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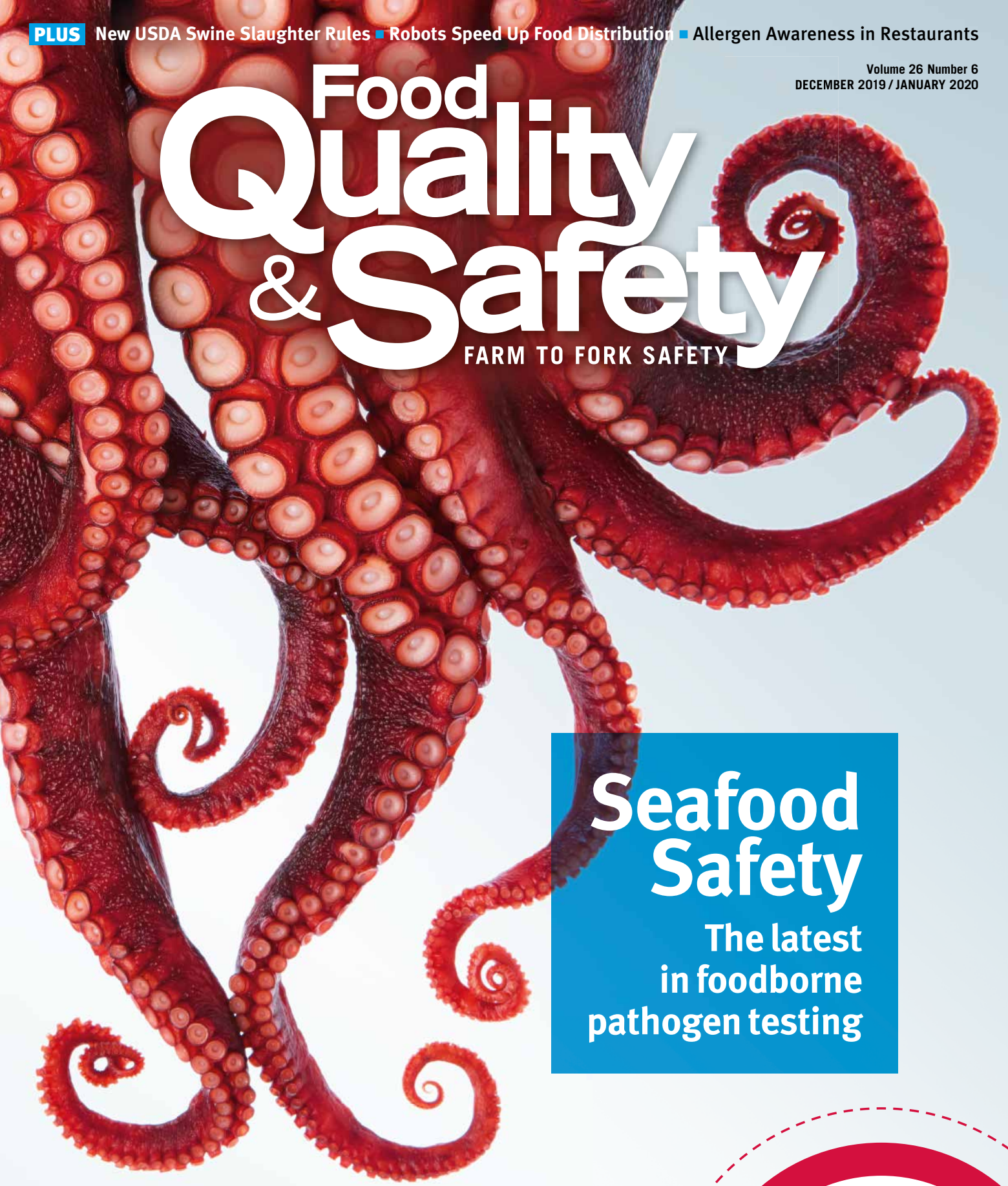
Volume 26 Number 6
DECEMBER 2019 / JANUARY 2020

Food Quality & Safety

FARM TO FORK SAFETY



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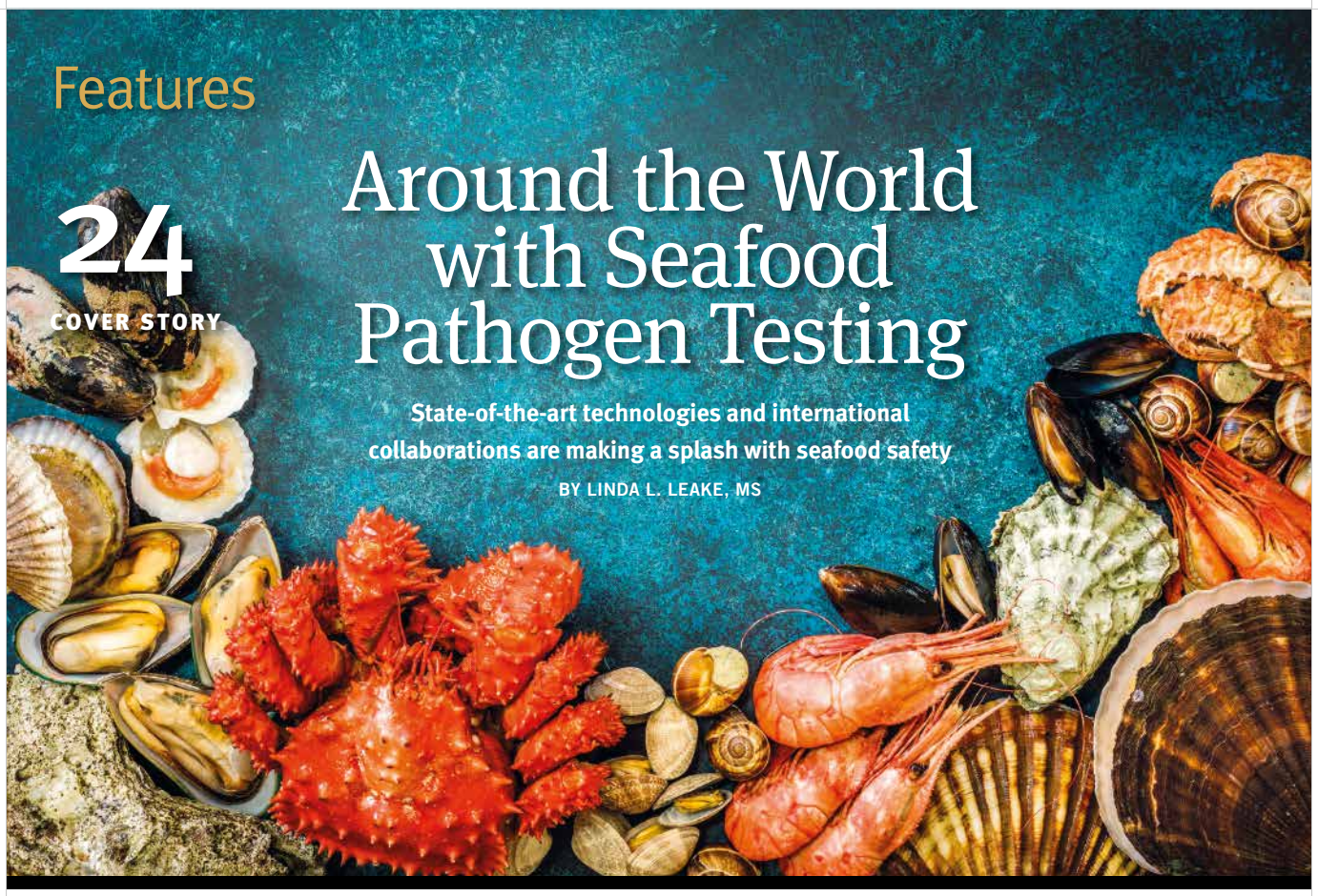

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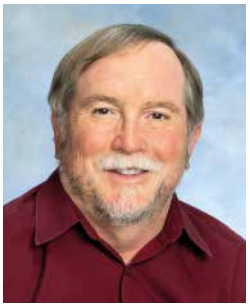
From The Editors



Food safety management is constantly evolving—just when we feel we have it under control, something else crops up to alter the equation. A bit over 100 years ago, the canning industry thought it understood how to can food safely. Botulism outbreaks attributed to black olives changed that and lead to the development of canning as a science thanks to persons like Dr. Karl Meyer and Dr. C. Olin Ball. The botulism outbreaks attributed to vichyssoise in 1971 lead to the establishment of low-acid canned food regulations in the United States. These regulations were based on those that were already in place in California.

Another watershed year for food safety was 1985, during the *Listeria monocytogenes* outbreak that was attributed to a soft-ripened cheese made with raw milk. This outbreak added *Listeria* to the list of significant food pathogens the industry needed to control, which included updating analytical methods to quickly isolate and identify the organism.

Thirty years ago, Dr. Steve Taylor was a voice in the wilderness crying out that allergens were a significant food safety hazard that needed to be addressed. Today, allergen management is an integral part of most food processors' food safety management systems. Allergens were also included in the preventive controls for human food regulations found in the Code of Federal Regulations, under 21 CFR Part 117, which mandates that processors establish programs to both keep undeclared allergens out of foods and properly label those that are in foods.

The trend has continued throughout the world. Among the food safety issues that have cropped up are acrylamide in baked and fried foods, adulterants such as melamine in dairy foods, and bovine spongiform encephalopathy in beef. Food safety issues also are often complicated by consumer misinformation on topics such as genetically engineered foods.

One of the new challenges in food safety will go hand-in-hand with the push for sustainability and a greener world. Many cities and some states have banned plastic bags at supermarkets to minimize plastic contamination. This means that consumers must bring reusable bags to stores, which can be manufactured from many different materials including plastic and fibers like jute and cotton. This sounds like a great idea, but there have already been outbreaks attributed to cross-contamination from one bag to another. Think about it: You have a cotton grocery bag that you bring to the market. You load it up with groceries including chicken breasts. The chicken leaks and contaminates the bag. Will you wash that bag?

And, we have another issue on the horizon: plastic. Hundreds of different foods are packaged in it, yet both land and sea plastic pollution are significant problems. Plastic packaging is used because it's safe and effective. Can we replace plastic packaging and still ensure that foods remain safe? Or will we go back to metal or glass containers? Or will someone come up with a biodegradable container or material that will protect food but not react with it? Stay tuned ....

Richard Stier
Co-Industry Editor

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FARM TO FORK SAFETY

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NEWS & NOTES

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Crayfish Linked to Sweden Salmonella Outbreak

The European Centre for Disease Prevention and Control (ECDC) reported in November that there have been 33 known cases of *Salmonella Mikawasima* in Sweden and seven other European countries.

"There is an ongoing investigation of *Salmonella Mikawasima* cases, which have been identified through exceedance analysis and whole-genome sequence analysis," Susana Barragan, a spokesperson for the ECDC, told *Food Quality & Safety* "ECDC is collecting further epidemiological and WGS [whole-genome sequencing] information from the countries in order to assess the extent of this event."

Although the majority of cases were reported in Sweden, others have been reported in the U.K., France, Denmark, and Ireland.

Moa Rehn, an epidemiologist for the Public Health Agency of Sweden, says it's investigating an outbreak of *Salmonella Mikawasima* in the country as people have been sick with the same *Salmonella* strain that has popped up throughout those European countries.

"We suspect that there is a common food source that has been distributed to several countries in Europe," Rehn told *Food Quality & Safety*. "A national outbreak team with participants from the Public Health Agency (Folkhälsomyndigheten), regional infectious disease departments, and the Swedish Food Agency is investigating the Swedish outbreak. Cases are being interviewed by the regional infectious disease departments to find out what those cases ate before falling ill."

> There have been 33 known cases of *Salmonella Mikawasima* in Sweden and seven other European countries.

The two dozen or so sick in Sweden live across 12 counties. The most recent known date of illness onset is Oct. 24, with those infected in an age range of 4 to 89 years.

The Public Health Agency of Sweden is performing a case-by-case study, comparing the food history of outbreak cases to non-outbreak cases from the same time period. They believe the probable source of infection is large crayfish sold at retailer ICA, according to Rehn.

After being made aware of the alleged problem by Folkhälsomyndigheten, the retailer has withdrawn all packages from their stores, though it released a statement that it randomly checked the Chinese crayfish it has in stock and did not detect *Salmonella*.

by Keith Loria

CEA Food Safety Coalition Welcomes First-Ever Executive Director

The New York City-based CEA Food Safety Coalition has named Marni Karlin as the group's first executive director. Karlin is charged with strengthening food safety standards and ensuring they are appropriate for the controlled-environment agriculture (CEA) leafy greens sector.

The CEA Food Safety Coalition comprises CEA leafy greens producers, including those that use hydroponic, aquaponic, and aeroponic methods.

"I am always seeking opportunities to use my skills and expertise to create a healthier, more sustainable food system," Karlin says. "I've done that through work with the organic sector, and in nutrition education, and now I'm excited to bring my skills, expertise, and experience in policy, advocacy, and coalition management to bear for the controlled environment agriculture leafy greens sector."

Previously, Karlin served as VP of government affairs and general counsel for the Organic Trade Association, representing the interests of the organic food, fiber, and agriculture sector in Washington, D.C. She also was counsel to Sen. Herb Kohl, D-Wis., on the Senate Judiciary Committee, advising the legislator through her engagement with coalitions of government, nonprofit, and for-profit stakeholders.

In her new role, Karlin will seek to grow the coalition's membership, educate consumers and regulators about this growing sector, and work with members, government agencies, and industry experts to strengthen food safety standards.

"As a growing sector, it's critical that we build a coalition of engaged stakeholders to advocate, educate, and work with external stakeholders now," she says. "It's important to have a seat at the table when standards and regulations are being discussed, and I'm excited to ensure that our sector has just that. We have a great opportunity to help people understand what we do—whether they're parents choosing to put our products on their children's plates, or regulators making important decisions to protect food safety and people's health."

by Keith Loria

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Report Reveals Food Authenticity Market Headed for Exponential Growth

A new report projects that the global food authenticity market is on a big upswing and will reach record numbers in the years ahead.

In 2017, the global food authenticity market was valued at $5.312 billion, according to research by KD Market Insights, Albany, N.Y. Researchers reported it should reach $9.84 billion by 2025, growing at a compound annual growth rate of 8.1%.

Food authenticity, defined in the report, is driven by numerous factors, including volatility in food prices, availability of raw materials and ingredients, economic conditions, regulatory developments, and large environmental impacts.

According to the UK's Food Standards Agency, food fraud is rampant and causes significant negative effects on both consumers and businesses. This includes everything from damage to brand reputations and revenue for retail businesses and processing establishments to health complications for the consumer due to its impact on food safety. That has given rise to innovative technology that's utilized to monitor food authenticity and tackle food fraud head on so more labs can confirm the food source and stop potential problems.

The food authenticity market is led by Europe, North America, and the Asia-Pacific region, with the last recording the highest growth rate last year thanks to an increase in processed foods production and the governments' implementation of new safety regulations.

KD Market Insights credits the U.S. for its regulations on labeling requirements and authenticity confirmation as being a key contributor to the projected increase in the years ahead.

The meat speciation segment is projected to grow at the highest compound annual growth rate during the forecast period, due to the increase in the number of frauds in meat products and adulterations.

by Keith Loria

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Beyond Vegan Burgers: Next-Generation Protein Could Come from Air, Methane, Volcanic Springs

ROME (Thomson Reuters Foundation) – It may sound like science fiction, but in a few short years the family dinner table may be laden with steak from a printer and other proteins produced from air, methane, or volcanic microbes.

With the explosive success of vegan beef and burger substitutes developed by Beyond Meat and Impossible Foods, the alternative protein sector just keeps growing.

According to investment bank Barclays, alternative meat sales could reach $140 billion—or 10% of the global meat industry—within a decade, or a 10-fold increase from current levels.

A new generation of products in the works melds cutting-edge technology with age-old fermentation processes to turn otherwise harmful or everyday elements into essential food ingredients, with the aim of reducing agriculture's massive carbon footprint.

According to the United Nations, agriculture, forestry, and other land use activities accounted for 23% of total net man-made greenhouse gas emissions from 2007 to 2016, soaring to 37% when pre- and post-production activity were factored in.

Livestock meanwhile are responsible for about 14.5% of global greenhouse gas emissions, according to the U.N. Food and Agriculture Organization.

Enter Solar Foods, a Finnish company working on an edible protein powder called Solein that uses water, air, and renewable electricity as a way to separate food production from agriculture.

"You avoid land use impacts like clearing forests for agriculture, use of pesticides and use of fertilizers that release greenhouse gases and so on," co-founder and CEO Pasi Vainikka told the Thomson Reuters Foundation.

Solein is made by putting microbes into a liquid and feeding them small bubbles of hydrogen and carbon dioxide, a process similar to making beer or wine, apart from the lack of grapes or grains, Vainikka explained.

As the liquid thickens, it is dried into a very fine powder that is about 65% protein and tastes much like wheat flour.

In September, Solar Foods struck an agreement with Nordic food company Fazer to develop products using Solein, which can be used in existing plant-based products or future offerings such as lab-grown meat.

Solein will cost about €5 per kilo ($2.50 a pound) to produce and will hit the market by 2021, Vainikka said.

"There's a lot of climate anxiety," he said. "And people are looking for hope and solutions and they're happy to see companies like ours, so that's encouraging."

Fermentation, Fermentation, Fermentation

Another company tackling agriculture's emissions through fermentation, Bangalore-based String Bio, is working to convert methane, a greenhouse gas more potent than carbon dioxide as it traps 28 times more heat, from waste and natural sources into protein powder—initially for animals.

Finnish company Solar Foods' protein powder Solein.

"We said this is probably the best impact we humans can have in this world, where we take something that we don't need for the environment and convert it into something we do need," said Vinod Kumar, who with his wife Ezhil Subbian set up the company.

Such environmental considerations, along with concerns over animal welfare and human health, have driven both demand and supply of alternative proteins, said Dan Altschuler Malek, managing partner at investment firm Unovis Partners.

Just 10 years ago he said retailers saw alternative proteins as a risky bet, but "today they realise there is a huge demand for all these products."

Unovis manages New Crop Capital, a fund that invests exclusively in start-ups developing meat, seafood, and dairy replacements, including Beyond Meat.

New Crop has also invested in Nova Meats, a Spanish company that uses a special 3D printer to produce steak that can mimic the taste and texture of meat.

The printers produce three-dimensional vegan steaks using cartridge-style syringes that extrude plant-based proteins.

Volcanoes and Tiny Organisms

Some have criticized plant-based alternatives flooding store shelves as highly processed and high in sodium, and Harvard scientists recently questioned their role in a healthy diet.

Others such as the Center for Consumer Freedom, which is backed by the food and beverage industry, have launched campaigns decrying so-called "fake meat" as loaded with chemicals.

Proponents counter that burgers have always been laden with fat and sodium and were never exactly considered health food.

The new generation of proteins are also less processed, said Thomas Jonas, CEO of Sustainable Bioproducts, whose protein is based on microbes found in volcanic hot springs at Yellowstone National Park.

In that barren, other-worldly, and dangerous landscape, researchers "discovered a bunch of life forms that across millennia evolved to survive in this environment," he said.

Having raised $33 million in February, the company plans to produce "a hamburger equivalent" next year through a "novel fermentation" of the microbes.

At full capacity its 35,000-square-foot (3,250 square meters) plant in Chicago could produce burgers equivalent to those made from cows grazing on 15,000 acres (6,100 hectares) of land, Jonas said.

For investors like Altschuler Malek, alternative proteins are all about options for consumers, with three essential caveats:

"It needs to taste great, it needs to meet certain price points, and it needs to be able to be manufactured in large volume," he said.

"There are amazing chefs all over the world that are doing plant-based products. But if you cannot convert that into mass manufacturing it's really hard to see how that can actually make a change in the world."

It is also an opportunity for a radical shift in agriculture which, despite incremental improvements, has remained much the same for centuries, Jonas said.

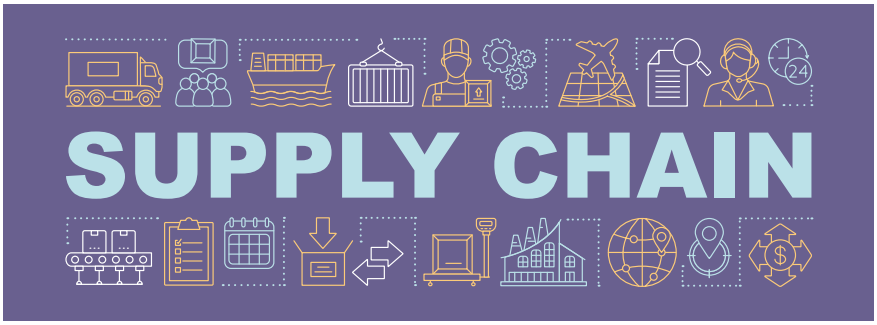
"Fundamentally we are surviving on this planet based on an agricultural system that has barely changed in the past 11,000 years . . . when we domesticated a handful of plants and animals."

"New technologies are really giving us tools for a second domestication–things that we didn't even know were there."

–Thin Lei Win, Thomson Reuters Foundation

FDA Extends Deadline for Supply-Chain Approval

With the clock ticking toward the implementation of its new supply-chain rules, the FDA announced it is extending its deadline for food producers to implement supply-chain control programs to approve hazard-control systems in place with their ingredients suppliers.



Under the Food Safety Modernization Act (FSMA), food producers will become responsible for abiding by a series of supply-chain rules (located in the Code of Federal Regulations, Title 21, Subpart G). These

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rules require producers that receive foods and food ingredients from other suppliers (called "co-manufacturers") to keep track of their suppliers' compliance histories, and only work with suppliers that consistently meet U.S. food-safety standards.

In November 2017, the FDA announced an initial enforcement discretion policy for the new rules. That policy was to last two years, until November 6, 2019, after which producers were expected to be compliant with the new guidelines.

"The complexity of the supply chain and the number of suppliers that manufacturers have, including facilities that manufacture under a brand name (i.e., co-manufacturing), necessitated that food companies were given additional time to adjust specifications and contract details to help facilitate compliance with the rule," Adrienne Seiling, vice president of strategic communications for the American Frozen Food Institute (AFFI), told *Food Quality & Safety*.

Some producers complained the demands of the new supplier-verification rules might force them to breach confidentiality agreements by requesting that ingredients manufacturers disclose specific processing details that might otherwise be considered trade secrets. In a letter to the FDA, signatories from 12 food industry associations explained the series of challenges the rule

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presents: Beyond the non-disclosure/confidentiality elements, producers are bound by a series of other contractual demands the associations argued the FSMA would force them to breach. The industry associations also argued that verifying all suppliers would require companies to hire more staff than they could afford.

"We commend FDA's 2017 decision to provide industry with an additional two years to implement the Preventive Controls supply-chain program requirements in certain situations involving contract manufacturing," wrote the signatories. "However, even with this additional time, there remain numerous compliance hurdles that have not been resolved. An extension of the compliance date will allow time for industry and FDA to develop a long-term resolution for this issue."

In a statement, the AFFI specified it "requested an extension to the enforcement discretion to allow for further consultation between FDA and industry to resolve these compliance challenges."

On the day that the discretion policy was to end, the FDA announced its decision to continue its enforcement discretion policy in reflection of the challenges industry faces in becoming FSMA compliant on these issues. The FDA will soon publish a notice in the Federal Register explaining the terms of the enforcement discretion policy extension, but no new compliance deadline has been set.

by Jesse Staniforth

'Creeping Silent Crisis' Seen Menacing World's Crops

ROME (Thomson Reuters Foundation) – A "creeping, silent crisis" is menacing the world's food supply as water shortages could jeopardize up to 40% of all irrigated crops by 2040, a U.S. think tank said on Monday.

Erratic rainfall caused by climate change also threatens the water supply for a third of crops that rely on monsoon, said the World Resources Institute (WRI).

"Humankind is not very good at acting before crisis happens. We're really good at crisis management but that's very reactive," said Rutger Hofste, an associate at WRI.

"This is a creeping, silent crisis and we would like to ring the alarm bells before it's too late," he told the Thomson Reuters Foundation by phone.

Scientists say water supplies are threatened by many factors, including climate change and mismanagement, but farming is one of the largest factors, using 70% of freshwater.

A crop scout walks through a soybean field to check on crops during the Pro Farmer 2019 Midwest Crop Tour in Allen County, Indiana.

REUTERS/P.J. HUFFSTUTTER/

On Monday, the think tank launched an online tool called Aqueduct Food, which maps water risks for more than 40 crops, including banana, coffee, soybean, and cotton.

Among irrigated crops, it found nearly 67% of wheat, 64% of maize, and 19% of rice could be in areas with extremely high water stress by 2040.

The three crops together account for more than 40% of the world's calorie supply, according to the United Nations' Food and Agriculture Organization (FAO).

Urgent action is needed, be it to improve irrigation and soil, better crop choices, or reducing food loss and waste, it said.

Reporting By Thin Lei Win @thinink
Editing by Lyndsay Griffiths
Thomson Reuters Foundation

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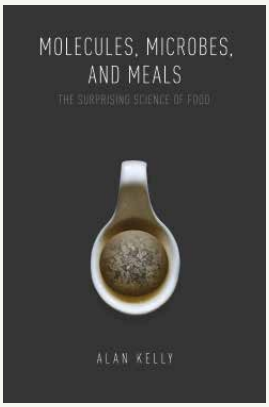
Book Review



Food Science for All

A new book explains food preservation and processing in a way that the general public can understand and enjoy

Molecules, Microbes, and Meals:
The Surprising Science of Food
by Alan Kelly
Oxford University Press, 2019
ISBN 978-0-19-068769-4

REVIEWED BY **PURNENDU C. VASAVADA, PHD**

Today's consumer wants to know everything about food: what to eat for weight loss, energy, or a myriad of other health benefits. Consumers are also interested in safety and suitability as well as where foods come from and how they're processed. The same is true for food industry professionals and artisanal food processors looking for basic information about food science and technology. Finding credible and scientifically sound information, however, isn't easy. Opinions, commercially biased information, and myths and misconceptions about food and food processing abound. While there is substantial scientific literature on the various aspects of food chemistry, food microbiology, food processing, engineering, and technology, very little credible, non-nonsense, and understandable information is available for lay consumers.

In his recent book, *Molecules, Microbes, and Meals: The Surprising Science of Food,* Alan Kelly provides an overview of the science of food, exploring all aspects of how the foods we purchase and consume have come to have the characteristics they do. The author starts with a confession," I am a food scientist," but presents the science of food in a unique style that's clear, credible, and enjoyable. Using common foods such as yogurt and cheese, the book explains the basics about the chemical components of food and ingredients and their role in the characteristics, flavor, texture, and qualities of food.

The book discusses key aspects and complexities of carbohydrates, proteins, fats, and other constituents in an easy-to-understand manner. Kelly describes the chemical structure of casein and its role in cheese making in fascinating prose without the use of a complex diagram one would find in dairy chemistry textbooks. In explaining the many types and roles of microorganisms, the author invokes the famous Clint Eastwood western, "The Good, the Bad and the Ugly," stating that (cue Ennio Morricone music and distinctive whistling) bacteria in food can be good (like probiotics), bad (like pathogens), or ugly (like the type that cause spoilage). He discusses spoilage bacteria, pathogens, spore-forming bacteria, and viruses in sufficient detail to explain what makes them grow and how we can control their growth or kill them to preserve and assure food safety. He also explains the Hurdle concept of food preservation in which salt, temperature, or preservatives are used to prevent the growth of microorganisms.

This books covers the principles of common food processing methods such as fermentation, concentration and dehydration, and freezing in a succinct yet effective way. Thermal processing such as pasteurization, including ultra-high-temperature and commercial canning, are explained thoroughly, including the principles of thermal lethality: – D- and Z- values. Kelly also covers novel food processing methods such as membrane filtration, high-pressure processing, and microwave heating. A separate chapter is devoted to discussing food packaging, including active, intelligent, and edible packaging.

One of the main focuses of the book is to explain the scientific underpinning of the flavor, texture, and qualities of food, and the transformations that occur when the products are cooked. The book also explores the convergence of science and art in food and the history of food. In this context the author describes the work of Nicholas Appert, who developed the art of appertization, a process of preserving food by placing it in a glass bottle, removing as much air as possible, and heating the sealed bottles in boiling water for a long period of time.

Finally, Kelly describes recipe development, formulations, and the sensory properties of foods, including appearance, flavor, texture, and taste. In this section he also includes information about the future of sensory science. He covers the popular topic of molecular gastronomy, which, he explains, resulted from collaborations between chefs and scientists.

Molecules, Microbes, and Meals argues that "every food product is a highly complex scientific entity and our understanding of the science of food can enhance our appreciation and wonder at it." I couldn't agree more. This book is full of interesting references to history and culture while explaining technical aspects of food chemistry, microbiology, and preservation and processing. It is an excellent introduction to food science and technology. I highly recommended it for anyone interested in information and understanding about all things food. ■

Dr. Vasavada is professor emeritus of food science at the University of Wisconsin-River Falls and a co-editor of *Food Quality & Safety.* Reach him at Purnendu.C.Vasavada@uwrf.edu.

Washington Report

The FDA Sets a Path to Smarter Food Safety

The agency is incorporating technology to trace foods and respond to outbreaks more quickly

BY **TED AGRES**

In early 2020, the FDA will unveil a "blueprint" outlining plans to modernize its approach to regulating food safety under the Food Safety Modernization Act (FSMA). These plans will include use of technology-enabled traceability tools such as blockchain, new predictive analytical measures to assess risk, and data analytics to improve root cause analyses and respond to contamination.

To help refine its analytical approach, the agency has solicited feedback through a federal docket and convened a public meeting. Representatives from the food and technology industries, consumer groups, academia, and officials from government agencies in the U.S. and UK attended a full-capacity meeting on Oct. 21.

"Smarter food safety is people-led, FSMA-based, and technology-enabled," Frank Yiannas, deputy FDA commissioner for food policy and response, told attendees in opening remarks. While much progress has been made to improve safety and efficiency, "today's food system has one major Achilles' heel, and that's a lack of traceability and transparency," he said.

Prior to the meeting, the FDA had asked more than 100 agency staffers to brainstorm ideas for turning the smarter food safety vision into reality. The four broad areas were tech-enabled traceability, smarter tools and approaches for prevention, new business models, and food safety culture. These then served as focal

points for discussion during the meeting, with the FDA and industry experts giving short presentations prior to simultaneous breakout sessions during which attendees offered comments and suggestions.

Tech-Enabled Traceability

Traceability and foodborne outbreak response involve technologies, data streams and processes to reduce the time needed to track and trace the origin of a contaminated food and respond to public health risks. Much of the discussion at the FDA meeting involved the need for clear data standards, challenges to implementing blockchain technology, ensuring protection of proprietary data, and enhancing outbreak response activities.

Currently, most food companies keep records of one step back to identify the source and one step forward to where the food has gone, as required by federal law. And many companies keep these records on paper, not electronically. Federal and state investigators found this especially frustrating in 2018 as they sought to determine the source of *E. coli*-tainted romaine lettuce from the Yuma growing region. Had growers and shippers used electronic records and blockchain technology, tracing the origin might have taken minutes or even seconds, instead of weeks and months.

Blockchain uses a decentralized, secure ledger that's shared by all parties in the supply chain to provide transparency on a product's origins. It can greatly assist in warning consumers about risks with specific foods and in implementing more targeted and efficient recalls. While the FDA does not intend to create a government-run blockchain platform, it will encourage industry to adopt this and other digital technologies to facilitate rapid traceability through the food distribution chain, Yiannas said.

Prior to joining the FDA in December 2018, Yiannas had been responsible for implementing blockchain technology for tracing produce sold at Walmart. In speeches to industry groups, he often tells how he was able to reduce the time needed to trace a package of sliced mangoes from farm to store from nearly seven days using traditional methods to a mere 2.2 seconds using blockchain. "An ability to deliver accurate, real-time information about food, how it's produced, and how it flows from farm to table is a game-changer for food safety," Yiannas said in a recent FDA publication.

But there are serious hurdles to overcome if blockchain is to be widely adopted by the food industry, said Alex Manders, head of blockchain services at Information Services Group, a Stamford, CT-based consultancy. These include incomplete knowledge of blockchain vendors, available technology solutions, collaboration models, and a lack of industry and governance frameworks, he said at the FDA meeting.

> "Today's food system has one major Achilles' heel, and that's a lack of traceability and transparency."
>
> —**FRANK YIANNAS**, deputy FDA commissioner for food policy and response

Manders urged the FDA to commission research to help industry facilitate blockchain implementation. But he cautioned against over-regulation. "New requirements ... could slow the adoption of real-world blockchain track-and-trace solutions," he said.

Perspectives on the FDA's Role

While most panelists and attendees applauded the FDA's initiative to formulate the new era smarter food safety, some noted that the agency should do more with the tools it already has.

"I think 'smarter' means more effective, that we're doing a better job, all of us, in reducing contamination and reducing the burden of food-borne illness," said Sandra Eskin, director of food safety at the Pew Charitable Trusts. "That may involve some shiny new technologies and it may involve some lower-tech but no less important tools," she told the conference.

"I don't think [the] FDA has to wait," Eskin added. "[The] FDA has to do something now. And that something is guidance to industry. What are those key data elements? What are best practices? A guidance document on traceability would be hugely helpful," she said.

Sarah Sorscher, deputy director for regulatory affairs at the Center for Science in the Public Interest, noted that the FDA needs to use its existing authority as well as potential new regulatory tools to promote progress. "The FDA has yet to deploy additional authorities [granted] under FSMA, key among these long-delayed water testing requirements of the produce safety rule," she said.

Focus on Blockchain

In announcing the smarter food safety initiative earlier this year, the FDA said government and industry should cooperate to leverage advances in digital technologies. These include blockchain to enhance product traceability, artificial intelligence and machine learning to facilitate food import inspections, and new packaging and transportation approaches to help modernize the food industry and meet the growing demands of e-commerce.

The FDA will launch a pilot project using artificial intelligence to enhance its ability to review imports at ports of entry to ensure they meet U.S. food safety requirements. The agency will also tap into its programs related to tracking the drug supply chain to see whether similar approaches might be adapted to tracking the nation's food supply.

"When you look at how other industries digitally track the movement of planes, ride sharing, and delivery of packaged goods, it becomes clear that we must explore how these types of technologies could improve tracking when it comes to food," acting FDA Commissioner Norman "Ned" Sharpless, MD, and Yiannas said in a joint statement at the time.

Tracing is only one area where technology can enhance food safety. "We'll also be looking at how to leverage emerging technologies and other approaches that are being used in society and business sectors all around us, such as distributed ledgers, sensors, the Internet of Things, and artificial intelligence," the two officials explained.

According to Natalie Dyenson, vice president for Food Safety & Quality at Dole Food Co., Inc., "blockchain is a journey. There is no one single provider

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that will be the silver bullet for the industry. But there is a lot of potential in the system already," she told the FDA conference.

Major industry players have been eager to gain a foothold in this burgeoning field. Walmart and other retailers are partnering with IBM Food Trust for blockchain services. Nestle is also partnering with IBM in a pilot traceability program in Europe for packaged instant mashed potatoes.

Financial services powerhouse MasterCard is looking to extend its blockchain-based Provenance Solution system, designed to combat money laundering, into food safety. Toward this end, MasterCard is partnering with Envisible LLC, a food supply chain system vendor, to pilot a seafood blockchain traceability program with Topco Associates LLC, a leading U.S. food cooperative.

"The identity of things is becoming even more important as consumers raise demands for transparency," said Deborah Barta, senior vice president for innovation and startup engagement at MasterCard, in a statement.

The FDA has taken a leaf from its own book. In late September 2019, the agency launched its Food Safety Dashboard, designed to monitor and track the agency's and industry's progress in implementing FSMA implementation. Initial metrics are available for the preventive control of human and animal foods rules and for the Foreign Supplier Verification Program. Data for additional FSMA rules will be added over time, the agency said.

"We know that we can't stop every outbreak of foodborne illness," Dr. Sharpless and Yiannas said in a statement. "However, reducing the incidence of illness and death attributed to contaminated food is a shared goal of growers, manufacturers, packers, suppliers, importers, and regulators alike." ■

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Market Initiatives

The Spices of Life

Spice industry professionals are devoted to safety and quality throughout the supply chain | BY **LINDA L. LEAKE, MS**

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Variety is the spice of life, and spices add so much variety to life. Treasured as trade goods for thousands of years, spices are used not only to season and preserve food, they have been embraced as medicines, dyes, and perfumes dating back to ancient times. The word spice comes from the Latin species, which means "wares." In the culinary world, spices are aromatic flavorings originating from seeds (fennel, mustard, nutmeg, and black pepper, for example), fruits (cayenne pepper), bark (cinnamon), flower buds (cloves), stigmas (saffron), roots (turmeric and ginger), and other plant parts.

Spices were a primary driver for early maritime and land trade routes developed between Europe and Asia, and remain a significant focus of international trade. In 2018, more than 22,000 metric tons of spices valued at $111 million were exported from the U.S., while imports of nearly 412,000 metric tons were valued at $1.76 billion, according to the USDA Foreign Agricultural Service's Global Agricultural Trade System. (A metric ton equals 2,204.6 pounds.) As with other food products, especially ones that are exchanged globally, spices are subject to food safety and quality concerns.

Microbial Hazard Concerns

The most important food safety issue that the spice industry deals with today is the need to manage the potential for contamination by microbial hazards, according to Laura Shumow, MHS, executive director of the American Spice Trade Association (ASTA).

Founded in 1907, the Washington, D.C.-based ASTA bills itself as "the voice of the U.S. spice industry in the global market." "ASTA represents the interests of approximately 200 members including companies that grow, dehydrate, and process spices," Shumow relates.

ASTA's members include U.S.-based agents, brokers, and importers. There are also member companies based outside of the U.S. that grow spices and ship them to the U.S. and other companies associated with the U.S. spice industry. "ASTA members manufacture and market the majority of spices sold in the U.S. for industrial, food service, and consumer use," Shumow elaborates.

Shumow points out that most spices require tropical or subtropical conditions to grow. "That means spices are typically grown in developing countries where sanitation and food handling practices may not always be adequate," she says. "Like all agricultural products, spices are commonly exposed to dust, dirt, insects, and animal waste before they are harvested. Then there are additional opportunities for contamination during primary processing, storage, and transportation. Much of the spices imported into the United States are essentially a raw agricultural commodity that will undergo extensive cleaning, processing, and treatment for pathogens once they enter the U.S. to ensure they are clean and free of microbial contamination."

Salmonella Control Is Essential

Foodborne illness attributed to spices is rare. But relative to potential microbial hazards that can affect spices, Shumow says that *Salmonella*, in particular, is a pathogen that must be controlled by treatment. "Spice companies use a variety of treatment methods to control for *Salmonella*, including ethylene oxide, propylene oxide, steam, and irradiation," Shumow notes. "This treatment is an essential food safety step in the spice supply chain. Spice companies must comply with the Preventive Controls for Human Food rule under the Food Safety Modernization Act."

The FDA basically defaults to a 5-log reduction of pathogens, Shumow says. "However, the FDA has advised ASTA it would accept a different approach if scientific evidence demonstrated the process would adequately control the hazard, and conversely could require a 6-log reduction if it would be reasonably foreseeable that

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the food could be contaminated with more than 100 colony-forming units per gram," she explains.

Quality issues related to spices include the potential to contain foreign material, as well as low levels of environmental contaminants, Shumow says. "These issues do not usually present a food safety issue, but are managed to ensure products meet quality and regulatory standards," she explains. "Spice companies may rely on supply chain controls such as sampling and testing, specifications, and supplier audits to mitigate these types of quality issues. The spice industry also employs a variety of equipment to physically clean spices, including air separators, sifters, and spiral gravity separators that separate sticks, stones, hair, insects, and other debris from the spice. These techniques are designed to ensure finished product complies with industry and regulatory specifications.

"The highest priority of ASTA is ensuring clean, safe spice for American consumers," Shumow emphasizes. "The association facilitates food safety in a number of ways, including the development of technical guidance, white papers, research, analytical detection methods, and education."

To this point, another ASTA offering is its Check Sample Program, which is proficiency testing designed to evaluate spice laboratories for a common range of analyses that are significant to the spice trade, Shumow explains. "Proficiency testing is the analysis of samples in conjunction with other laboratories testing the same sample type at the same time," she elaborates. "The program allows individual laboratories to evaluate their performance and set goals for improvement and consistency in analyses."

Guidance for Industry

ASTA publishes Clean, Safe Spice Guidance, which includes references to FSMA and information related to the FDA's Reportable Food Registry, Shumow says. "ASTA has worked and continues to work with companies and other associations to disseminate this guidance throughout the supply chain," she relates. "ASTA also collaborates with organizations in spice-producing regions of the world to provide education and resources on food safety and good agricultural practices for spice farmers and processors."

> "Much of the spices imported into the United States are essentially a raw agricultural commodity that will undergo extensive cleaning, processing, and treatment for pathogens once they enter the U.S. to ensure they are clean and free of microbial contamination."
>
> **—LAURA SHUMOW, MHS,**
> executive director of the American Spice Trade Association

Publicly available resources include ASTA's Identification and Prevention of Adulteration Guidance Document, Good Manufacturing Practice Guide for Spices, Good Agricultural Practices Guide, and HACCP Guide for Spices and Seasonings. "Likewise, ASTA offers several resources for non-member purchase, including an analytical methods manual and recorded webinar series," Shumow adds.

Educational and training resources for member companies are another offering in the ASTA toolbox, Shumow adds. "Webinars and workshops are regularly offered for the industry," she relates. "Recent topics covered by expert speakers have included whole-genome sequencing, new research on allergens, traceability/blockchain technology, and validation of spice process controls."

Changing Concerns

Issues with spices have changed over the years, says Martin Mitchell, chairman emeritus of Certified Laboratories, Inc. "Prior to the 2000s, 90 percent of spice industry concerns focused on product quality parameters, like cleanliness, color values, and volatile oil content," he relates. "Today, as Laura Shumow points out, bacterial contamination, particularly with *Salmonella*, is the major concern.

Based in Melville, N.Y., Certified Laboratories is an independent laboratory specializing in microbiological and chemical analyses of numerous foods and beverages, including spices. The firm also maintains operations in Aurora, Ill., Turlock, Calif., and Buena Park, Calif. Certified participates in the ASTA Check Sample Program, Mitchell notes.

Mitchell says Certified does the majority of the independent testing of spices in the U.S. "We test for most all of the ASTA members, as well as spice companies throughout the world," he relates.

A long-time ASTA member, Mitchell has served on the board of directors, and is a member and former chair of the Food Safety Committee. He was also a member of the ASTA Methods sub-committee that developed and approved the official ASTA testing methods for spices.

"In the early 2000s, there was some talk in the industry about *Salmonella*, but it was not universally accepted as a concern, especially since *Salmonella* does not proliferate on dry spices," Mitchell says. "But it has evolved to a major effort to control bacterial contamination, since by the mid-2000s *Salmonella* and other pathogens were traced to spices. At that time most spices came into the country untreated and any bacteria present were not necessarily treated upon arrival."

Most imported spices are now cleaned and subjected to a kill step by the U.S. processors when they take possession, Mitchell continues. "And there are now industry expectations for a validated kill step, documented sanitation controls, and pathogen testing for all spices, so they are sold to food manufacturers, food service customers, and consumers pathogen free," he emphasizes.

Adulteration Issues

Mitchell concurs with Shumow that adulteration is another major concern in the spice industry. "Some imported ground spices from Third-World countries are coming in adulterated," he elaborates. "For example, lead and lead chromate have been found in cumin and turmeric, and Sudan dyes have been identified in red pepper. Herbs such as sumac have been added to ground oregano."

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Legal Update

A Primer on the New USDA Swine Slaughter Rules

Everything you need to know about the first major overhaul of the swine slaughter inspection system in half a century

BY **JOEL S. CHAPPELLE, ESQ.** AND **SHAWN K. STEVENS, ESQ.**

This September, the USDA published its final rule to modernize swine slaughter inspection. The Final Rule for the Modernization of Swine Slaughter Inspection amends the federal meat inspection regulations. The New Swine Inspection System (NSIS) is the culmination of a 20-year process spanning four presidential administrations and is aimed at modernizing the swine slaughter inspection system. It represents the first major overhaul of federal swine slaughter regulations in more than 50 years.

Extraordinary advancements in science and technology have fundamentally altered our understanding of food safety. As a result, the predominantly organoleptic inspections conducted by the federal government since the early 20th century are approaching the point of obsolescence. According to Sonny Perdue, who heads the USDA, the NSIS is "the culmination of a science-based and data-driven rule-making process which builds on the food safety improvements made in 1997, when USDA introduced a system of preventive controls for industry."

According to the executive summary published in the final rule, the USDA Food Safety Inspection Service (FSIS) established the new rule with three primary goals in mind: to improve the effectiveness of inspection, to more efficiently and effectively use USDA's limited resources, and to facilitate industry innovation by revoking maximum line speeds and allowing establishments to reconfigure evisceration lines. Collectively, the FSIS hopes the new rules will reduce the presence of pathogens in pork products and improve compliance with the Humane Methods of Slaughter Act. The rule applies to establishments that slaughter swine market hogs. Establishments that slaughter swine other than market hogs are not eligible to operate under the NSIS unless they obtain a waiver under the Salmonella Initiative Program.

The NSIS has generated significant controversy and at least one lawsuit has already been filed to challenge the law. Here's what you need to know about the rule, the controversy surrounding it, and how the new rules may inform the future trajectory of regulatory oversight in the food industry.

The Rule

Unlike most regulatory regimes, the NSIS offers companies the choice of whether to adopt the new inspection protocols. Companies that elect not to operate pursuant to the NSIS will remain subject to traditional inspection protocols. Some of the amended regulations, however, will affect all swine slaughter establishments, regardless of the inspection system under which they operate.

Specifically, all swine slaughter establishments will be required to develop, implement, and maintain written procedures to prevent contamination by enteric pathogens, and to eliminate visible fecal material, ingesta, and milk throughout slaughter and dressing operations. These procedures must be memorialized in Hazard Analysis Critical Control Point (HACCP) Plans, sanitation standard operating procedures, or other prerequisite programs. Additionally, the procedures must include microbial sampling and analysis to monitor process control for enteric pathogens. Establishments will be required to collect and test at least two carcass samples for microbial organisms, one at pre-evisceration and one at post-chill (after completion of all slaughter interventions). Importantly, companies must prove the measures are effective in controlling illness-causing pathogens.

For companies participating in the NSIS, establishment personnel will now be tasked with sorting and removing unfit animals before ante-mortem inspection. Previously, this task was undertaken by FSIS inspectors. Although this is one of the more controversial aspects of the new rule, FSIS inspectors will continue to conduct 100 percent of ante-mortem and carcass inspections and will still conduct post-mortem inspections after personnel have identified and trimmed any defects. Companies must also develop written procedures ensuring that unfit animals do not enter the food supply, and personnel must tag, tattoo, or otherwise mark swine that are deemed unfit.

The rule mandates maintaining records documenting the total number of animals and carcasses sorted and removed per day and the reasons for their removal. If, during sorting activities, personnel identify any animals suspected to have a reportable or foreign animal disease, they are to immediately notify FSIS inspectors. Among the other changes to recordkeeping requirements, companies will now be required to maintain records documenting that ready-to-cook pork products comply with the new regulations. That is, ready-to-cook products must be evaluated to ensure they are free of visible defects or materials that would render them unsuitable for cooking without further processing.

Another key component of the rule is aimed at more effectively utilizing USDA resources. The general idea is that by streamlining deployment of inspectors, the agency will be able to conduct more offline inspection activities, which are ostensibly more effective in terms of ensuring food safety. Put differently, the agency posits that shifting inspection personnel from on-line inspection to offline verification activities will improve inspection efficacy overall, and thus improve food safety outcomes. While that may at first seem counterintuitive, it isn't necessarily so. Emerging food safety issues are often detectable in the context of trends, i.e., gradual increases in the presence of indicator organisms. Such increases would of course be invisible to on-line inspectors.

Finally, the rule revokes maximum line speeds. As a result, companies will now be able to set their own line speeds, provided they are able "to maintain process control for preventing fecal contamination and meeting microbial performance measures for carcasses during the slaughter operation." Importantly, the FSIS will still retain the ability to slow or stop the line if necessary. According to the USDA, based on the results of its pilot programs over the last 15 years, revoking maximum line speeds is unlikely to result in a higher prevalence of *Salmonella*.

For companies that intend to operate under the NSIS, the deadline to notify their FSIS District Office is March 30, 2020. Establishments that do not notify their District Office of their intent by March 30, 2020, will be deemed to have chosen to continue operating under their existing inspection system. The regulations that prescribe procedures for controlling contamination throughout the slaughter and dressing process, and the regulations governing new recordkeeping requirements, will take effect on Dec. 30, 2019, in companies with 500 or more employees. Companies with 10 to 499 employees will have until Jan. 29, 2020.

The Controversy

Critics of the new rule argue that it puts the fox in charge of the henhouse. Unfortunately, much of the backlash has been based on misleading or inaccurate information. The provisions generating the most controversy have been those placing establishment personnel in roles previously occupied by USDA inspectors. Critics further argue that placing personnel in an inspection or "sorting" role creates an inherent conflict of interest, whereby employees might be faced with the prospect of reprisals if they are perceived as too aggressive in ferreting out animals. But, in fact, most companies are contractually protected against having to pay for unfit animals. And while it is true that by the USDA's own estimates, there could be a 40 percent reduction of on-line inspection personnel in some facilities, it is also true that the FSIS will continue inspecting 100 percent of animals before slaughter and 100 percent of carcasses by carcass inspection. Thus, the fears appear to be largely groundless.

Another oft-criticized aspect of the new rules is the revocation of maximum line speeds. Under the new rule, establishments will be allowed to determine for themselves what line speeds are adequate to effectively eliminate fecal contamination and comply with microbial standards. The argument against this rule is that abolishing maximum line speeds will incentivize companies to put profits over the safety of workers and consumers. Notwithstanding these concerns, FSIS inspectors will retain authority to reduce line speeds if they believe an establishment is operating unsafely. If it appears to FSIS inspectors that a plant is operating outside of safe parameters, they will be able to step in and take action. Thanks to the more efficient deployment of FSIS inspectors under the new rules, the FSIS will be better positioned to identify emerging problems.

To this point, industry has been largely supportive of the new regulations. The general consensus appears to be that the amended regulations will give establishments greater operational autonomy to pursue novel food safety improvements. Likewise, the science itself supports the notion that reducing the number of on-line inspectors, more efficiently deploying agency resources, and fostering industry innovation will ultimately enhance overall food safety. Specifically, the USDA conducted a quantitative probabilistic food safety risk assessment to evaluate the potential changes in *Salmonella* illness risks that would result from modification of FSIS inspection allocation. The peer-reviewed findings confirmed that the rule's measures are likely to lead to an overall reduction of foodborne illness. This is what it means to modernize. Stated differently, maintaining historical numbers of on-line inspectors is, increasingly, a waste of the USDA's already limited resources. Those resources would be better devoted to performing other food safety related roles.

Unfortunately, in the realm of science and regulation, more effective policies are not necessarily more popular. Likewise, the extraordinary science and years of careful research underlying the changes are difficult to distill into a readily consumable format. As a result, we are likely to see continued controversy in the food industry as we continue to refine and modernize food safety in years to come. ■

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Food Defense

The Role of Monitoring in Food Defense Plans

Learn how to operate in compliance with FDA requirements

BY **DAVID K. PARK**

Most readers of these periodic food defense articles are familiar with activities associated with the design and implementation of a Food Defense Plan (FDP) that complies with the requirements of FDA 21 CFR 121, Mitigation Strategies to Protect Food Against Intentional Adulteration (IA rule). The rule is aimed at preventing intentional adulteration from acts intended to cause wide-scale harm to public health, including acts of terrorism targeting the food supply. Many of your facilities are, or soon will be, operating in compliance with provisions under this regulation. It's useful to revisit the role of required monitoring.

Food Defense Plan Basics

Food defense monitoring is defined by the FDA as follows: "To conduct a planned sequence of observations or measurements to assess whether mitigation strategies are operating as intended." Food defense monitoring procedures must be performed at sufficient frequency and include keeping records, as appropriate, to the mitigation strategy's nature and management component and its role in the facility's food defense system (See 21 CFR 121.140). Food defense monitoring is conducted by appropriately trained food defense individuals who can assess whether mitigation strategies are operating as intended (21 CFR 121.3) and with adequate frequency (21 CFR 121.140(b)). Food defense monitoring is just one of three mitigation strategies management components. The other two are food defense corrective actions and food defense verification.

Regulations require your facility to apply appropriate mitigation strategies management components by considering the nature of the strategy and its role in your facility's food defense system to ensure its proper implementation (21 CFR 121.138). As purposely written into the rule, your facility has the flexibility to identify and implement food defense monitoring procedures that are appropriate for your own unique operating environment. Your facility must first determine if it has Actionable Process Steps (APS), which are points steps or procedures in a food process where significant vulnerabilities exist, at which mitigation strategies can be applied, and that the strategies are essential to significantly minimize or prevent the significant vulnerability. If there are no APSes, then your facility wouldn't need to establish mitigation strategies.

Some aspects of food defense monitoring are similar to the food safety monitoring requirement as part of the Preventive Controls for Human Foods (21 CFR Part 117) rule (and Preventive Controls for Animal Foods 21 CFR Part 507). For example, each preventive control is monitored as appropriate to the nature of the preventive control and its role in the facility's food safety system. The same requirement applies to the Food Safety Modernization Act IA rule.

Food safety monitoring is more likely than food defense monitoring to document that the minimum or maximum values for parameters have been met. With food safety hazard control, monitoring is frequently assigned as a continuous process. Food defense monitoring, in comparison, often occurs less frequently. Monitoring can be continuous or periodic, and monitoring intervals can frequently change. For example, mitigation monitoring ac-

tivity frequency will be heightened when there are access points to production areas that contain APSes and where there's no continuous mitigation monitoring system available, such as in the use of continuous surveillance CCTV.

As with the design, implementation and monitoring of a Food Safety Plan or FDP is no less important. However, monitoring procedures, the frequency of monitoring, and who's assigned to conduct the monitoring may be different. In some cases, the same employee may monitor both food safety hazard control and food defense mitigation strategies in areas they are familiar with and stationed at. Also, a food facility experiences normal changes in physical facility, equipment design and installation layout, changes in personnel, and changes in food ingredient and packaging materials involved in production around APSes. As these changes occur, so might the vulnerabilities and their assigned mitigation strategies, which may not remain effective. Monitoring can determine if an FDP needs to address the effectiveness of implemented mitigation.

Your entire facility FDP must be reanalyzed at least every three years (21 CFR 121.157(a)). The following circumstances also necessitate reanalysis, perhaps even sooner than three years:

1. A significant change to activities creates a reasonable potential for a new vulnerability or a significant increase in an existing vulnerability.
2. Your facility learns that there's new information about potential vulnerabilities associated with the food operations within your facility.
3. An assigned mitigation strategy or FDP isn't properly implemented and may allow a food defense gap to exist.
4. The FDA, or other industry facility, learns of the discovery of new vulnerabilities, credible threats to the food supply, and/or developments in scientific understanding (21 CFR 121.157(b)).

Document, Document, Document

Monitoring activities must be documented and are subject to food defense verification (21 CFR 121.140(c)). Your facility's food defense monitoring procedures should answer the following four questions:

1. What specific APSes and their mitigation strategies will be monitored?
2. How will monitoring be conducted?
3. How often will monitoring be conducted?
4. Who will do the monitoring?

Regardless of how a mitigation strategy is monitored, monitoring activities must be documented (21 CFR 121.140(c)). The frequency of monitoring depends on the nature of the mitigation strategy and the facility's food defense system. Your facility can determine the frequency of monitoring needed so long as the frequency is adequate to provide assurances that the mitigation strategies are consistently performed (21 CFR 121.140(b)).

In some cases, it may be necessary to develop a new procedure to adequately monitor a mitigation strategy. In many instances, facilities may elect to have an employee observe whether the mitigation strategy is operating as intended.

A monitoring procedure occurring on periodic, but irregular, intervals can be beneficial for the facility in two ways:

1. It's more difficult for an inside attacker to anticipate a monitoring failure, and
2. It requires less human and other resources than more frequent monitoring.

For mitigation strategies that are monitored concurrently with their implementation, the monitoring frequency would depend on the intended mitigation strategy frequency. For example, the use of tamper-evident seals on transport conveyances may be determined by the frequency and sampling of received deliveries. The monitoring procedure would be to check the original seals for integrity or indications of tampering and match seal or documentation numbers upon arrival of the load at the receiving dock, before off-loading materials from the transport vehicle.

How Should You Monitor?

In some cases, it may be necessary to develop a new procedure to adequately monitor a mitigation strategy. In many instances, facilities may elect to have an employee observe whether the mitigation strategy is operating as intended. However, the flexibility to monitor mitigation strategies in other ways, such as electronic monitoring of an access control device—for example, automated monitoring and alarming of electronic locks on a door or gate that prevents access to an APS. Effective monitoring procedures can involve human observation, machine (electronic) observation, or a combination of both.

Where mitigation strategies may lend themselves to constant monitoring, exception records to document monitoring may be appropriate. This can be done through an automated system that's put in place to monitor whether the mitigation strategy is operating as intended. For example, a mitigation strategy may be to restrict access using a locking door that's opened only by a specially coded access card. If the door is left ajar and does not self-close for any period beyond the time it takes to enter and re-secure the door, an automated monitoring system alarm indicates that the door isn't secured. Whenever the system alarms, an automatically generated exception record documents the instance where and when the mitigation strategy wasn't operating as intended.

In addition to technology-based mitigation strategies, there also may be personnel-based mitigation strategies that lend themselves to constant monitoring. Personnel-based mitigation strategies (e.g., a two-person rule) are monitoring methods that restrict unauthorized access to designated sensitive areas to help ensure the strategy is operating as intended.

When considering monitoring procedures for mitigation strategies, it's important to consider what existing practices, procedures, and conditions are in place around the APS and to consider the nature of the mitigation strategy and its implementation effectiveness. Your facility can consider how existing food defense trained and qualified employees and supervisors can incorporate monitoring a mitigation strategy into their normal operations or job duties.

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In some circumstances, food defense monitoring may be incorporated into other physical security, maintenance, quality, or worker environmental health and safety responsibilities. For example, it may be most efficient to task an employee who frequently traverses the area to monitor the self-closing action of doors or door locks opened with key-swipe cards as part of their normal daily routine.

Who Will Monitor?

You should specify in your facility's written procedures the position of the employee who will monitor your mitigation strategies and describe how they are to perform the monitoring procedure. The employee's duties should include notifying management and following the food defense corrective actions procedures as specified in the FPD when observations or measurements indicate mitigation strategies aren't operating as intended. When a person is assigned to perform monitoring, that person must have the education, training, or experience (or a combination thereof) necessary to perform the assigned duties. (21 CFR 121.4(b)(1)). Your facility has the flexibility to assign monitoring responsibilities consistent with this requirement. Such individuals who perform these duties may include, among others:

- Production line personnel;
- Equipment operators;
- Supervisors;
- Maintenance personnel; or
- QA personnel.

Production workers involved in food defense activities can help build a broad base of understanding and commitment to the culture and responsibility of ensuring food defense. It's often useful to consider periodically assigning monitoring duties to an employee not normally stationed in an area where there's an APS. This allows your facility to capture different perspectives and observations or identify a necessary modification to the current requirements.

When Do You Monitor?

Many food facilities find that non-routine or non-scheduled monitoring of food defense mitigation strategies is additionally important in situations such as:

1. During second- and third-shift manufacturing and warehouse activities.
2. When the number of facility contractors or temporary or substitute workers increases, or when unsupervised service providers are allowed access to production areas.
3. When seasonal extremes of temperature affecting environmental working conditions within the production area (e.g., open internal and/or non-secured external doors for ventilation and temperature control for worker comfort).
4. During spikes in community crime and violent incidents.
5. During product or packaging rework activities.
6. When non-staggered employee departures from receiving, production, and warehousing areas to break areas occur.
7. During temporary construction activity.
8. When automated, electronic systems (e.g., card readers, door alarms) are deactivated for repair or a system installation upgrade.
9. Immediately following the termination of disgruntled employee.
10. During an extended loss of facility power.

Monitoring versus Verification

Lastly, monitoring shouldn't be confused as the verification activity. Food defense monitoring is a separate mitigation strategies management component from other activities, including corrective actions and verification. Monitoring activities can often identify when mitigation strategies aren't effective and when there might be an increased probability of a successful attack on your facility's product. In this comparison of terms, control of mitigation strategies around APSes are verified by routine monitoring. These are complimentary activities, and both are important in holistic food defense activities, but the two are different.

In the context of food defense, monitoring is the real-time observation and measurement of the execution of a set of validated design and implemented instructions for controlling a hazard/risk/threat to a facility, personnel, and/or product and packaging. Monitoring could include data outputs from instrumentation devices, visual inspections by personnel, and observations of procedure execution, but monitoring activities are the processes that must be used to detect a potential facility or product security breach.

Verification is the process by which an evaluation is made of whether a set of implemented mitigation strategies around APSes has been working as designed. Monitoring, on the other hand, identifies important points of potential system failure that could, if not mitigated, increase the probability of a successful intentional product or packaging adulteration attack, resulting in loss of product security that could adversely impact public health or cause widespread economic disruption.

Somebody Needs to Do It

I'll end the article by re-telling a very clever short story, famously used the world over in organizational development circles. The brief story speaks so well to the cause of system breakdowns:

"There was an important job to be done and Everybody was sure that Somebody would do it. Anybody could have done it, but Nobody did it. Somebody got angry about that, because it was Everybody's job. Everybody thought Anybody could do it, but Nobody realized that Everybody wouldn't do it. It ended up that Everybody blamed Somebody when Nobody did what Anybody could have done!" (Anonymous) ■

Food Defense Plan Builder

On Sept., 19, 2019, the FDA launched an updated version of the Food Defense Plan Builder to help companies meet the requirements of the Intentional Adulteration rule under the FDA Food Safety Modernization Act (FSMA). According to the FDA, the free, updated Ver. 2.0 tool has been aligned with the requirements in the IA rule so that it can be used to easily create food defense plans and support compliance with the rule. The tool is available with a registration at: https://www.fda.gov/food/food-defense-tools-educational-materials/food-defense-plan-builder

Park is the principal for Food-Defense, LLC. He has practiced food protection technical and management consulting for 46 years, is an FDA-recognized international processing authority, and an FSPCA PCQI Lead instructor. Reach him at dkpark72@aol.com.

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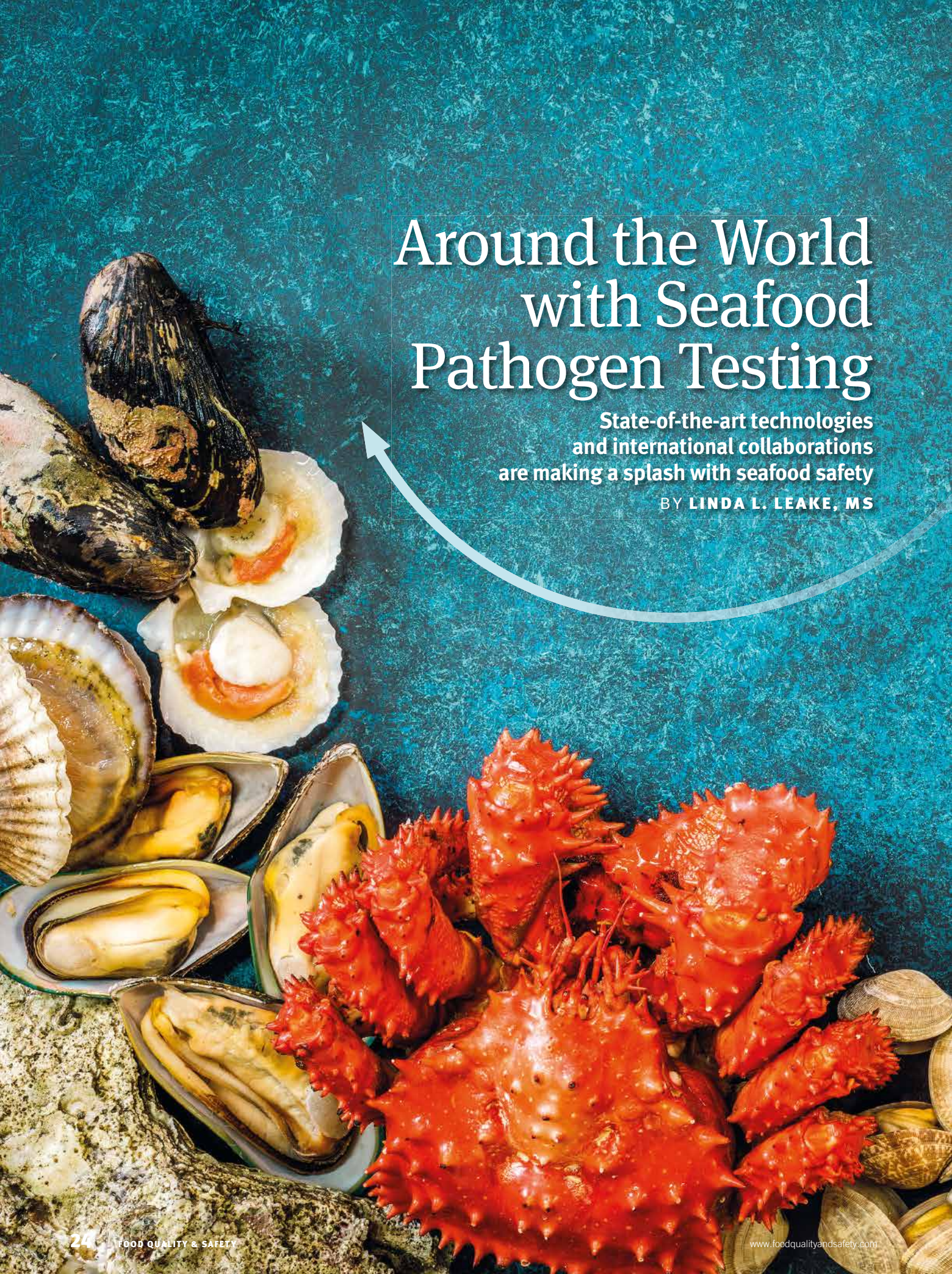

Around the World with Seafood Pathogen Testing

State-of-the-art technologies and international collaborations are making a splash with seafood safety

BY **LINDA L. LEAKE, MS**

Seafood is a whale of an industry throughout the world.

Fish consumption grew from 19.8 pounds per capita in 1961 to 44.5 pounds in 2015, at an average rate of about 1.5 percent per year, according to a 2018 report from the Food and Agriculture Organization of the United Nations (FAO). Preliminary estimates for 2016 and 2017 point to further growth to about 44.75 pounds and 45.2 pounds, respectively, FAO projects.

Estimated U.S. per capita consumption of fish and shellfish was 16.0 pounds in 2017, an increase of 1.1 pounds from the 14.9 pounds consumed in 2016, according to the National Oceanic and Atmospheric Administration (NOAA).

Not surprisingly, pathogen control and testing of seafood for microbiological hazards is an issue of ever-increasing importance.

In 2019 the FDA published its Evaluation of the Seafood HACCP Program for Fiscal Years 2006-2014. Presenting data from actual inspections, the report states, "The success rates for having and implementing HACCP (Hazard Analysis and Critical Control Points) plan controls for the hazards of pathogen growth/toxin formation and scombrotoxin were noticeably less than those for the other hazards."

Prominent Seafood Pathogens

Foodborne pathogens typically associated with seafood products and seafood processing plant environments include *Vibrio vulnificus*, *Vibrio parahaemolyticus*, *Salmonella spp.*, and *Listeria monocytogenes*, according to Kitiya Vongkamjan, PhD, an assistant professor in the department of food technology at Prince of Songkla University in Hat Yai, Thailand.

Dr. Vongkamjan says the various rapid technologies available for detection of these pathogens offer several benefits, including:

- determination of specific pathogens in raw materials, finished products, and environmental samples
- detection of low numbers of pathogens in complex matrices of organic materials that are loaded with non-pathogenic microorganisms
- monitoring of process control, cleaning and hygienic practices during manufacture
- time, labor, and expense savings

"In contrast to conventional methods, rapid detection enables generation of fast and reliable results, which is especially important in light of ever-increasing global seafood trade requiring rapid transport over vast distances," Dr. Vongkamjan relates.

Rapid detection methods can be categorized into nucleic acid-based, antigen-antibody based, biosensor-based, and phage-based methods, Dr. Vongkamjan notes.

Nucleic Acid-based Methods. Scientists have developed nucleic acid-based methods for detection and identification of specific DNA or RNA sequence of the target pathogen, Dr. Vongkamjan says. "Detection of a target nucleic acid sequence is performed by simple polymerase chain reaction (PCR), hybridization probes, or primers," she elaborates. "Nucleic-acid based methods detect specific genes in the target pathogens associated with seafood."

PCR-based methods are often classified into conventional PCR and real-time/quantitative PCR (qPCR), Dr. Vongkamjan explains. "Real-time PCR combines the specificity of conventional PCR with the quantitative measurement of fluorescence for monitoring amplification of specific genes in the target pathogens," she explains. "A number of qPCR schemes have been designed to detect target genes such as the cholera toxin gene (ctxA) of *V. cholerae* or the tdh/trh genes of *V. parahaemolyticus* in fish and crustacean samples. Detection of multiple target genes of different species, serotype, or subtypes can be done in a single reaction by multiplex assay."

Loop-mediated isothermal amplification (LAMP) is another variant of nucleic acid-based methods, Dr. Vongkamjan continues. "Most LAMP-based assays have been used for detection of *V. parahaemolyticus*, *V. vulnificus*, *Salmonella spp.*, and *L. monocytogenes* in seafood and environmental samples. LAMP is proven to be more specific and sensitive compared to the other PCR-based assays for the detection of foodborne pathogens."

Antibody-based Methods. Antibody-based detection relies on a highly specific and sensitive antibody-based system for the antigen present on the target pathogen, Dr. Vongkamjan says. "Most antigens contain amino acid sequences that are distinguishable among the target pathogens and other related non-target organisms," she relates. "This specificity allows strong reactivity of antibody to the antigen in the target pathogen. Enzyme-linked immunosorbent assay is one such standard pathogen detection tool, whose detection system is based on enzyme-labeled reagents."

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Phage-based Detection Systems. Phages are viruses that can infect bacteria, Dr. Vongkamjan notes. "Wide-range applications of phages have been reported, including as pathogen detection systems," she says. "Phages are typically modified to carry a gene such as a luciferase that encodes a protein, allowing for its rapid or easy detection. A real-time light emission produced by luciferase in the infected pathogen, such as *Listeria*, can be detected."

Biosensor-based Methods. Biosensors are devices used to detect biological analytes, such as pathogens, according to Jane Ru Choi, PhD, a postdoctoral fellow in biomedical engineering at the University of British Columbia, Vancouver, Canada.

"These devices are named based on their detection approaches, such as colorimetric, fluorescent, electrochemical, and chemiluminescent-based biosensors," Dr. Choi relates. "Biosensors can be implemented in point-of-care (POC) devices, which are diagnostic tools used to obtain results quickly close to the subject of the test.

With advances in POC testing, scientists have developed microfluidic chip-based devices including paper-based devices, such as lateral flow test strips and three-dimensional paper-based microfluidic devices, Dr. Choi says. Both microfluidic chip-based and paper-based devices can employ colorimetric, fluorescent, chemiluminescent, and chemiluminescent-based approaches, she elaborates.

"Despite some limitations, including poor sensitivity and lack of quantification, these emerging technologies are fast gaining popularity for use in detecting food contaminants, including those in seafood," Dr. Choi points out. "POCs offer numerous advantages, including being affordable, sensitive, specific, user-friendly, rapid and robust, equipment free, and deliverable to end users."

Ribotyping

Certified Laboratories, Inc., based in Melville, N.Y., typically uses ribotyping for pathogen "fingerprinting" in seafood, according to Martin Mitchell, Certified's chairman emeritus.

"Ribotyping is a molecular technique that capitalizes on unique genomic structures to differentiate strains of the pathogen," Mitchell relates. "Ribotyping offers the benefits of molecular biology at less cost than whole-genome sequencing (WGS).

"Ribotyping and WGS refer to two specific techniques that fall under the broader term of "strain typing," Mitchell continues. "Strain typing is any technique used to differentiate or determine the commonality of one strain of organism from another."

According to Mitchell, strain typing is a useful tool for environmental monitoring in seafood processing establishments. "If, for example, sanitation is not effective in removing *Listeria* from a plant, strain typing can be used to determine if the organism came in on raw product, or if there are harborage issues in the facility," he explains. "If the specific *Listeria* organism identified after sanitation is the same as the one identified before sanitation, that's an indication there is a harborage issue."

Supporting the U.S. Seafood Inspection Program

Fish and seafood products testing is conducted by the National Seafood Inspection Laboratory (NSIL), Pascagoula, Miss., to support the U.S. Department of Commerce Seafood Inspection Program through the NOAA National Marine Fisheries Service (NMFS), according to Jon Bell, PhD, NSIL director. "NOAA's Office of International Affairs and Seafood Inspection (OIASI) is the U.S. competent export certification authority for fish and fisheries products," Dr. Bell relates.

The NSIL supports the Seafood Commerce and Certification Division of the OIASI by verifying that U.S. exports meet importing governments' food safety requirements, Dr. Bell notes. The verification process includes pathogen and indicator organism testing, along with processing audits conducted by the OIASI Seafood Inspection Program (SIP), he says.

"We conduct microbiological analyses on fish and fishery products for human consumption and aquatic fisheries byproducts to be used as ingredients in animal feeds and pet foods," Dr. Bell elaborates. "We test for a number of microbiological contaminants, including *Listeria*, *Salmonella*, *Staphylococcus aureus*, fecal coliforms, and *Vibrio* bacteria, among others."

> "In contrast to conventional methods, rapid detection enables **generation of fast and reliable results,** which is especially important in light of ever-increasing global seafood trade requiring rapid transport over vast distances."
>
> **—KITIYA VONGKAMJAN, PHD,**
> **assistant professor in the Department of Food Technology at Prince of Songkla University in Hat Yai, Thailand.**

"We also test for hazards in finished ready-to-eat seafood products, including cooked, packaged, vacuum packed, and frozen items," adds Angela Ruple, MS, NSIL supervising lead analyst.

Ruple says NSIL laboratory professionals employ both traditional culture and more automated rapid methods, including PCR. "When testing products for compliance with SIP procedures requirements and export certification, we use validated methods from AOAC International and the FDA's Bacteriological Analytical Manual," she notes. "Since NSIL is International Organization for Standardization (ISO) 17025 accredited, we also do in-house validations and verifications."

Molluscan Safety Issues

Dr. Bell notes that marine biotoxins are a growing concern within the Interstate Shellfish Sanitation Conference (ISSC), a cooperative body that implements the FDA's National Shellfish Sanitation Program (NSSP). (He serves as the NOAA representative on the ISSC.)

"FDA regulates seafood safety, but states have overlapping responsibility through their public health programs and laboratories," Dr. Bell points out. "Another established safety concern of the NSSP is naturally occurring *Vibrios* in harvest waters and shellfish."

Dr. Bell says the NSIL supports *Vibrio* projects, including ecoforecasting by NOAA's Coastal Ocean Services. "Ecoforecasting predicts how ecological events can indicate conditions that may impact human health, food, water, and the environment," he explains.

Mollusk Safety: UK Focus

"When we talk about seafood safety at the Centre for the Environment, Fisheries and Aquaculture Science (Cefas), we generally mean safety of bivalve mollusks, oysters, mussels, and clams," says Rachel Hartnell, PhD, principal scientist for seafood safety at Cefas.

An agency of the U.K. government's Department of Food, Environment and Rural Affairs, Cefas operates two laboratories, one in Weymouth, Dorset, and the other in Lowestoft, Suffolk.

Cefas is the UK's National Reference Laboratory for monitoring bacteriological and viral contamination of bivalve mollusks, and is responsible for coordination of the UK's food safety official control program, with thousands of samples passing through the laboratories annually, Dr. Hartnell reports.

In February 2019, FAO designated Cefas as a Reference Centre for Bivalve Molluscs (European spelling) Sanitation. "This is the first time the FAO designated a Reference Centre in the mollusk sector," says Dr. Hartnell, who serves as the Cefas lead for the center. "The mission of the center is to support the FAO vision for a globally unified system for shellfish safety."

International collaborations are underway at the FAO Reference Centre. For example, in May 2019, the Cefas laboratory in Weymouth hosted the Joint FAO/World Health Organization (WHO) Expert Meeting on Microbiological Risk Assessment to update FAO/WHO guidance to reduce public health risks from pathogenic marine *Vibrios*.

At that meeting, 19 experts in the fields of genomics, epidemiology, risk assessment, pathogen detection, method standardization, and remote sensing from 13 countries focused their attention on how state-of-the-art methods could be used to inform risk assessments, Dr. Hartnell reports. "The long-range goal is the development of future international seafood safety standards," she explains.

Commercial International Testing Services

NSF International is headquartered in Ann Arbor, Mich., but the presence and scope of its seafood services are worldwide.

"We provide seafood services from offices and labs in Everett, Wash.; Elizabeth, N.J.; Santiago, Chile; San Miguel, Peru; Guayaquil, Ecuador; Shanghai, China; Busan, South Korea; Delhi, India; Bangkok, Thailand; and Ho Chi Minh City, Vietnam," says Tom White, global manager for certification and audits for NSF International's seafood services.

NSF conducts full microbiological testing for seafood, including pathogens (*Listeria*, *Salmonella*, and *E. coli* O157:H7),

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Optimize Clean in Place

Software-guided power ultrasound can make the process more efficient | BY CLÉMENT CHAPPUIS

While clean in place (CIP) has been the dominant cleaning method for food industries since the second half of 20th century, it's now facing several challenges. Food processors are questioning how to make it more efficient and less expensive.

The four main parameters in cleaning (known as TACT) include:

T: Time (total and of each cleaning phase)
A: Action (mechanical effect)
C: Concentration (of cleaning chemicals)
T: Temperature (of water/cleaning chemicals)

There are two main challenges when starting an optimization process. One includes how modifying one of these four parameters will affect hygiene or quality performance. Raising the temperature, for example, will have a bactericidal effect but can increase mineral scaling when cleaning chemicals have a high pH and are loaded with product remains, as the same cleaning chemicals are being recirculated in the CIP process. This situation is very common in dairies where the main cleaning agent is caustic: The cleaning chemical contaminates itself with calcium-rich product residues during washes, which in turn reduces its effectiveness over time.

Another challenge is how to measure performance. Typical CIP sensors will be flowmeters (action), conductivity meters (concentration), and thermometers (temperature). The sensors will just report the current or planned situation (for example, run caustic at 1.2% and 30 m3/h for 20 minutes at 75 C). None of these sensors will report whether this time is ridiculously long or just barely sufficient. Let's be clear—sensors are very important during production, but the installation of novel devices that use methods like spectrophotometry to accurately measure each step's time of efficiency remain relatively infrequent. For this reason, any change done without introducing new technology will be very inefficient as it will require extensive visual checks, bacteriological tests, and a lengthy validation process.

As the benefit-risk ratio of implementing new technologies for CIP optimization is often perceived unfavorably, when it comes to solving hygiene or quality issues most companies will try in the beginning

Removal of Maillard reaction fouling in pipes by software-guided power ultrasound.
Image 1: Pipe after CIP for 50 minutes without sonication. Image 2: Pipe after CIP with simultaneous sonication for 30 minutes.

to extend washing time or raise chemical concentrations. However, most of the time these changes won't solve the problem.

At the end, all this then translates to massive resources wasted globally every day, with a huge environmental and economic impact, without ensuring a better-quality performance. Hence, the best ways to achieve both quality improvement and savings is to increase the information available by adding specialized sensors, investing in data analysis, and adding novel technologies.

Technology-Supported CIP Optimization

A relatively novel technology that can support a CIP optimization through several angles is software-guided power ultrasound. This technology involves plate waves, sound-guided metal plates, or pipes (also called Lamb waves). Akin to a low-power micro-vibration, the ultrasonic waves act on the fact that the first connection between fouling and metal pipe is weak Van der Waals forces, and disrupt this first interaction, preventing fouling from sticking harder. If action is taken already at that point and nucleation points are prevented from forming, then metal surfaces can be kept clean for a very long time.

This power ultrasound technology is efficient on various types of fouling and its benefits are especially seen where CIP chemicals aren't performing as expected or chemical use isn't an option. Uses include:

- ***Burnt Foodstuff:*** Caramelized sugars or Maillard reaction residues are difficult for chemicals to remove. They need surfactant additives, and even with them, washing performance is often poor if the layer is thick. Ultrasound is able to crack this layer and help cleaning chemicals to act deeper and remove burnt residues.
- ***Thick Fat:*** Caustics are efficient on fat provided the layer remains relatively thin. In very fatty processes (like butter or meat processing), fat clogging of pipes is common. Ultrasound has a very strong emulsifying effect that removes fat blockages in a matter of minutes, or can even prevent fat from depositing.
- ***Thick Scale:*** Though minerals are often handled by complexing additives or by acid, some processes aren't able to use them or require lengthy and costly rinses. Ultrasound cracks through loosely assembled crystals within seconds.

Software-guided power ultrasound will increase mechanical effect (the "A" of TACT), which in CIP is often the most critical performance parameter. This is done mostly thanks to cavitation.

Besides its use during CIP, software-guided power ultrasound can be used during most production runs to prevent fouling from forming in the most difficult places. It can also be used for sterilization steps. This technology allows for longer production runs and increases production capacity and savings as CIP is needed less often. ■

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Cover story: Around the World ... *(Continued from p. 27)*

standard plate counts, *Coliform/E. coli,* and yeast/mold, White notes. "For pathogens we run PCR analysis with culture confirmation," he says.

In 2018, NSF conducted roughly 1,200 lab tests on seafood products, White reports. Testing environmental swabs from seafood processing facilities is another NSF service, he adds.

"The majority of our work is mainly with seafood processors, but we support a wide variety of clients, including canners and fishermen," White relates.

"With 80 percent of all seafood consumed in the U.S. being imported from other countries, microbiological testing will continue to be an important step in protecting consumers from foodborne illnesses now and into the future," White predicts.

Commercial PCR Test Kits for Seafood

BIOTECON Diagnostics GmbH, Potsdam, Germany, offers a number of test kits for pathogen identification in fish and seafood products, according to Olaf Degen, MBA, the firm's head of operational marketing.

The most recent offering, foodproof *Listeria* plus *L. monocytogenes* Detection LyoKit, introduced in 2019, is relevant for use with products like tuna salad and tuna sandwiches, Degen relates. "This LyoKit enables the simultaneous detection of the food-relevant sensu stricto *Listeria species, L. monocytogenes, L. innocua, L. seeligeri, L. welshimeri, L. ivanovii,* and *L. marthii*, as well as the specific identification of the pathogenic species, *L. monocytogenes,* in a single PCR reaction," he elaborates.

The BIOTECON Diagnostics portfolio contains the foodproof *Vibrio* Detection LyoKit, which Degen says detects and differentiates between *V. parahaemolyticus, V. vulnificus,* and *V. cholerae* in a single PCR test. The *Vibrio* kit is particularly useful for quality control laboratories testing raw, ready-to-eat seafood and for shrimp aquaculture, Degen points out.

BIOTECON Diagnostics also offers the foodproof Norovirus (GI, GII) plus Hepatitis A Virus Detection Kit. "This specifically detects human pathogenic noroviruses of the genogroups I and II, and hepatitis A virus of the genotypes 1, 2, and 3 in a real-time PCR multiplex assay," Degen says. "The virus test system has been validated with various matrices, including fresh oysters, mussels, shrimp, fresh and frozen tuna, sushi, and water."

All of the BIOTECON Diagnostics pathogen test kits allow analysis to be performed in less than 24 hours with high sensitivity and 100 percent specificity, Degen notes. "In addition, yeast and molds can be detected in fewer than six hours directly from seafood samples using our foodproof Yeast and Mold Quantification LyoKit, instead of the usual five days it takes with standard methods," he says. ■

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Figure 1. Electric fluid heater.

Best Practices for Clean in Place

The equipment you need to design an ideal system

BY **MIMI CARTEE** AND **PATRICIA NHAN**

In 2011, the increased public awareness of food pathogens contributed in large measure to the passage of the Food Safety & Modernization Act (FSMA), which put into place a far more rigorous set of regulations surrounding food safety than had ever existed. In recent years, equipment cleaning processes employed by the food and beverage industry have come under even more increased scrutiny. This is the result of the widespread publicity around pathogen outbreaks in commercially processed food, including *E. coli* found in Californian romaine lettuce in 2018, and the presence of *Listeria* in Blue Bell ice cream in 2015. A drive toward more efficient food production coupled with the increased awareness of food pathogens has led the food processing industry to shift its focus to the equipment cleaning processes—specifically cleaning equipment surfaces that come into direct contact with food.

Designing a Clean-in-Place System

There are two basic approaches used in cleaning food processing equipment. The first, clean out of place (COP), is used for cleaning pieces of equipment and utensils that can be easily removed from the production line and disassembled for cleaning (e.g., beaters used in mixers). The second approach, called clean in place (CIP), is employed in aseptic and other processing operations where the interior surfaces of the food processing line, such as tanks and piping, cannot be easily reached and disassembled for cleaning. CIP cleaning is the more difficult of the two cleaning processes, and typically involves specialized CIP systems, employing fluid pumps and heaters.

In a CIP system, cleaning fluids are typically heated to increase their cleaning efficiency. Depending on the application, a few different cleaning agents may be used, including hypochlorites, peracetic acid, ozone-enriched water, and acid anionic. The cleaning fluid is circulated through the CIP system in a prescribed manner to regulate the flow, mixing, temperature, time, and mechanical force used with the cleaning agent to achieve maximum results.

Historically, steam-based heat exchangers were used to heat cleaning fluids used in CIP applications in the food and beverage industry. In recent years, the trend has been to use electric fluid heaters (often in-line types) that may be easily incorporated into CIP skids (see Figure 1). These electric fluid heaters provide the flexibility needed for designing into different types of CIP systems, and are ideally suited for lower process flows.

In selecting a fluid heater for CIP applications, there are several critical factors to consider, including:

- ***Sanitary Design***
  - Components such as the heating element, valves, and gaskets, used

in the construction of the heater eliminate possible locations for contaminants to thrive in the heater.
- Wetted surfaces in the heater should be constructed of 316L electropolished stainless steel, as it presents an extremely smooth surface to the cleaning fluid.

• ***Dead Leg Eliminating***
- Eliminate any areas outside of the regular fluid flow path that could harbor pathogens.
- Non-threaded design fittings provide a smoother surface with few nooks and crannies.

• ***Fluid Drainability***
- Cleaning fluids should be completely drained from the system after use.
- An input on the bottom of the heater should allow for complete gravity draining of the heater.

• ***Temperature Control***
- Maintaining an accurate fluid temperature is essential for the efficiency of the cleaning process.
- Temperatures may fluctuate more readily in steam-powered heat exchangers than electrically powered fluid heaters, leading to inconsistent cleaning results.

While fluid heaters are at the heart of the clean-in-place process, there are other considerations to be taken into account when designing an ideal CIP system. First, engineer your system for efficient operations. Easy access to the cleaning equipment is also important, especially during FDA inspections.

Most important, though, is a CIP line that's designed for maximum cleaning against microbial agents. With this in mind, use the proper tanks for the cleaning agents. Fluid tanks should have smooth and continuous welds, be self-draining, and their interior surfaces should be round or tubular, not flat, with no ledges or recesses that could harbor contaminants.

Then, identify and use the proper cleaning agents for your particular application. Hypochlorites are ideal for cleaning stainless steel surfaces that come into direct contact with food. Peracetic acid can be used against all microorganisms and may be applied with either cool or warm water. Acid (anionic) is an effective cleaning agent for removing hard water films or milk stone (found in dairy operations). Finally, ozone-enriched water kills microbes as effectively as chlorine without the hazardous side effects that come with chlorine's use, and has been approved by the FDA for use on food contact surfaces.

Most important is a CIP line that's designed for maximum cleaning against microbial agents.

Your CIP system must also be designed for the correct fluid flow rate to ensure cleaning "turbulence" and thorough cleaning results. The fluid flow rate through the CIP system's process piping should be greater than or equal to 5 feet per second. The flow rate is a function of the pump size—ideally, it should be able to produce a flow rate that's at least four times greater than that required during cleaning operations, so selecting the proper fluid pump for your CIP system is critical.

Finally, your CIP system needs to be engineered with the proper connections between the component pieces. Avoid creating lively dead areas that are outside of the cleaning agent process flow. These too are ideal locations for pathogen growth.

Even the most carefully designed CIP system will need to be monitored on an ongoing basis once it's in use to ensure that it's working as intended. "Automation" does not equal "automated process control." Several items in the CIP system need to be checked on a regular basis, including cleaning chemical concentrations, pH levels, and pump/metering device performance. Also, check the water chemistry on a periodic basis. Hard water can precipitate on surfaces and clog holes, compromising fluid flow and coverage. A well-designed and well-maintained CIP system will ensure that your food-processing line is operating at maximum efficiency, and delivering results that will minimize the likelihood of food pathogen problems. ■

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While most industry professionals are familiar with clean in place, a good cleaning program also involves clean out of place, as applicable to the process.

Clean Out of Place to Complement Your Clean in Place

The best cleaning programs involve both processes

BY **MEGAN MORAN**

Cleaning in manufacturing facilities is essential to preventing microbiological buildup on processing equipment and producing a safe product for consumers. While most industry professionals are familiar with clean in place (CIP), a good cleaning program also involves clean out of place (COP) as part of the process.

CIP is a term most industry professionals are familiar with, as it's used in food manufacturing facilities as an efficient and effective process to clean manufacturing equipment and help ensure food safety and quality. You can think of CIP like a washing machine connected to your food processing equipment, dedicated to rinsing, washing, and sanitizing the internal components of that equipment.

The COP process can be used for equipment and components that require at least some disassembly to be cleaned. COP is generally beneficial for cleaning individual parts like hoses, fittings, nozzles, trays, knives, clamps, and even conveyor belts that are taken off the machinery to be cleaned, removing them from the CIP cleaning cycle.

Automated and Manual Processes

While essentially any cleaning completed "out of place" is considered COP, there are both automated and manual processes. Manual involves cleaning by sanitation personnel, often with buckets of water, brushes, chemical solution, and elbow grease.

Rather than manually cleaning individual out-of-place items, many facilities elect to use an automated COP system. This ensures a detailed clean and saves the operation the labor and stress of manual cleaning. You might think of automated COP like you would the use of a dishwasher cleaning your dinner dishes. Larger pieces of removed machinery are placed inside a COP tank to be cleaned. For smaller items, such as gaskets, a COP basket can be used to ensure those items aren't lost during the COP cleaning cycle.

Once parts have been disassembled and placed in the tank, a cycle similar to CIP is run. The parts in the tank are rinsed, cleaned, and sanitized through an automated COP cycle. There are six common steps in a COP cleaning process:

1. Dry cleaning. This step removes product residue or other debris from the equipment.
2. Rinse the parts in the COP tank. This will also remove any additional residue or debris the dry cleaning did not remove.
3. Cleaning the equipment with a soap or chemical. When done in the COP tank, the parts are run through a cycle that circulates the water and chemical solution with the appropriate action to effectively clean the equipment.
4. Rinse the parts in the COP tank. This will remove any residual chemical.
5. Complete a visual inspection or swabbing to ensure parts were adequately cleaned. If the parts do not pass, a re-clean is needed before moving on to the next step.
6. Sanitize the parts in the tank. This generally involves leaving them to soak in a sanitizer solution until the equipment is ready to reassemble.

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Quality

50 Years of Glycerol Ester of Wood Rosin

Why this beverage-weighting agent continues to be a safe additive

BY **BRIAN MERCK** AND **KEN KENNEDY**

Glycerol esters of rosin, commonly known as ester gums, are highly versatile resins used in adhesives, coatings, inks, and other markets. Their unique functionality has led to specialized food applications in beverages and chewing gum.

An interesting example is the use of glycerol ester of wood rosin (GEWR) as a beverage-weighting agent (BWA) for citrus-flavored beverages. This application was created by a long-term cooperative approach with beverage customers and regulatory agencies. Food applications require rigorous testing to demonstrate safety and compliance with all global standards. The safety of GEWR was originally established by rigorous toxicological testing and has been further proven by five decades of global use in beverage production. Active support of the regulatory process has demonstrated an ongoing commitment to product safety that's a global expectation of consumers for all food additive manufacturers.

Scientific opinions by the European Food Safety Authority in 2010 and 2018 reiterated that a valid safety assessment of glycerol esters of rosin in food applications should consider species-specific differences and require appropriate compositional and toxicological data. The approval of the original GEWR, which is derived from longleaf and slash pines, was based on this foundation of testing that ensures food additive safety.

Beverage-Weighting Agent Technology

Many citrus-flavored beverages, such as carbonated soft drinks and sports drinks, are emulsions of flavor oils in water. These drinks are technically challenging, requiring the production of emulsions stable in the form of concentrate, syrup, and diluted beverage over a range of storage and handling conditions. Beverage instability results in oil droplets migrating to the surface of the liquid with undesirable effects on taste and appearance. Emulsion stabil-

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(Continued from p. 33)

ity requires both an emulsifier and a BWA, with the BWA used to increase the density of the dispersed flavor oil phase, thereby reducing the density difference between the oil and aqueous phases and enhancing stability.

Glycerol esters of rosin are the best known and most commonly used weighting agents in the beverage industry. There are two distinct types on the market: GEWR and glycerol ester of gum rosin (GEGR). GEWR was identified in the 1960s as an ideal candidate for application as a BWA. This versatile resin, based on a natural and renewable feedstock, has excellent solubility in essential oils. An extensive process of applications development and product safety testing established GEWR as the predominant beverage-weighting agent in the market. GEGR has trailed in the footsteps of GEWR in an attempt to gain the same widespread market acceptance.

GEWR versus GEGR

Glycerol esters of rosin are used to modify the properties of diverse formulations in adhesives, coatings, inks, and food applications. Their broad compatibility and solubility encourage uses in a wide array of markets. The primary differences in GEWR and GEGR arise from the sourcing, pine species, and production processes used for their feedstock rosins. Rosins derived from different pine species can vary widely with respect to composition and physical properties, such as softening point, causing performance disparities in some end uses. Although GEWR and GEGR are used in many of the same markets, they are not interchangeable in all applications. GEGR traditionally has been less expensive than GEWR but is limited by less comprehensive regulatory approvals in areas such as beverages.

GEWR: Wood rosin is the natural resin produced by the solvent extraction of aged pine stumps followed by a liquid-liquid solvent refining process. This technology was developed in the first half of the 20th century. The feedstock is stump wood from longleaf (Pinus palustris) and slash (Pinus elliottii) pines grown in the southeastern United States. These stumps are left in the ground after harvesting of the pine trees for other uses and are a renewable resource. The refining process produces rosin of highly consistent quality, meeting purity specifications required by numerous end-use applications.

GEWR is produced by the reaction of food-grade glycerine with refined wood rosin at temperatures in the 260-280°C range. After the required acid number range has been reached, the product is purified by countercurrent steam stripping.

The above definition of GEWR is based entirely on the original wood rosin process that has been in continuous operation to this day. Its approval for use in beverages was the basis for the successful development and approval of GEWR as a beverage-weighting agent.

The wood rosin purification process was developed specifically for the longleaf/slash crude rosin originating in the southeastern United States. Since the extractives in pine stump wood have a wide range of structures and polarity, the composition of the wood rosin product will depend on the specific pine species and the extraction and refining solvents chosen—in other words, the pine species and extraction process determine the chemical identity of the rosin, which means the process for any new GEWR needs to be well defined, thoroughly documented, and understood by the regulatory authorities.

GEGR: Gum rosin is produced by tapping living pine trees. The oleoresin exudate is collected, filtered, and distilled to remove turpentine, leaving gum rosin as the product. This rosin is sourced from a variety of pine species in China, Brazil, Indonesia, Mexico, Vietnam, and other countries. GEGR is produced in a manner similar to GEWR, although manufacturing processes and final product form may vary significantly depending on the supplier.

Much compositional variability is found in gum rosin sourced from different pine species and geographical locations. Use of GEGR as a beverage-weighting agent has been complicated by incomplete compositional and toxicological data. Understanding the composition of a natural raw material like rosin is critical in order to meet regulatory standards.

Regulatory Approvals

Food additive safety is verified by national and international regulatory agencies. The regulatory process has been a key driver in the successful development of the BWA market.

The FDA approved GEWR for use in beverages in the early 1960s. During the review and approval process, a suggestion was submitted that the product be referred to by the broader term of "glycerol ester of rosin." Since available data didn't support this proposal, this suggestion was rejected, and "glycerol ester of wood rosin" was adopted. This was an early acknowledgement that the source of the feed rosin was important and that all glycerol esters of rosin could not be considered equivalent based on superficial similarities. The FDA ultimately approved GEGR use in beverages in 2005, followed by Health Canada in 2010, but multinational regulatory agencies have not followed suit due to incomplete compositional and toxicological information.

The Joint FAO/WHO Expert Committee on Food Additives (JECFA) carried out a comprehensive evaluation of GEWR produced from P. palustris and P. elliottii beginning in 1974. JECFA took a conservative approach to evaluating and approving this material as a food additive, and the original manufacturer of GEWR initiated a long-term program of analytical and

Glycerol esters of rosin are the best known and most commonly used weighting agents in the beverage industry.

The long-term success of GEWR as a beverage-weighting agent has required continued engagement with and active support of the regulatory process.

toxicological testing at JECFA's request. From the beginning, JECFA emphasized the need to more fully characterize the material from which the glycerol ester of rosin was prepared, including specifying the species of pine tree used. The rigorous evaluation process culminated in 1991 with specifications for GEWR under International Numbering System (INS) 445.

In 2008, the FDA requested that JECFA consider the extension of INS 445 approvals to GEGR. The basis was a claim of chemical equivalence between GEGR and GEWR to justify relying on the extensive toxicological testing done on the original GEWR product. JECFA maintained a consistent, science-based approach in its evaluation of this request. During evaluation of the GEGR petition, the committee noted that the chemical composition of GEGR varies depending on the pine species, geographical differences, and the techniques used in the processes of rosin production. JECFA noted that limited data was available on the variability of the resin acid composition of GEGR in commerce and that complete information on the composition and ester distribution of GEGR had not been submitted. Therefore, officials were not able to claim similarities to GEWR. JECFA was unable to establish specifications and an allowable daily intake for GEGR due to the lack of information.

GEWR is the only glycerol ester of rosin approved for use in beverages by the European Food Safety Authority (EFSA). EFSA was petitioned by T&R Chemicals, Inc., in 2008 for the approval of GEGR as a beverage-weighting agent under E 445. A claim of chemical equivalence was put forth by the petitioner to justify use of the original GEWR toxicity test data. The EFSA Scientific Panel on Food Additives and Nutrient Sources Added to Food (ANS) reviewed the proposal and concluded that the available data was too limited to evaluate GEGR's safety as a food additive. The panel couldn't verify chemical equivalence of GEGR and GEWR due to the lack of critical information on composition, so toxicological data for GEWR could not be used for read-across to GEGR.

Recent Developments

The EFSA issued a scientific opinion in 2018 after completing a re-evaluation of GEWR as a food additive. The EFSA noted that the toxicological studies that were the basis for E 445 and INS 445 approvals were based on GEWR produced from a mixture of the two species: P. palustris and P. elliottii. No comparable toxicological studies were available for GEWR originating from other pine species, and insufficient compositional information was available for those variations. Given this lack of information, determining chemical equivalence of GEWR from other pine species with GEWR originating from P. palustris and P. elliottii wasn't possible, making read-across of toxicological data invalid.

The long-term success of GEWR as a beverage-weighting agent has required continued engagement with and active support of the regulatory process. This should be an expectation for any responsible food additive manufacturer, whether attempting to bring a new product to market or to support an existing product. ■

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Clean Out of Place ... *(Continued from p. 32)*

The Four Pillars of Good Cleaning

It's also important to note that all good cleaning activities, whether CIP or COP, involve the main steps of TACT: Time, Action, Concentration, and Temperature.

- Time is defined as how long the cycle runs and can vary depending on the parts being cleaned, as well as the COP equipment and chemical used.
- Action is the turbulence of the COP tank. Depending on the parts being cleaned, some systems have a predetermined setting.
- Concentration is the amount of chemical used in the COP. This is defined on the chemical label. A high concentration may require an additional rinse to ensure all the chemical was removed. A low concentration may require a reclean due to inadequate cleaning.

The COP process can be used for equipment and components that require at least some disassembly to be cleaned.

- Temperature of the water is based on what you're trying to accomplish. Hot water is usually used for a caustic clean, while room temperature water is used for a sanitizer soak.

An automated system controls each of these steps to help reduce personnel labor and ensure consistency in the process. Equipment today is also designed to be more sanitary than in the past, which aids in the cleaning process of the equipment.

Utilizing CIP and COP as complementary cleaning methods allows sanitation personnel to better clean and sanitize foodservice production equipment, whether it's assembled or disassembled. Their implementation can help ensure food safety and quality all the way down the line. ■

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▲ Fully integrated with its surrounding manual operations, Mercadona's warehouse control system moves products from goods reception to storage, retrieval, picking, and sorting, and loads the orders for delivery. It can handle and prepare orders for Mercadona's over 1,600 supermarket stores in just six hours.

How Automation Can Fight the Clock on Shelf Life

A new breed of robotic systems can accelerate fulfillment

BY **DEREK RICKARD**

One of the most important aspects of the food supply chain is maximizing shelf life. Companies need to get products to stores quickly to widen the purchasing window and ensure product freshness for consumers. From the moment a product is harvested or produced, the clock is ticking. In some cases, products may spend the majority of their life cycle in transit from supplier to retailer. For instance, Florida oranges may be shipped hundreds of miles across several states. Pineapples may come from as far as Mexico, Honduras, or Guatemala. To adjust for transportation time, companies adopt specialized packaging and temperature control to increase product longevity and preserve goods' appearance and freshness.

While these techniques can help prolong shelf life, efficient product handling in distribution can save time as well. This is where automation can be a great benefit. Automated order picking systems can streamline and accelerate fulfillment so organizations can keep up with the need for speed in food distribution.

A New Breed of Automation

The distribution center is where companies experience some of their greatest pain points, particularly when they rely solely on manual order fulfillment. Employees have to scramble up and down long stretches of aisles, pick orders, and bend to lift heavy crates or boxes. Order picking is a strenuous and injury-prone job, highly dependent on the physical endurance and speed of each individual. These risks have

made careers in materials handling less appealing to job seekers, resulting in rampant labor shortages seen nationwide.

Despite interest in automation as a solution to these challenges, many facilities have resisted investing because previous systems ran storage and order picking as separate functions, which can be too slow for the timely demands of food logistics. But today, there is a new breed of robotic systems that integrate picking and handling into a single solution.

These systems can handle all operations in any order simultaneously, streamlining product handling and saving time. Products can be picked immediately. Distribution centers that implement these integrated solutions are often up to six times more efficient than their manual counterparts. Automation speed means facilities can prepare orders closer to the time of a truck's anticipated arrival for more on-time deliveries and a faster time to market.

Further, automation can fill in the operational gap left by labor shortages and improve work conditions for existing employees. Namely, automation can alleviate existing staff from the physical burden of distribution and elevate them into new technical and supervisory roles. These are safer and more fulfilling positions centered around managing warehouse operations and overseeing automated systems. And, with the flexibility to handle seasonal changes in availability and demand, companies can get the freshest food in front of consumers year round.

Delivering Freshness to Supermarkets

Product freshness is a central part of Spanish supermarket giant Mercadona's corporate philosophy. To uphold this commitment and maximize product shelf life, Mercadona chose to invest in automation in its new Guadix, Granada distribution center.

The distribution center was designed to handle around 6,000 SKUs with zones for different product types: one for dry produce, two for refrigerated products, one for frozen products, and a production area for bread. Installed robots provide buffer storage and order picking as one flexible operation. They handle full crates of fresh fruit, vegetables, and meat in the refrigerated zones where there are around 300 different SKUs in some 30,000 crates. A warehouse control system manages all systems and material flow through the facility, and provides complete product tracking and traceability.

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Fully integrated with its surrounding manual operations, the system moves products from goods reception to storage, retrieval, picking, and sorting, and loads the orders for delivery. It can handle and prepare orders for Mercadona's over 1,600 supermarket stores in just six hours. Products reach stores with more time to spare, providing Mercadona consumers with only the freshest selection of products.

The Guadix center has been so successful that Mercadona plans to automate fresh food distribution in four new distribution centers. The automation in these facilities will help ensure product freshness for 2 million of the 5 million households that shop at Mercadona every day.

Optimizing Dairy Distribution

Similarly, dairy distribution centers have to move products from storage to dispatch with speed and precision—especially given the industry's strict sell-by dates. When it came time to build a new liquid milk plant, Kroger chose to develop a state-of-the-art facility centered around automation. This would help ensure the quality and freshness of its products and reduce workers' exposure to injury and work-related strain.

The Mountain View Foods facility built in Denver, Colorado, processes fresh conventional and organic milk and packages aseptically processed milk, creams, and juices. The facility's end-to-end automated solution can store up to 36,000 crates and picks 32,000 crates per day. The system handles stacks of single plastic dairy cases on non-traditional, knee-high, plastic belt conveyors. The cases or stacks are picked according to specified sequences on one end of the facility and then palletized for truck loading at the other end, allowing for significant storage buffering in between. A warehouse control system is used for all order processing, gantry movements, and stack transport. Moreover, like at Mercadona, the software collects data on operations, giving Kroger 100-percent traceability for its dairy products.

Kroger benefits from orders picked with 100-percent accuracy at faster speeds, which results in shorter lead times, longer shelf life, and fresher products. Kroger has seen a dramatic difference between its traditional, manual facilities and the Mountain View Foods' automated system through increased efficiencies and rapid handling, reduced labor costs and errors, and product traceability.

Product freshness and shelf life are critical to all food manufacturers and distributors: Everyone is in the same fight against the clock. Automated technology can provide a distinct advantage through enhanced speed, accuracy, and flexibility. Ultimately, maximized shelf life means more satisfied consumers, less spoilage and waste, and greater profits. ■

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E. coli Illness Linked to Romaine Lettuce Expands

FDA, CDC, and state health authorities are investigating an outbreak of illnesses caused by *E. coli* in the U.S. Epidemiologic, laboratory, and traceback evidence indicates that romaine lettuce from the Salinas, Calif., growing region is a likely source of this outbreak. According to the CDC, at press time, there have been 102 cases of illness reported in 23 states.

Based on available traceback data, FDA requested that industry voluntarily withdraw romaine grown in Salinas from the market and withhold distribution of Salinas romaine for the remainder of the growing season.

Products that were part of the USDA Food Safety and Inspection Service announced recall related to this outbreak investigation had a "best by" date of November 1, 2019 or earlier and should no longer be on the market.

The FDA and state partners are conducting a traceback investigation to determine whether a common supplier or source of contamination can be identified. This investigation involves collecting and analyzing potentially hundreds of distribution records to trace the romaine that may have been available at points of exposure reported by ill people to their source.

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The Salinas region, as defined by the United Fresh Produce Association and the Produce Marketing Association Romaine Taskforce Report, includes the California counties of Santa Cruz, Santa Clara, San Benito, and Monterey.

French Regulator to Ban Some Glyphosate Products

French health and environment agency ANSES said December 9, 2019 that it was banning glyphosate-based weed killers that represent most of the volume of such products sold in France, ruling there was insufficient data to exclude health risks.

The agency was withdrawing the marketing license for 36 products and these would no longer be authorized for use after the end of next year, it said in a statement.

The products accounted for nearly three-quarters of the volume of glyphosate products sold in France in 2018, it said.

Applications to launch four new glyphosate-based products had also been rejected, ANSES added.

Glyphosate, first developed by Bayer's Monsanto unit under the brand Roundup, has been a focus of controversy since a World Health Organization agency concluded in 2015 that it probably causes cancer.

It is now off-patent and marketed worldwide by dozens of other chemical groups.

In 2017, French President Emmanuel Macron pledged to ban glyphosate in France within three years, rejecting a European Union decision to extend its use for five years.

Austria, which is attempting to be the first European country to ban all uses of the weed killer, said on Monday a law on the ban cannot go into force on January 1, 2020 as planned because the European Commission was not properly notified.

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Bayer's home country of Germany will ban the substance from the end of 2023.

ANSES said it had been reviewing the 69 glyphosate products available in France as well as 11 applications to market new products.

"ANSES has decided that 36 of these products will be withdrawn from the market and will no longer be allowed for use from the end of 2020, due to a lack or absence of scientific data which would allow all genotoxical risk to be ruled out," the agency said.

It did not detail which products were covered by the withdrawal decision.

ANSES said it would complete its review of glyphosate products by the end of next year, and that only products that met EU criteria and which did not have adequate alternatives would be allowed to be sold in France.

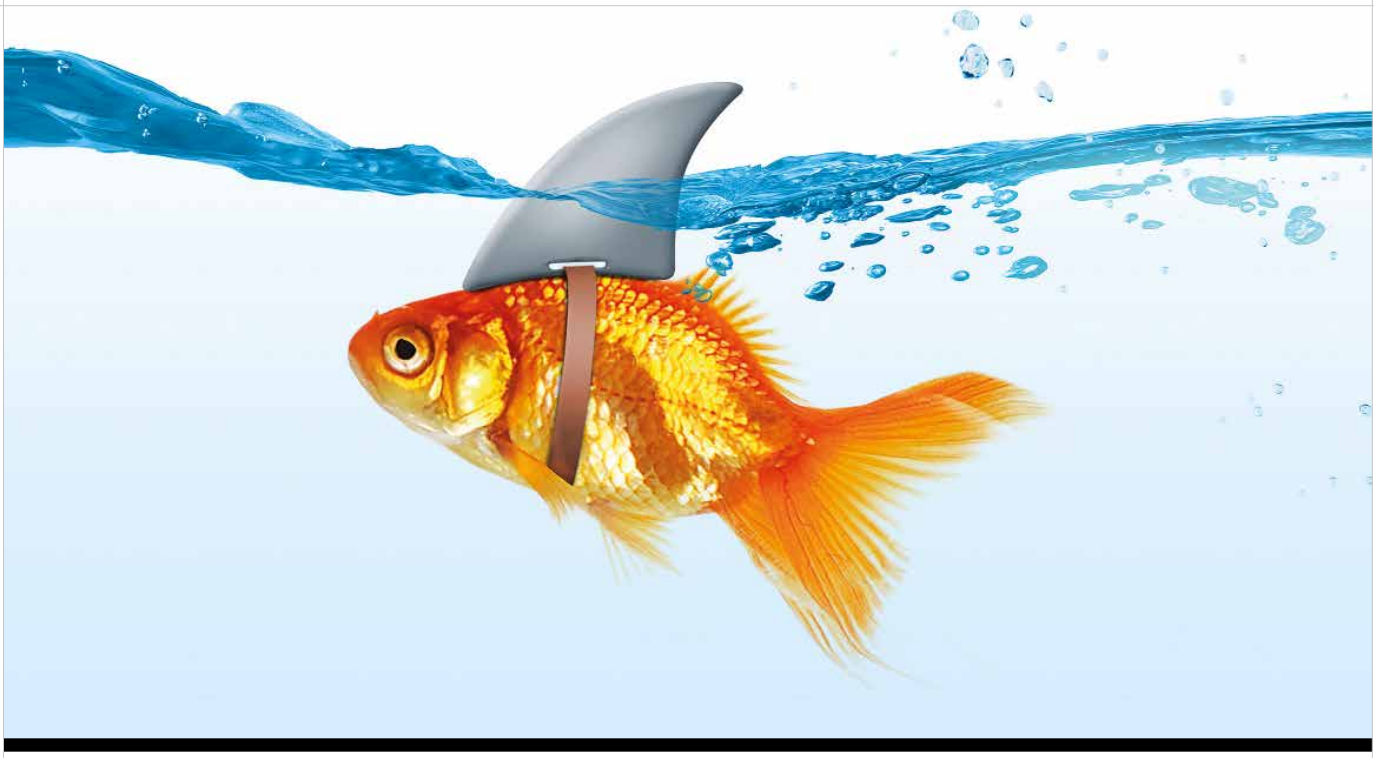
Bayer said it would comply with the ANSES decision but was "fully behind our glyphosate-based products."

The group planned to provide additional data to ANSES as a way of "working toward renewing the marketing authorizations for our glyphosate-based products in France," a spokesman added in an emailed statement.

Bayer faces potentially heavy litigation costs from U.S. lawsuits in which plaintiffs claim Roundup causes cancer, which Bayer disputes.

—By Reuters Staff

Testing



Mystery Fish

Why fraud is rampant in the seafood industry and challenging to address

BY **STEVEN WILSON**

Food fraud has been in place since food was first bought and sold. There has always been a party willing to cheat the next to make money. In recent years, food fraud has been part of many discussions whenever a body of the industry or the government has gathered. The Codex Alimentarius Commission, the international body that sets standards for government agencies for trade purposes, is attempting to deal with the subject in its Committee on Food Import and Export Inspection and Certification Systems. There is a discussion of how the ISO 22000, the family of standards on food safety systems management, can best address food fraud. In addition, the Foreign Agriculture Organization recently held a workshop in Rome on the subject that included experts from around the globe. Everyone in the food trade including industry, government, and advocacy groups are concerned, and rightly so.

A Weighty Problem

The seafood industry is no stranger to fraud. Regulators have been struggling with the issue for many years. The U.S. Government Accountability Office studied seafood fraud in 2009 (GAO-09-258) and found it continues to be a problem and that cooperation between the federal agencies is a must. The fraud typically involves increasing perceived value.

By far the biggest problem of fraud in seafood is added water weight. There are some estimates that over half of some fishery products have added weight at some level. This comes in many forms. Shrimp processors add an ice glaze to protect the shrimp from water loss in the frozen state and from dehydration. This is a good processing practice, but it can be abused. It all depends on how the water is considered in the net weight. If the ice weight is part of the declared label net weight it isn't unusual for the seller to keep the total net weight to the declared, thereby selling water weight at a higher price. It's also a practice by some to "overglaze" or add more glaze water than necessary to keep the product costs down. Any of these practices mean the buyer, or consumer, is getting less shrimp for their money.

Another means of adding water is to allow the natural properties of the fishery product to come into play. Soaking shucked scallops in water will permit the scallops to draw in water weight. This

action often happens naturally during processing—some water will be drawn up simply by transporting the product down the line using water so allowances must be made. However, this has been helped along by some producers by adding a water retention agent. Doing so lets the scallop soak up much more water in a shorter time. Some producers have been caught leaving the scallops in large totes of water with this agent for days. In this way a scallop can soak up to 50 percent of its weight in water. At $10 or more a pound that water becomes quite expensive.

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There are some estimates that over half of some fishery products have added weight at some level.

Finally, it's common for some fishery products to be injected or tumbled with water and other liquids and flavorings. This is an acceptable practice if there is sufficient time or means to permit the water to drain from the flesh. Not permitting this drainage can, of course, add water weight.

Bait and Switch

Substitution and mislabeling not only defrauds consumers and robs them of their ability to make informed choices, but also harms law-abiding fishermen and the sustainability of domestic fisheries. The substitution of a cheaper, less desirable fish for a more expensive fish in higher demand undercuts the price a fisherman will be paid for the true product. Because the harvest amounts of most fisheries are limited, the law-abiding fishermen cannot make up this price shortfall. This threatens the viability of legitimate commercial fishing enterprises and increases the pressure on managers to raise the harvest limits to unsustainable levels. There's also a concern if the species involved are allergenic to a segment of the consumer base, making it not only fraud, but also a food safety issue.

Substitution within the supply chain, especially for imported seafood, is also a concern. Shipments just of the raw commodity are often made up of many harvest events. These combined lots go to several points for further processing and are sometime comingled with other lots, all prior to entry into the United States. This comingling can hide illegally harvested fish within a legal harvest. The various steps of processing and comingling can make it difficult to determine the legality of the fish entering the U.S.

All indications are that species substitution is a low percentage of seafood entering into the United States, although the lot sizes can be large. Where species substitution is a problem is at the retail counter. In this scenario it doesn't appear to be intentional, so it becomes a mislabeling concern.

Species substitution also occurs at the border ports to get around a particular tariff. Claiming a shipment of tilapia is grouper could be done to try and keep that naming throughout the sale, thereby netting a greater increase in revenue for the seller. But claiming a shipment of Vietnamese catfish is tilapia could be a way to not pay the tariff fees on the catfish species or to get around any particular import quota. Ultimately there's a net gain in that fish that wouldn't enter the country or would enter at a higher price could now be sold.

Finally, improper labeling is also a means to hide the actual processor. This could manifest itself in one firm selling its premade cans for canned tuna to another firm with the can code present. This would mean the codes would identify the original firm so that it's possible for the second firm to sell its product even if they are on a detention list. The product is still safe to consume but is illegally or improperly entering the country.

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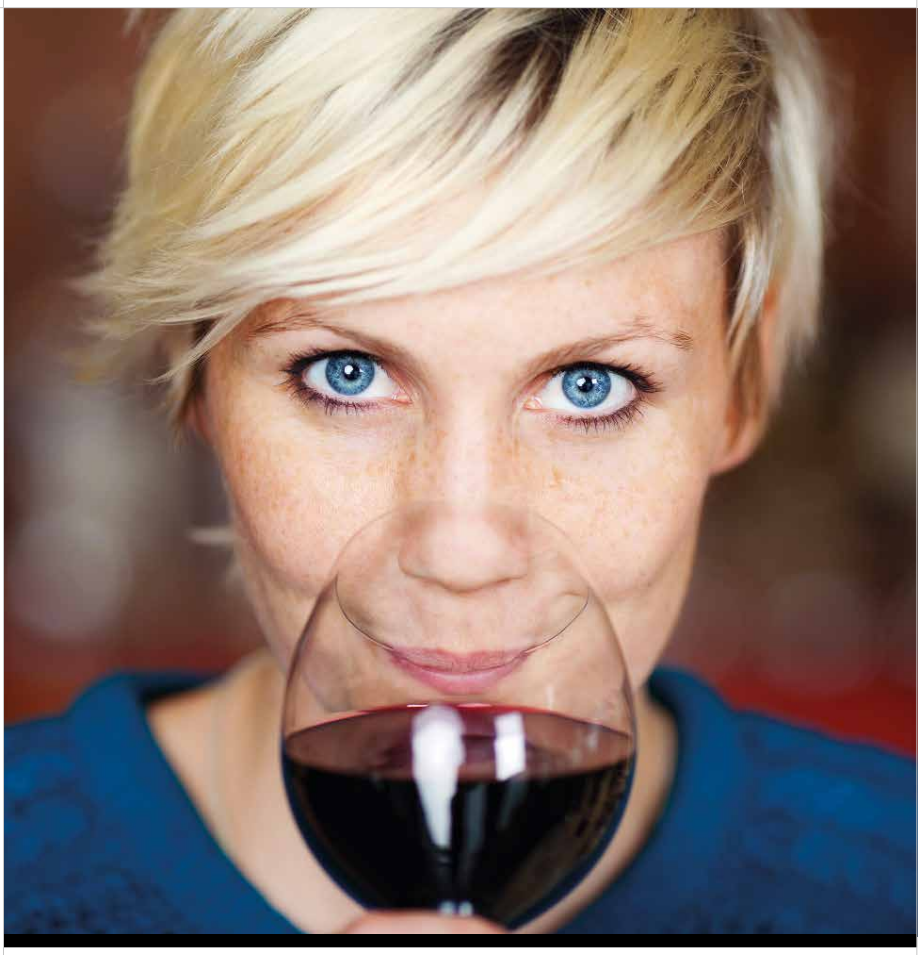
In The Lab



Extend the Shelf Life of Wines

Automated titration systems can improve sulfite monitoring

BY **GAYLE GLEICHAUF**

Ask wine connoisseurs about their favorite vintage and they'll probably mention the aroma from the uncorked bottle, the color in the glass, and the complex flavors. However, unwanted oxidation, discoloration, and microbial growth during production and after bottling can compromise all of these characteristics, putting revenues and reputations at risk.

To prevent these undesirable processes and extend product shelf life, winemakers commonly add preservatives in the form of sulfites—sulfur-containing compounds such as hydrogen sulfite (HSO_3^-), sulfite salts (SO_3^{2-}), and sulfur dioxide (SO_2)—that possess strong antioxidant and antimicrobial properties. Achieving the right balance of sulfites in wine is of utmost importance to protect product quality in line with stringent regulations. Increasingly, many wineries are recognizing the benefits of using automated titration systems that are capable of monitoring sulfite levels and delivering accurate and reliable results, quickly and cost-effectively.

The Importance of Monitoring Sulfites

Sulfites may be added at various stages of the wine production process, from the crushing of the grapes until just prior to bottling, depending on the type of wine being produced and the individual preferences of the winemaker. They may be present in wine as free sulfites (HSO_3^-, SO_3^{2-} or SO_2, depending on the pH) or bound to other wine components, such as phenols and carbonyl compounds.

For wineries, getting the level of sulfites right is of critical importance. If sulfite levels are too low, wine quality can be compromised, potentially resulting in the need to discard entire batches. Get sulfite levels too high, however, and wineries face a different set of challenges. Not only is the over-addition of sulfites costly, the presence of excess sulfites can delay key fermentation processes and have a detrimental impact on wine taste and aroma.

On top of this, sulfites are thought to cause allergic reactions in some people. Consumers who are particularly sensitive to sulfites may experience symptoms including skin rashes, stomach complaints, and breathing difficulties. Regulations around sulfite levels are in place to protect the public's health, and wineries cannot sell wines that don't meet these regulations.

Regulatory requirements for total sulfites (free and bound) in wine vary by region and product type. In the United States, wines cannot exceed total SO_2 levels of 350 mg/L, and any wines containing more than 10 mg/L sulfites must be labeled with a warning. In the European Union, tighter controls around sulfite use are enforced, with different limits depending on the type of wine. These regulations limit total SO_2 to 150 mg/L in most red wines and 200 mg/L in most white and rosé wines. Sparkling wines may contain up to 235 mg/L total SO_2, while certain sweet wines may contain higher sulfite levels up to a maximum of 400 mg/L. Similar regulations around sulfite levels are in place in other countries.

Determine Sulfite Levels

A wide range of methods are available to monitor sulfite levels in wine. These include distillation followed by acid/base titration, iodometric titrations, and enzyme assays involving colorimetric or spectrophotometric detection techniques.

The Monier-Williams method and the Ripper iodometric titration are two of the more widely used methods for the determination of sulfites in wine. The Monier-Williams method is a multi-step process that first involves capturing SO_2 in hydrogen peroxide by distillation. The sulfuric acid that's generated from this step is then titrated with sodium hydroxide to determine the concentration of SO_2. While the Monier-Williams method is a very precise technique for determining levels of sulfites in wine, the need to perform a distillation step often makes the use of this method for routine analysis applications impractical.

The Ripper titration is an alternative approach that enables sulfites to be measured directly, without the need for time-consuming distillation steps. Many wineries perform this iodometric titration manually, using starch as an indicator to monitor a color change end point. Levels of free SO_2 can be determined by acidifying samples prior to titration, while total SO_2 can be measured by first treating samples with sodium hydroxide, which releases the bound sulfites. After the bound sulfites are released, the titration proceeds as for the free SO_2.

If sulfite levels are too low, wine quality can be compromised, potentially resulting in the need to discard entire batches. Get sulfite levels too high, however, and wineries face a different set of challenges. Not only is the over-addition of sulfites costly, the presence of excess sulfites can delay key fermentation processes and have a detrimental impact on wine taste and aroma.

Despite this, using the manual Ripper titration to measure SO_2 can be challenging for a number of reasons. Given the need to monitor the color change associated with this titration method by eye, it can be problematic to accurately determine end points in red wines, as the dark color of the sample can make it difficult to identify the onset of the color change. This limitation means that measurements can often be inconsistent and unreliable, putting the quality and regulatory compliance of the end product at risk. Moreover, as operators must be fully engaged with the titration throughout the experiment, manual titrations can be very resource intensive. For wineries with limited resources or those deciding to scale up production, the need for a dedicated, trained operator, or team of operators (for large productions), to perform manual Ripper titrations can prove to be a bottleneck.

Using Automated Titrators to Measure Sulfites

Given the importance of monitoring sulfite levels to protect the quality of wine and extend product shelf life, winemakers are increasingly using automated titration systems to generate results faster and more efficiently. As automated Ripper titrations use electrodes to monitor potentiometric end points, rather than subjective color changes, they provide precise results regardless of which operator performs the test. Moreover, by generating accurate results that are right the first time, these systems are able to support rapid and more informed decision-making.

Modern automated titration platforms are also capable of performing testing with no manual intervention except for the

(Continued on p. 56)

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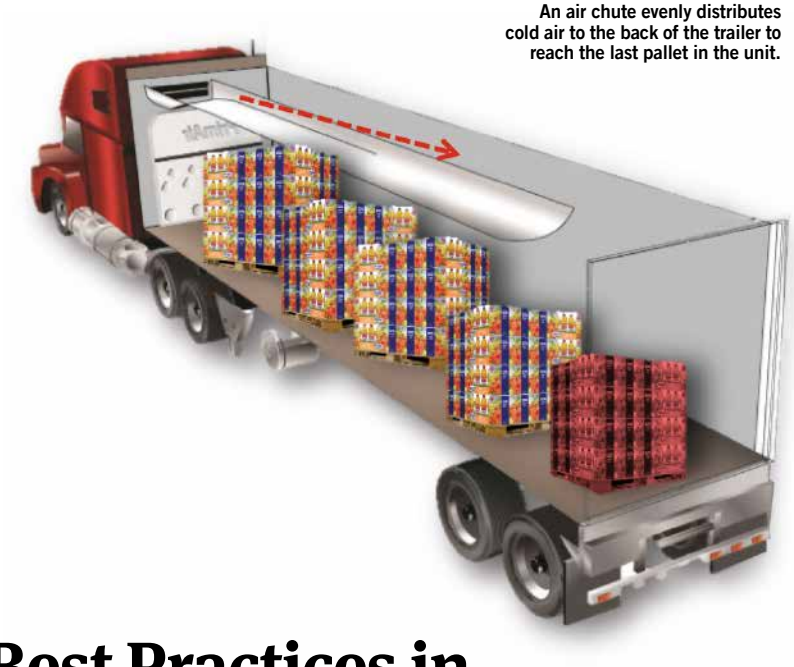

An air chute evenly distributes cold air to the back of the trailer to reach the last pallet in the unit.

Best Practices in Refrigerated Food Transport

Ensure optimal food quality with these tips

BY **TOM KAMPF**

Temperature excursions during refrigerated food transportation reduce product shelf life. Maintaining the integrity and quality of refrigerated cargo is paramount to preventing these issues. Stakeholders, from fleets that transport food to distribution centers and manufacturing facilities, follow industry standards to ensure food safety.

As an ecosystem, it's vital that all involved in the food transportation and storage cold chain understand these procedures. Temperature-controlled vessels transport perishable cargo. Consistent temperatures preserve the integrity of the product to prevent spoilage, and fleets maintain a tight temperature band with minimum variations to ensure the product has the longest possible shelf life. In addition to standard food safety procedures, fleets can follow food transport best practices to ensure the product quality and longest shelf life while realizing fuel savings.

The Pre-Trip Inspection

The first step to ensure optimal food quality is to perform a pre-trip inspection of the transport refrigeration unit (TRU) and the trailer. Manufacturers should set pre-trip inspection requirements that include clearing previous alarm codes or addressing and mitigating existing alarms. Drivers should perform a visual inspection of the trailer to ensure the unit isn't physically compromised in any way. Lastly, drivers should ensure there's enough fuel onboard to operate the unit for the expected duration of the trip.

Pre-cooling the trailer ensures that cargo doesn't reach inappropriate temperatures during or immediately after loading. The same standards apply regardless of the starting and final trailer temperature to ensure temperatures are within food safety guidelines.

Fleets begin the pre-cooling process by setting the TRU setpoint at the manufacturer's desired temperature. Some air will escape the unit during loading, so some manufacturers prefer the temperature to be set below the set point. Distributors of the product in transport generally set the pre-cooling guidelines.

Protocol dictates that those pre-cooling conditions are met before operators load pallets onto the truck or trailer. For example, a manufacturer of ice cream might want to pull down the temperature to -20 degrees Fahrenheit before loading, while others may prefer to load at -10 degrees Fahrenheit. The key is keeping within the product's tolerance range to maintain the its integrity.

Single-temperature refrigeration units pull down the temperature of the truck or trailer to the desired temperature. Typically, refrigeration units utilize a high speed to pull down to the setpoint quickly. Pulling the trailer temperature down at a low speed may take longer, but it's a worthwhile consideration, as it can equate to significant savings in fuel costs.

Maintain Precise Temperature Control During Transport

Fleets can optimize the refrigeration unit and trailer to maintain desired temperature control, ensuring product integrity and negating potential losses from temperature variations. Airflow is one of many important factors in reducing temperature excursion risk. Here are four ways to improve airflow within the trailer:

1. Install Door Switches. It's a best practice to turn off the trailer before opening doors to load cargo. Hot air will be

pulled into the trailer if the unit is running when trailer doors are open. In food distribution with multiple stops throughout the day, drivers may forget to turn off the unit before unloading cargo, which repeatedly increases the overall trailer temperature. Trailers with door switches will automatically turn the unit off when the driver opens the doors. This process protects the integrity of the cargo throughout the loading and unloading process.

2. Stimulate Airflow and Circulation. Consistent airflow and circulation from the front of the trailer to the back helps maintain appropriate temperatures throughout the trailer. This is key to minimize the risk of hot spots, especially around temperature-sensitive cargo. An air chute distributes cold air to the back of the trailer before it cycles back toward the front, which reduces risk of short cycling.

Effective loading significantly improves airflow throughout the trailer. These configurations are best for palletized products, which should be placed away from walls and doors so air can flow freely around the load. The air acts as an insulator to protect pallets from hot or cold conditions outside the trailer and to maintain the set temperature inside.

3. Understand the Impact of "Off Time" in Start/Stop Operation. A unit in start/stop operation can significantly impact overall temperature variations within the trailer. Fleets benefit from understanding when to run continuous or start/stop mode based on the type of cargo in transport.

Carriers generally run a start/stop operation when transporting frozen products because frozen cargo isn't as sensitive to temperature variations. Frozen cargo tolerates mild temperature variations of a few degrees without risk of spoilage. However, with temperature-sensitive fresh products, the temperature variations from the front to the back of the trailer can be significant. Small changes in the restart temperature could mean wild fluctuations in the actual trailer temperature, leading to cargo degradation and shorter shelf life.

> Consistent temperatures preserve the integrity of the product to prevent spoilage, and fleets maintain a tight temperature band with minimum variations to ensure the product has the longest possible shelf life.

4. Achieve Quality Assurance with Telematics. With telematics solutions, fleets open a window into their real-time operations and have critical visibility for temperature-sensitive cargo and equipment. In the past, drivers were alerted to alarm codes when they viewed a flashing remote status light on the side of the truck from their side mirror. This practice took drivers' eyes off the road and only alerted drivers to low fuel, temperature status, or if an alarm was triggered, but not the nature of the alarm. Drivers would then have to pull over to the side of the road and look at the Human Machine Interface (HMI) to investigate further.

Today, telematics automates sensors and alarms to notify drivers and fleet managers of a potential problem before spoilage occurs. Drivers and fleet managers receive notifications straight to their smartphones with Bluetooth systems or via an app that makes equipment monitoring and remote diagnostics easier and more accessible. With state-of-the-art telematics solutions, fleets monitor cargo integrity, improve fleet uptime, and manage fleet operating and maintenance costs more effectively.

Telematics programs send instant notifications of problems within the unit so fleet managers can diagnose the issue and formulate a solution without disrupting the cargo temperature. Real-time remote monitoring mitigates potential issues like compromised load integrity or disrupted delivery schedules before they occur. Fleets improve uptime and drivers can keep their eyes on the road.

Integrating telematics is a process of continuous improvement. Fleets that are just beginning to utilize telematics typically start by installing door switches to ensure the unit turns off during deliveries, while fleets that take an all-inclusive approach to telematics implement driver training, change loading practices, adjust pre-cooling procedures, and more. ■

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Tackle Dairy Challenges with the Right Equipment

Pneumatics can improve cleanliness and increase efficiency

BY **AMIT PATEL**

Today's dairy industry faces several challenges. Plant-based products, like almond and soy milk, are altering the traditional product lineup. The varieties of products are growing rapidly, with the explosion of choices in the yogurt, milk, and ice cream aisles. In addition, the dairy industry finds itself dealing with rapid shifts in consumer preferences requiring greater flexibility in processing and packaging. There are also increasing financial pressures stemming from production capacities, the overall farming economy, and labor shortages.

At the operations level, there are several concerns. Dairy processors need equipment that allow them to meet the highest standards of cleanliness. Pneumatics has a long history in the dairy industry, with applications that vary widely from cheese and butter making to yogurt and drink production. On the processing side, a single piece of dairy mixing and blending equipment could have 40 or more hygienic process valves that help control the flow of raw ingredients. In the packaging area, pneumatic devices like piston valves, manifolds, and cylinders are located on most equipment, providing actuation or motion control. In today's challenging environment, pneumatics technology offers many critical advantages.

Cleanliness

One of the most important aspects in a dairy operation is cleanliness, especially in meeting regulatory standards. Pneumatics offers an advantage in helping to ensure equipment meets the hygienic standards of all the regulatory bodies, like 3-A Sanitary Standards Inc. (3-A SSI) in the U.S. and EHEDG, the European Hygienic Engineering and Design Group.

Started largely for dairy certification more than a century ago, 3-A SSI now applies to a variety of different food and beverage processes. The 3-A standard is rigorous, requiring that any seals touching the liquid not harbor any pathogen or bacteria. They must be highly cleanable and able to withstand high temperatures. There can be no grooves or crevices, with a maximum allowable surface roughness of just 0.8 micrometers.

Electrically actuated valves would require a specific design change or to be placed in an enclosure to meet washdown requirements, which adds cost and takes

up valuable floorspace, so they are not commonly used in the process area of a food or dairy plant. Pneumatic equipment, on the other hand, is ideal for work in hygienic or rugged environments where frequent washdowns are required. In high-temperature, high-pressure washdown applications, some pneumatic directional control valves feature hygienic design, the ability to withstand aggressive detergents and chemicals, plus a high degree of modularity and flexibility for operational benefits. For dust-off or light washdown uses, for example in secondary packaging or handling applications, some companies like Emerson provide air cylinders that meet FDA, NSF, and ISO 6431, 15552, 21287 standards and feature a clean profile design to minimize potential pocket areas where dirt and contaminates can collect.

Modularity

Dairy processors need equipment that has a high level of modularity so they can react to rapidly changing consumer preferences. Pneumatics offers quick setup and easy changeout, giving dairy operations the ability to upgrade, fix, replace, or quickly change the parameters of their equipment.

For instance, one machine may be used to fill 6-, 12-, or 18-ounce containers with different products. This requires machine components that can adapt quickly to the different container sizes depending on the product being processed. This could be more relevant for packaging operations, where dairy processors can expect a lot of rapid cycling on the packaging line—for example, as single-serve containers change over to club-size containers.

Being able to adapt efficiently with minimal downtime helps increase overall equipment effectiveness. In some cases, by simply changing the machine's automation program accordingly via the controller interface, the pneumatic functionality can readjust automatically based on the requirements for the new product run.

Reliability

Because pneumatics equipment avoids some of the complexity inherent in other power technologies, it's known for dependable operation with less downtime.

Pneumatics offers abundant advantages to dairy processors, including cleanliness, modularity, reliability, performance, low cost, worker safety, versatility, and future-proofing.

New IIoT edge devices can collect data from the pneumatic system to identify leaks, monitor energy usage and air consumption, and calculate the life expectancy or mission time of a pneumatic component.

It's also easy to fix, keeping maintenance costs low. It simply needs to have clean air. Built to work in a production environment, pneumatic devices also have a long-life expectancy, completing millions of cycles and withstanding high actuation rates.

In addition, pneumatics technology is well-positioned to utilize Industrial Internet of Things (IIoT) capabilities. New IIoT edge devices can collect data from the pneumatic system to identify leaks, monitor energy usage and air consumption, and calculate the life expectancy or mission time of a pneumatic component. For example, by using appropriate data from an IIoT gateway device, maintenance technicians can predict that a shock absorber at the end of an actuator is deteriorating just by sensing an increase in its stroke speed, even if only by a few milliseconds. By knowing which equipment needs maintenance before it actually fails, plant engineers can avoid unplanned machine downtime and replace defective components with shorter and fewer machine stoppages.

Performance

Pneumatics equipment can handle high-speed production or high-speed motion sequences, using valves engineered for high actuation rates. Pneumatically operated pilot valves can be used throughout the facility to actuate a variety of critical on/off process valves and packaging equipment. They're used extensively in packaging lines where weight and high cycling are critical. They perform in short to long strokes in a variety of operating conditions from high temperatures and high pressures for aggressive washdowns. Plus, they have high shock absorbance.

Cost Efficiency

Pneumatics technology generally has a lower initial cost than electronics on a component versus component basis, and is extremely cost-effective in operation, routinely saving operational expense be-

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cause of its energy efficiency, reliability, and low maintenance costs. While electric devices may offer more control, that added capability may not be as relevant in food and dairy processing as it is in other industries. In addition, pneumatic technology is more washdown friendly than electrical devices, which need a temperature-controlled environment to avoid overloaded circuits.

Compressed air is usually available throughout a dairy plant, so connecting more devices when needed for a new application usually results in little incremental cost. In fact, the more pneumatics connected to a compressor and the closer the total demand is to the capacity of the compressor, the more efficient pneumatics becomes. Conversely, a smaller number of pneumatic components using a smaller portion of a compressor's capacity would be less efficient in operation. That's why it's best to evaluate costs on a case-by-case basis.

Worker Safety

Pneumatics can help address plant safety issues in several ways using a proven technology (compressed air). As a result, dairy producers hoping to comply with ISO and other regulatory standards have a wide range of traditional pneumatics products to choose from.

For example, Emerson is advancing an integrated, scalable zoned safety approach, allowing up to three safety zones to be isolated on a machine from a single pneumatic assembly. With zoned safety, the valve manifold can be configured to shut down pilot air and power only to the control equipment that will come in contact with the operator. The rest of the machine can remain in operation. Zoned safety helps design engineers satisfy Machinery Directive 2006/42/EC and comply with ISO 13849-1 and ISO 13849-2. It reduces the number of safety system components by up to 35 percent, requires fewer connections, and saves valuable real estate within the machine and manifold.

Versatility

Compressed air is normally available throughout the typical dairy processing facility, so dairy processors can deploy pneumatics almost anywhere in the plant. And, at a deeper level, pneumatic devices prove

Pneumatics Improve a Cheese-Making Operation

Cheese products are processed batch to batch in an environment that requires frequent washdowns involving a lot of solids. If there's an accident, no toxic chemicals or contaminants can touch the food.

For certain hard cheeses, raw product is formed into round wheels, called fascere, that can weigh almost 90 pounds each. The wheels are dipped in brine for three weeks and allowed to mature for at least a year in air-conditioned storage. The back-breaking process of forming, turning, pressing, and molding the cheese is often done manually.

One Italian cheese-making equipment provider, Progema Engineering S.R.L., is working to automate the heavy lifting. The company is using corrosion-resistant, double-acting pneumatic cylinders to move the blocks of cheese, which are saturated with liquid. The Emerson AVENTICS washdown CL03-EV directional control valves are installed directly on the machines, with actuators in decentralized locations so that compressed air lines are shorter with no dead volumes or pressure losses, thereby reducing air consumption. The entire process meets food industry standards.

Additionally, the liquid whey pressed out of the wheels of cheese is now recovered. Formerly discarded, the whey is sold for use in protein powders and shakes, generating a new revenue stream for dairy operations.

The Emerson AVENTICS washdown CL03-EV directional control valves (shown left) are installed directly on the cheese-making machine (below), with actuators in decentralized locations, so that compressed air lines are shorter with no dead volumes or pressure losses, thereby reducing air consumption.

©EMERSON AVENTICS

An Emerson AVENTICS cylinder.

Pneumatic technology is more washdown friendly than electrical devices, which need a temperature-controlled environment to avoid overloaded circuits.

their versatility by communicating across a wide range of industry protocols, like Ethernet-based protocols, Open System Interconnection (OSI), and IO-Link, and even Process Field Bus (PROFIBUS) and DeviceNet. As a result, it's easier for dairy processors to use pneumatic devices that comply with national and international standards, anywhere in the world.

This high level of flexibility has allowed the dairy industry to deploy pneumatics in a widespread fashion. Equipment designers are learning to specify pneumatics quickly and easily, helping dairy machine OEMs meet end-user requirements for machines that are faster, more efficient, or consume less energy or air. Dairy processors are deploying pneumatics throughout their plants, reducing ramp up and training time required when they introduce new equipment. Dairy plant workers are developing a high level of familiarity, learning how to operate and maintain pneumatics equipment and controls.

Plant Engineering Advice for Implementing Pneumatics

There are several key best practices to follow when implementing pneumatics in a dairy operation:

- Mount the valves close to the cylinders to avoid long air lines and wasted energy.
- Mount the cylinders so they can be easily cleaned.
- Decentralize valve manifolds on larger production lines.
- Size pneumatic systems for optimal performance to avoid wasting energy on compressed air.
- Ensure the air pressure is constant to maintain optimal actuator cushioning by placing the regulators close to the actuators.
- Filter the compressed air according to the applications for which it is being used. If possible, place filters by each valve manifold.
- Lubrication for pneumatic components generally may not be needed, but if it is, be sure to use food-grade (type NSF H1) lubricants.

Pneumatics offers abundant advantages to dairy processors. Pneumatic devices can handle the rigors of a dairy's rugged washdown environment. They're easy to upgrade or change, giving dairy operations the flexibility to respond to changing consumer preferences. They can be used almost anywhere, tapping into compressed air that's available throughout the plant. Finally, pneumatic technology can help dairy operations comply with regulations, protect workers and equipment from harm, and help maintain a high level of production and minimize downtime through predictive maintenance. ■

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Mystery Fish *(Continued from p. 41)*

Keeping Up with Fraud

A high majority of the seafood products consumed in the United States are imported, with the numbers varying from 80 to 90 percent, according to the National Marine Fisheries Service. The United States is also one of the largest exporters of seafood in the world. In general, fish and fishery products are one of the highest traded commodities. There are hundreds of species in various product forms. These products originate from countries with wide-ranging infrastructures, capabilities, and controls. Seafood mislabeling is extremely challenging for law enforcement as over half of the world's fish production is processed at sea or soon after landing, as noted in a 2009 FAO report. This could render the species unidentifiable without forensics. Also, the farther a fish gets from harvest, the more likely it is to be mislabeled.

The main authority to prevent seafood fraud in the United States belongs to the FDA under the Food, Drug and Cosmetic Act. The National Marine Fisheries Service has also utilized the Lacey Act, a federal law protecting wildlife, in appropriate situations to address fraudulently labeled seafood imports. The Customs and Border Patrol works with federal agencies to assist in managing, and at times halting, illegal or unacceptable shipments entering the United States. The federal authorities work with state and local regulators to address issues between states and at retail and food service locations. This cooperation no longer rests upon government agencies alone. The various third-party registration systems being utilized by the industry are also working now to address food fraud as part of their standards and audits. End-to-end traceability using digital means may be a solution.

The issue of food fraud continues to get worse as unscrupulous players find new and innovative ways to cheat. Current enforcement strategies aren't keeping up and many food fraud penalties are minor. Every country addresses adulteration and misrepresentation, but fraud often isn't handled at the same level unless food safety is also compromised. Many agencies have limited budget resources and must focus on food safety out of necessity. The growing trend of e-commerce is complicating the situation even more, making it very difficult to trace back violations. Too many people are involved in the supply chain, forcing those businesses that want to fight fraud to end up supporting it in some way just to stay in business. The good news is that many businesses, organizations, and governments on an international level want to eliminate food fraud and are finding ways to communicate and work together to solve this global concern. ■

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Safety in Tech

Software can help you make sure your suppliers are compliant with FDA regulations

BY **DAVID ISAACSON**

According to a report by the U.S. Public Interest Research Group, the total number of food recalls in the U.S. increased by 10 percent between 2013 and 2018. In the last year alone, the USDA Food Safety and Inspection Service recalled over 10,000 tons of food. Food quality issues have contributed to the roughly 48 million people who get sick, 128,000 who are hospitalized, and 3,000 who die from foodborne diseases each year in the U.S., based on estimates by the U.S. Centers for Disease Control and Prevention.

One of the key challenges that food manufacturers face in preventing recalls is how to ensure their suppliers maintain effective quality management procedures. This includes monitoring food supplies that come from foreign countries; there are more than 200 countries or territories (and roughly 125,000 food facilities and farms) that supply 32 percent of the fresh vegetables, 55 percent of the fresh fruit, and 94 percent of the seafood that Americans consume annually.

Unfortunately, many importers still rely on manual processes that are limiting their ability to keep track of supplier data and quality processes. This not only puts consumer safety at risk but can also inhibit a company's ability to comply with FDA regulations. Organizations that struggle to locate data because they're forced to sift through paper records are likely to be flagged during an inspection. Instead of relying on manual methods, importers should look for a software solution that can house all their critical quality data in one central, easy-to-access location. Not only does centralizing data make it easier for importers to address the FDA's questions, but it also enables them to more efficiently and effectively manage suppliers.

Finding a Solution

By investing in a supplier quality management tool, importers will have direct access to critical compliance and quality data, such as materials, testing and sampling records, audit findings, and corrective actions. Additionally, with the right tool, importers will be able to update data in real-time and require their suppliers to do the same. As an added bonus, this level of automation will significantly streamline previously manual processes, giving both importers and suppliers the resources they need to focus on what matters most: the safety and quality of the product.

The most effective supplier quality management tools can ensure finished product quality with automated control and visibility over all elements in an organization's supply chain—from local manufacturers to global suppliers. Importers should look for solutions that can track suppliers and materials, build qualitative and quantitative supplier ratings, and trigger actions to improve supplier quality, all from one yeasy-to-use interface. Ideally, the solution will be able to automatically:

- Track and evaluate the quality of supplier goods in real-time.

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- Identify scenarios that may warrant supplier corrective action, such as nonconforming material, missed or delayed delivery, and investigation of a customer complaint.
- Manage the approval process for changes to products and processes made by suppliers.
- Generate reports for suppliers categorized by commodity and date.

For one global provider, leveraging a sophisticated quality management solution that incorporated the above features was critical to its success. With the right software in place to automate contract management processes, the organization was able to achieve a 5,000 percent return on investment and significant productivity gains. Another national fast-food chain centralized and automated its vendor approval system, which allowed it to shave weeks off its vendor approval process and get new products to market faster without sacrificing food safety.

This type of solution is especially helpful when navigating the complexities of the FDA's recently enforced Foreign Supplier Verification Program (FSVP), a key compliance and safety rule under its Food Safety Modernization Act (FSMA). With the number of food recalls increasing and the threat they represent to U.S. consumers, manufacturers, and the economy, it's no surprise that the FDA is cracking down by enforcing one of its key regulations around imported goods. Foreign food suppliers and U.S. importers that are uncertain about whether they're ready for the inspections should first take a step back and review their quality processes to ensure they—and the other companies operating in their supply chain—are meeting every one of the FDA's compliance and safety rules.

Getting to Know the FSVP

The FSMA has been referred to as the most sweeping reform of U.S. food safety laws in more than 70 years. The focus of the act is to ensure more effective prevention of safety issues in the U.S. food supply by taking a comprehensive overhaul of every segment of the supply chain, from farm to fork. It was signed into law by then-President Obama on Jan. 4, 2011, and in the years since the FDA has been working to develop the final rules.

One of those rules is the FSVP, which at its most basic level requires that the same food safety standards are applied to all foods sold in the U.S., whether they're produced in Minnesota, Mexico, Morocco, or Montenegro. The program puts the onus on U.S. importers to verify that their foreign suppliers are producing food in a manner that provides public health protection and to ensure that the supplier's food isn't adulterated or misbranded with respect to allergen labeling.

The rule was formally finalized in 2015 and the first compliance date was set in May 2017, with compliance dates extending throughout 2020. According to the FDA, compliance dates for FSVP are based on:

- The foreign supplier's size: Companies will have a longer amount of time to comply with FSVP rules when suppliers qualify as small or very small businesses. The FDA has helpfully provided a Small Entity Compliance Guide
- The company's role in the food supply chain: Importers that are also manufacturers and subject to supply-chain provisions of preventive control rules should refer to compliance dates in those established rules. If this is applicable, then those rules may provide more time for compliance than the FSVP dates outlined on the FDA website.
- Whether suppliers are subject to other rules: Importers whose suppliers are already subject to preventive control or produce safety rules may also have more time to demonstrate compliance.

Evaluating Foreign Suppliers

Under the FSVP, importers are responsible for leading the evaluation of their foreign suppliers, which includes taking actions such as:

- Determining known or reasonably foreseeable hazards with each food.
- Evaluating the risk posed by a food, based on the hazard analysis and the foreign supplier's performance.
- Using that evaluation of the risk posed by an imported food and the supplier's performance to approve suppliers and determine appropriate supplier verification activities.
- Conducting supplier verification activities.
- Conducting corrective actions.

"Hazards" are anything defined as being reasonably likely to cause illness or injury that occur naturally, are unintentionally introduced, or are intentionally introduced for the purposes of economic gain, such as substituting a less-costly ingredient. This could include:

- Biological hazards, such as parasites and disease-causing bacteria.
- Chemical hazards, including radiological hazards, pesticide and drug residues, natural toxins, food decomposition, unapproved food or color additives, and food allergens.
- Physical hazards, such as glass or metal.

If an importer finds that one of their foreign suppliers is at risk for nonconformity or is using processes and procedures that might put public health at risk, the importer must promptly take corrective actions. These actions could include discontinuing the use of that supplier until the cause of noncompliance has been addressed. Importers are also subject to their own set of conformities that ensure their quality and safety standards adhere to the FDA's regulations.

Beyond investing in software, importers should also identify ways to prepare their suppliers for FSVP inspections, such as performing a mock inspection. By taking the time to walk through all the FSVP criteria ahead of time, importers will be able to pinpoint any challenges or quality concerns that need to be addressed before the FDA inspectors arrive.

While FSVP preparedness is undoubtedly time-consuming for suppliers and importers alike, it's also critical to ensuring the safety of our products and, ultimately, our consumers. And although it's essential that importers get themselves and their foreign suppliers ready for inspection as soon as possible, it's even more important that they establish quality management best practices to consistently ensure the quality of the products they deliver to the public, support more efficient supply chain management, and instill consumer trust. Thankfully, with the right tools and processes in place, every company will be able to easily maintain compliance and product quality year-round. ■

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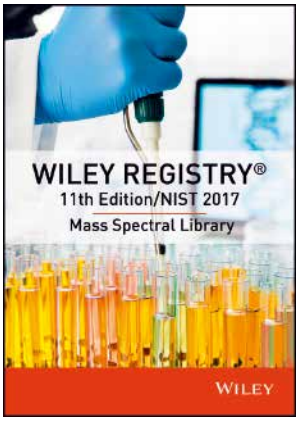

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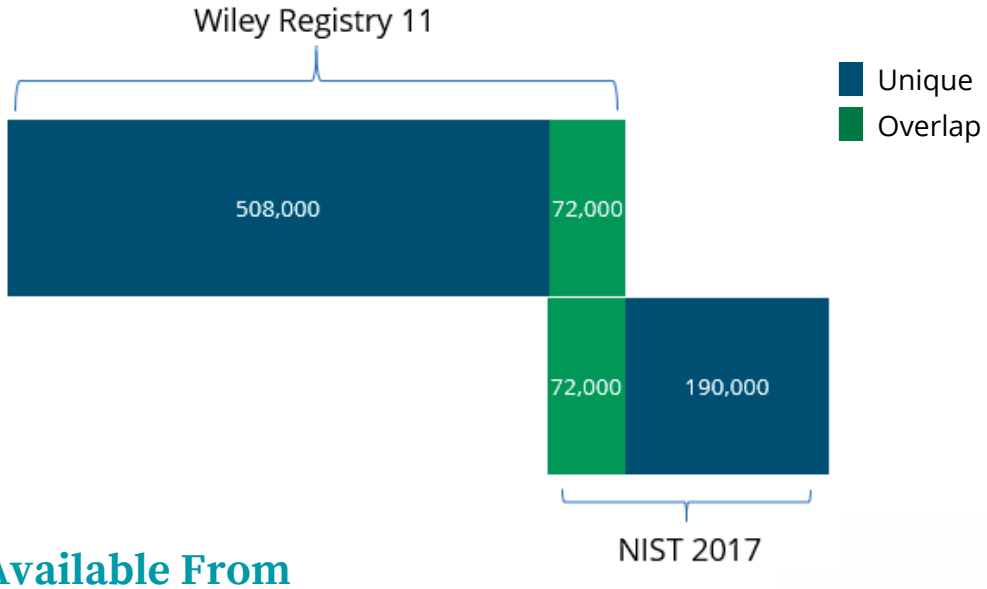

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Allergen Awareness

Are restaurants and food service doing enough?

BY **RICHARD F. STIER**

Food allergens and allergen awareness are hot buttons in the world of food safety. Allergen management is an integral part of the preventive controls regulation found in 21 CFR 117 and has been part of food safety management systems in the U.S. and throughout a large part of the world for many years.

There are two industries, however, where allergen management could well be improved: the food service and restaurant sectors. This issue was brought to the forefront several years ago when I attended a meeting of Technical Committee 17, a subcommittee of the International Organization for Standardization (ISO) that developed and is charged with reviewing the ISO 22000 food safety standard "Food Safety Management Systems — Requirements for Any Organization in the Food Chain." I had dinner one evening with members of the subcommittee at an Irish restaurant, and when looking at the menu, we noted that each item noted what food allergens were in that product.

None of us had seen anything like this in the U.S. There is the occasional restaurant that mentions that an item contains a food allergen and there are others such as Applebee's and Buffalo Wild Wings that will provide customers with a separate allergen menu, but such operations are the exception rather than the rule. The best allergen management program that I have ever seen was developed by a private school that was feeding over 1,000 children per day. They used the Al-Aware tags to introduce the students to allergens and tagged each menu item with the name of the allergen and the colored Al-Aware tags. In addition, they introduced the program in the classrooms so they brought the system directly to the children. The food service manager even designed and patented holding trays that were meant to minimize the potential for cross-contact.

Sadly, this program collapsed when the food service director retired. The operation now proudly maintains gluten-free and dolphin-safe instead of what are including more common food safety concerns.

Servers in the U.S. are generally rather poorly educated when it comes to allergen awareness. I say generally because there are some persons and restaurants that are knowledgeable and have made the effort to make sure their servers are properly educated about food allergens. A few years back, I was having dinner with friends at local restaurant. The restaurant was featuring shank of wild boar that evening. One of my friends ordered it, but stated that soy was a concern with her. The server thought that might be a problem. He checked with the kitchen and confirmed that part of the marinade was soy sauce, so our friend had to order something else. Unfortunately, not all servers are this good nor are restaurants so diligent.

The bottom line is, maybe we should look at what Europe is doing.

European Restaurants and Allergen Awareness

I want to state that this isn't a scientific evaluation, but the comments of a food

14 Food Allergens Defined by the European Union

Celery
Cereal containing gluten
Crustaceans
Eggs
Fish
Lupin
Milk
Molluscs
Mustard
Nuts
Peanuts
Sesame
Soybeans
Sulphites

Source: European Food Safety Authority

scientist who has had the opportunity to travel throughout the European Union and enjoy the food all over. I have also had the chance to look over menus and talk to restaurant owners about allergen management.

> Any operation that relies on word of mouth to ensure that the message on allergens is delivered to customers must commit to a training program of some sort to ensure that the servers know the menu and which items contain allergens.

Thanks to the people at the Food Allergy Research and Resource Program (FARRP), I was able to obtain copies of the EU regulations governing allergens. There are specific regulations for foods that aren't pre-packaged—that is, foods served in restaurants, canteens, or cafeterias. The EU has defined 14 food allergens: celery, cereals containing gluten, crustaceans, eggs, fish, lupin, milk, molluscs, mustard, nuts, peanuts, sesame, soybeans, and sulphites.

There are various ways that operators may comply with these regulations, including:

1. Ensure that each menu item that contains allergens properly references the allergen(s) they contain.
2. Establish a table that shows all menu items and the allergen(s) they contain.
3. Post a conspicuous announcement that the restaurant sells foods that contain food allergens and that sensitive customers should ask their servers about the foods being served.

Let's look at these three means of complying with the EU regulations. One way to note allergens on a menu is to include color coded and numbered allergens. Customers can cross-reference the numbers or colors next to their menu selection with the master list found at the back or front of the menu. This kind of menu has pros and cons. It allows restaurant patrons to easily understand what allergens are found in each item on the menu, but it places a burden on restaurant owners or operators. Every time there's a menu change or update, the menu will have to be redone. This can be a real issue with restaurants in tourist areas that change menus with the seasons. They have the option to print addenda that can be provided to customers with the main menu, but it does add costs. It can also stifle creativity in the kitchen as chefs will need to clear menu items in advance and be sure that new items that contain potential allergens will be properly flagged.

Restaurants in the European Union may use an identification system on menus to inform customers of potential allergens.

The second option is for restaurant operators to create a table that lists all menu items on one axis and the 14 allergens on the second axis. The allergens in each item are check marked with an X or a check. The advantage of this format is that the restaurant can put together a master list of not only what they are serving but what they might be serving. Both of these formats make it easy for customers, especially potential patrons who are sensitive to certain foods, to find foods that they can safely consume.

The final option is the most complex as it relies on competent servers and observant customers. The restaurant is required to post signage in a visible location in the restaurant or within the menu that the foods they're serving may contain food allergens. The signage must also state that customers should ask their servers about potential allergens. This requires servers who know the menu and can answer any questions with regard to the presence

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of allergens. On the whole, a server in a restaurant in the EU is probably better educated with regard to food allergens than a comparable person in the U.S. This may be a function of how they do business. Servers in Europe are generally paid better than those in the U.S. and are able to make a living wage in that role. If one talks with persons who have sensitivity to certain foods, however, the consensus is that one really cannot put their faith in the server, whether they are in the U.S. or in Europe.

Any operation that relies on word of mouth to ensure that the message on allergens is delivered to customers must commit to a training program of some sort to ensure that the servers know the menu and which items contain allergens. This program should also include information on the importance of avoidance for sensitive individuals and what happens when such an individual is exposed to a food allergen. Simply telling people that allergens can cause issues such as gastrointestinal distress, skin reactions, respiratory problems, and, in the worst case, systemic problems such as anaphylactic shock and death, really isn't adequate. We must emphasize this point with photographs and statistics.

There are other materials available to restaurant operators that they can use to augment their allergen management programs. Wiberg Gmbh, an Austrian ingredient supplier, has developed an allergen awareness document that's used in menus or posted in restaurants. This chart has also been modified for use as a master list. Each item on the chart is assigned a number or letter and the menu items are flagged appropriately. Other organizations such as WKO have developed similar documents.

Lessons for the U.S.

Could we better identify allergens here in the United States? The answer is a resounding YES. There will be challenges, however. One of those is how restaurants and food service are regulated. Individual states and counties or cities within those states need to establish and enforce regulations based on their interpretation of the food code.

A combination of stronger regulation at the state and local levels and a commitment to protecting customers at the restaurant level could enhance allergen awareness in the food service and restaurant industries. This should include, but not be limited to, clearly informing potential customers what allergens are in the menu items and making sure that service staff are properly educated as to what's in the menu items and the consequences of food allergen exposure. And, finally, the kitchen staff must put into practice programs to avoid cross contact so that foods aren't inadvertently contaminated with an undeclared allergen. The Applebee's and Buffalo Wild Wings models would be good examples to follow. Ideally, any person with a food allergy should be able to look at a menu and be completely confident in what he or she orders. ■

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Extend the Shelf Life ... (Continued from p. 43)

initiation of tests with the push of a button, enabling wineries to undertake sulfite testing more efficiently. In addition, this ease of use frees up operators to work on other tasks, such as additional safety or quality tests, and gives wineries the flexibility and capacity to quickly scale up sulfite testing activities without having to significantly expand their teams. The latest automated platforms for sulfite testing extend beyond data collection to processing and analysis, enabling wineries to automatically calculate and store results in line with regulatory requirements, while avoiding the risk of transcription errors that can occur using manual workflows.

Additionally, some of the latest titration platforms enable wineries to program and save frequently used method details in the system for routine use by operators. These convenient and intuitive systems can help wineries work more efficiently by eliminating the time required to set up the relevant conditions before each test. More advanced platforms will allow system administrators to lock the pre-programmed tests, preventing them from being changed by unauthorized users. For laboratories with large workflows, these features can be highly beneficial in increasing productivity and delivering more consistent results.

The robustness of sulfite testing workflows is a key priority for many wineries, especially those with high-volume testing requirements. Recent improvements in the operational resilience of automated titration systems are helping to minimize maintenance requirements and simplify upkeep. Some modern automated titrators will even diagnose performance issues and guide operators through recalibration and maintenance steps using clear on-screen instructions. As sulfite testing is often undertaken by operators without any in-depth technical knowledge, the improved simplicity and ease of use of these systems can allow wineries to extend the interval between maintenance operations and get titrators back in action more quickly when issues do arise. These innovative features improve operational efficiency and productivity and help get wineries back to what they're good at: ensuring great wine makes the journey from vineyard to wine glass. ■

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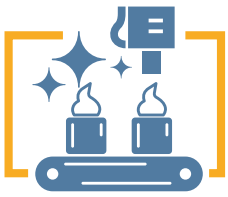

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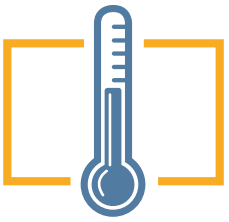

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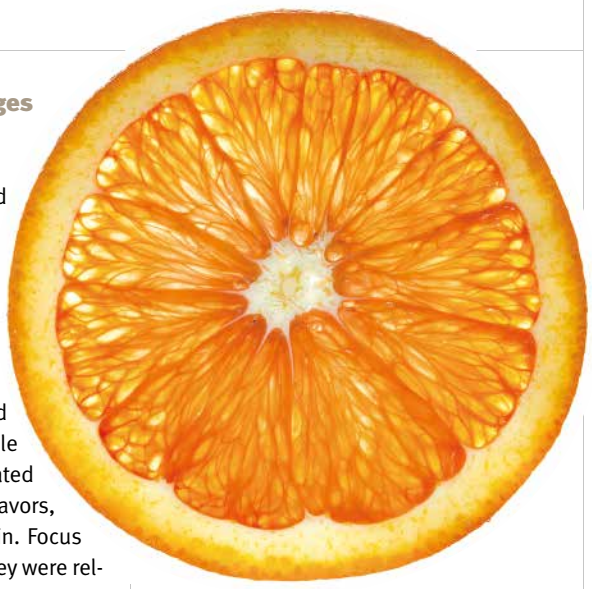

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ARTICLE: Evaluation of California-Grown Blood and Cara Cara Oranges Through Consumer Testing, Descriptive Analysis, and Targeted Chemical Profiling

The acceptability of Moro, Tarocco, Cara Cara, Shahani, Bream Tarocco, Boukhobza, and Sanguinelli oranges from both commercial and research orchards was tested with adult (n = 152) and child (n = 72) consumers. Qualitative focus groups were also conducted to understand consumer familiarity and thoughts about the fruit. Sensory descriptive and chemical analyses were carried out to identify drivers of liking. Overall, consumers preferred the lighter colored varieties consisting of Tarocco, Cara Cara, and Boukhobza. One cluster of adults (n = 80) showed preferences toward sweet and fruity flavors and away from sourness and citric acid. The second adult cluster (n = 72) was tolerant of the sour fruit but did not like fruit high in bitterness and flavonoid content. The largest child cluster (n = 42) showed preferences for samples higher in orange and tropical flavors (Cara Cara, Tarocco, and Boukhobza varieties). The appearance of the Cara Cara was strongly liked by the consumer population in both quantitative and qualitative settings. Hunter scale a color values strongly correlated to the higher berry/dried fruit flavors, and concentrations of naringenin. Focus group participants noted that they were relatively unfamiliar with blood oranges. Growers and producers may want to invest in the lighter colored varieties, such as Cara Cara, Tarocco, Boukhobza, and Shahani, as these were liked by a majority of consumers and were low in less desirable sensory characteristics, such as bitterness and sourness. ***Journal of Food Science*, Volume 84, Issue 11, November 2019, Pages 3246-3263.**

ARTICLE: Alpha-Casein and Beta-Lactoglobulin from Cow Milk Exhibit Antioxidant Activity: A Plausible Link to Antiaging Effects

Studies on the discovery and function of antioxidants are consistently being performed because oxidative stress can cause various diseases. Many compounds and natural products have antioxidant activity in vitro; however, it is often difficult to reproduce their effects in vivo. Additionally, methods to measure antioxidant activities in cells are also scarce. Here, study authors investigated the antioxidant activity of milk proteins by observing the formation of arsenite-induced stress granules as a tool to evaluate antioxidant activity in cells. Milk proteins not only decreased the formation of stress granules in several cell types but also scavenged 2,2'-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid) (ABTS) radical cations in vitro. In addition, milk proteins inhibited cellular senescence based on an SA-β-galactosidase assay, and increased differentiation to myotubes from myoblasts isolated from the skeletal muscles of mouse pups. Taken together, the results demonstrate that milk proteins have an antiaging effect, especially prevention of skeletal muscle loss, through their antioxidant activities. ***Journal of Food Science*, Volume 84, Issue 11, November 2019, Pages 3083-3090.**

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(Continued from p. 58)

ARTICLE: Prediction of commercial spaghetti quality based on sensory and physicochemical data

In this paper, a range of nine commercial spaghetti samples was studied to compare and describe relationships between physicochemical and sensory data. Analysis of variance showed that all examined sensory and physicochemical properties were significant ($p < .05$) in discriminating the samples, which could support the usefulness of their application in characterizing the spaghetti appearance quality. According to the results of sensory analysis, the samples were differentiated into four significantly different quality groups, regarding the overall appearance of the samples, as well as all individually evaluated attributes. Successful rating of the appearance quality of commercial spaghetti can be conducted on the basis of instrumental determinations, in the first place using color and mechanical characteristics. Principal component analysis was used to discriminate groups of samples according to similarity in physicochemical and sensory parameters, and the first two principal components explained 75.04% of the total variance of samples. ***Journal of Food Processing and Preservation*, Volume 43, Issue 11, November 2019, e14172.**

ARTICLE: Coupling membrane processes to obtain a lycopene-rich extract

Lycopene is a carotenoid found in tomatoes and other red fruits and vegetables. It is known for its antioxidant properties, which are associated with the prevention of cancer. Raw tomatoes and tomato-based products are important sources of dietary lycopene. This study aimed to evaluate the integration of diafiltration and reverse osmosis processes to concentrate tomato pulp and to obtain a lycopene-rich extract with a high antioxidant capacity and a low molecular weight. Diafiltration was efficient in desalting the tomato pulp, maintaining the lycopene concentration of the tomato at the same level as the whole tomato pulp. The permeate flux of the diafiltrated tomato pulp was 29.5 L·h−1·m−2 and the concentration factor of lycopene was 2.4. Additionally, it was found that the antioxidant capacity increased at the same rate than the lycopene content. ***Journal of Food Processing and Preservation*, Volume 43, Issue 11, November 2019, e14164.**

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NEW PRODUCTS

Transport Refrigeration Units

The Thermo King T-90 Series of truck transport refrigeration units with standard integrated telematics hardware easily connect fleets with their cargo. Fleets can activate TracKing with the flip of a switch to easily monitor, control, and analyze their refrigerated fleet operations. The included premium Human Machine Interface improves usability, diagnostic capabilities, and ease-of-use. The T-90 burns less fuel as the unit cools and reduces the hours that the engine runs to decrease costs and save energy. **Thermo King, thermoking.com**

Hygienic Flexible Conduits

Cleaning regimens are an important and essential part of ensuring safety and quality in the food industry. Flexicon's range of hygienic flexible conduits and fittings protect critical power and data cables from damage

caused by mechanical, electrical, or environmental influences in hygienic environments. Flexicon conduits feature smooth, easy-to-clean surfaces while stainless steel hygienic fittings create a complete system, helping ensure peak operational efficiency and eliminating downtime during cleaning or maintenance. Designed in accordance with EN1672-2 and EN ISO 14159, Flexicon conduit and fittings allow for efficient cleaning while ensuring that cleaning processes do not damage or compromise equipment operation. They also protect against buildup of microbes and bacteria. Chemical and thermal resistance allows food manufacturers to clean and sterilize using bleach without the risk of product degradation. **AFC Cable Systems, afcweb.com/flexicon/**

Laboratory Casework

HEMCO's UniLine Casework is constructed of welded 18-gauge steel. Base cabinets have a load capacity of 500 pounds per linear foot. Its powder-coat finish is environment friendly, attractive and long lasting. Casework is tested independently to be SEFA 8 compliant.

Drawers extend to 18 in. full open, and have an interchangeable, interlocking drawer head that is sound deadened for quiet operation. A one-piece drawer body with radiused bottom makes for easy cleaning. A 150-pound dynamic drawer slide assembly is mounted on welded channel assemblies. The interior is powder-coated steel, with an optional stainless steel interior. The doors are two-piece double-wall construction that are painted before assembly.

An insulated door filler is for added rigidity and quiet operation. The recessed toe space is 4 in. high by 3-1/2 in. deep, which promotes laboratory cleanliness. The cabinet base features a lower corner reinforcing gusset with 0 to 2 1/2 in. adjusting levelers on all four corners. The cabinet height is adjustable from 35 in. to 37 1/2 in. **HEMCO, HEMCOcorp.com**

Bird Deterrent

The AVIX Autonomic Mark II by Bird Control Group is a fully automated bird deterrent that effectively and harmlessly scares birds away 24/7 and can reduce bird nuisance by up to 90%. Bird Control Group's lasers leverage a bird's innate fight or flight response by shining a laser beam across a predetermined path or structure, which in turn cause the bird to "escape" the perceived imminent danger. The human eye sees the laser as a moving green dot, but a bird's eye interprets this same dot as an actual beam of light or barrier and will fly away to avoid contact, or abort landing in the arc the laser is protecting. Wireless connectivity allows the user to easily program the device through the use of an app, as well as monitor system status, laser activity, and switch the system on and off. **Bird Control Group, birdcontrolgroup.com**

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Water-Powered Injector

The Dosatron D132 Series is available. It's easy to set up with no programming necessary—just set the injection rate and turn on the water. It's compatible with nutrients, sanitizers, acids, and line cleaners. The D132 is part of the Mega-Flo Series. It has the D14 Series familiarity with the high-performance piston, a low number of internal parts, and there are no Venturi tips to clog. The D132's low injection rates allow for direct injection of undiluted products, and maintenance is easy. **Dosatron International, dosatronusa.com**

Salmonella Molecular Test

The 3M Molecular Detection Assay 2 – *Salmonella* has earned a new extension from AFNOR Certification for its NF VALIDATION. The new extension includes 375 g samples of infant formula and infant cereals with or without probiotics, as well as dairy powders. The 3M Molecular Detection Assay 2 – *Cronobacter* had previously earned this validation in 2018 at the 300 g sample size, meaning that producers are now able to use the 3M Molecular Detection System to test for both *Salmonella* and *Cronobacter* at the same time with the same samples.

The 3M Molecular Detection System, which last year became a primary method of the USDA Food Safety and Inspection Service for the detection of both *Salmonella* and *Listeria*, combines isothermal DNA amplification and bioluminescence detection. It provides an accurate reading in less than 24 hours. Comparative research has shown that the 3M Molecular Detection Assay 2 – *Salmonella* can process a set of 96 samples 1.7 times faster than the closest competitive technology. In addition to streamlining the workflow, training is simplified, since all assays use the same lysis and amplification protocol. **3M, 3m.com**

Liquid Cooling Solutions for Industrial Electronics

Pfannenberg EB 2.0 Large Packaged Chillers and PWS Series Air to Water Heat Exchangers provide contaminant-free, cost-effective component cooling without adding heat to the local environment.

Closed-loop liquid cooling efficiently and economically improves performance for advanced manufacturing processes and

electronics in hot, dirty environments using field-proven water circulation technology. Designed to guarantee full separation of water lines and airflow paths, Pfannenberg liquid cooling systems feature integrated electronic thermostats and flow control components for accurate temperature control and superior energy efficiency. Liquid cooling offers an ideal cooling solution for spindle motors and automation drives in automotive manufacturing, power plant electronics and solar inverters in energy production, and oven controls and product coolers/dryers in pharmaceutical production, as well as for paper and printing, plastic manufacturing, and water/wastewater applications. **Pfannenberg, pfannenbergusa.com**

Pull Wire Switches

STEUTE's Series ZS Pull-Wire Switches are ideal for on/off control switching or opening/closing electrically operated doors or gates. Models are available with powder-coated aluminum, or fiberglass-reinforced thermoplastic housings. Units feature positive-break NC contacts, IP65 or IP67 ingress protection, and EN ISO 13849-1 and cCSAus-compliance. **ZF Electronic Systems, switches-sensors.zf.com/us**

The Spices of Life *(Continued from p. 16)*

Industry deals with the problem by requiring certificates of analysis for all imported spices, and also by testing imported product, Mitchell says. "The standard is zero tolerance for chemicals and foreign botanical matter mixed in with pure spices," he points out. "Adulteration is not a problem with spices originating in the U.S. But some countries with less oversight are selling ground spices, so the risk of adulteration has become both a food safety and quality issue."

New Proficiency Test

Fapas, the proficiency testing arm of Fera Science Ltd., Sand Hutton, York, UK, introduced on Sept. 1, 2019, a proficiency test for contamination of cumin with the allergens sesame and gluten.

The process begins when a customer orders proficiency testing materials online from the Fapas website, according to Mark Sykes, MS, Fera's lead senior scientist for proficiency testing. "The testing materials are shipped to the laboratory on the advertised date," Sykes relates. "The laboratory then analyzes the test materials using their own method—for allergens this is typically an enzyme-linked immunosorbent assay (ELISA)—and submits its results to Fapas online, before the closing date."

For this new Fapas offering, there is just one test, but two test materials are provided to each participant and the results are grouped and assessed according to the brand of ELISA kit they used, Sykes explains. "The Fapas online site for entry of results has a list of commonly available commercial ELISA test kits and participants select the one they have used," he elaborates.

"The results receive rigorous statistical analysis by Fapas' proficiency testing experts," Sykes says. "A confidential report is published online for the customer, typically within 15 days of test results submission. Fapas can also provide interlaboratory reports for multiple connected laboratories that show an overview of global performance."

This new sesame and gluten proficiency test for cumin adds to Fapas's current portfolio of proficiency tests that address the potential for contamination of spices. "The Fapas portfolio also includes black pepper, chili powder, ginger, paprika, turmeric, and garlic powder," Sykes notes. ■

Leake, doing business as Food Safety Ink, is a food safety consultant, auditor, and award-winning freelance journalist based in Wilmington, N.C. Reach her at LLLeake@aol.com.

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