., *et. al.*, *J. Colloid Interface Sci. 546*: 221–230, June 2019, https://doi.org/10.1016/j.jcis.2019.03.056.

Researchers from Imperial College London, Procter & Gamble Co., and the Rutherford Appleton Lab, UK, have studied the spontaneous formation of multilamellar vesicles (MLVs) from low concentration (<30 wt%) aqueous micellar solutions of sodium linear alkylbenezene sulfonate (NaLAS) upon cooling, employing a combination of optical microscopy (OM), Small Angle Neutron Scattering (SANS), and Cryo-TEM. Upon cooling, MLVs grow from, and coexist with, the surfactant micelles, attaining diameters ranging from hundreds of nanometers to a few micrometers depending on the cooling rate, while the d-spacing of internal lamellae remains unchanged, at similar or equal to 3 nm. While microscale fluid and flow properties of the mixed MLVs and micellar phase depend on rate of cooling, the corresponding nanoscale structure of the surfactant aggregates, resolved by time-resolved SANS, remains unchanged. Their data indicate that the mixed MLV and micellar phases are in thermodynamic equilibrium with a fixed relative volume fraction determined by temperature and total surfactant concentration. Under flow, MLVs aggregate and consequently migrate away from the channel walls, thus reducing the overall hydrodynamic resistance. Their study demonstrates an approach for elucidating the molecular and mesoscopic structure of low concentration NaLAS solutions, and understanding how structure and flow properties are dramatically influenced by temperature variation about ambient conditions.

## S&D ANA Applicability of near infrared spectroscopy for real-time soil detection during automatic dishwashing

Heidrich, P., *et. al.*, *J. Near Infrared Spec. 27*: 183–90, June 2019, https://doi.org/10.1177/0967033518821835.

This review by authors from the University of Bonn, Germany, and Henkel, Germany, considers the use of NIR spectrometry to detect and determine concentrations of different soils in dishwashing liquor during automatic dishwashing in real-time. If it is possible to differentiate between soils, this could be an opportunity to react specifically to them (e.g., by increasing the water temperature if fat components are not sufficiently emulsifying). The possibility of an automatic adaptation of the dishwashing process to different soils and soil levels could lead to a shorter, more environmentally friendly, and cost-reducing process. In a first approach, an emulsion containing three soil types (oatmeal, egg-yolk, and butterfat), water, and detergent were used to develop NIR spectrometry prediction models. Transmittance spectra obtained with a Fourier transform near infrared (FT-NIR) spectrometer of testing standards of 76 automatic dishwashing cycles with seven samples per cycle were taken at various times during the main washing process for calibration (and validation) of the NIR spectrometry prediction models. The spectra were pretreated to develop NIR spectrometry prediction models for each type of soil using the partial least squares regression method with cross-validation. Overall, the coefficients of determination in cross-validation are R-2 > 0.92 for all NIR spectrometry prediction models developed. The results of the prediction models developed show that NIR spectrometry technology is a promising method to predict different levels of predefined soils in dishwashing liquor. The NIR spectrometry models were applied to an automatic dishwashing process with soiled dishes instead of emulsions containing soils to test their applicability. The resulting dishwashing process could be tracked in real-time by the dissolved soil concentrations, observed in the dishwashing liquor.