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Volume 30 Number 6
DECEMBER 2023 / JANUARY 2024

Food Quality & Safety

FARM TO FORK SAFETY

An underwater photograph of a large blue-striped fish in the foreground, with several smaller fish and seaweed in the background. The water is clear and blue.

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Food Quality & Safety (ISSN 2572-8644) is published 6 times a year in Feb/Mar, Apr/May, Jun/July, Aug/Sept, Oct/Nov, Dec/Jan by Wiley Subscription Services, Inc., a Wiley Company, 111 River St., Hoboken, NJ 07030-5774.

Print subscriptions are free for qualified recipients. Annual paid subscriptions are available to European readers at €164, U.K. readers at £133, and rest of the world readers at \$248. For subscription questions, email customer service at wileygit@vuserice.de.

APEX, Folio Ozzie, and ASBPE award winner for editorial and graphics excellence.

POSTMASTER: Send all address changes to *Food Quality & Safety*, Wiley Periodicals LLC, c/o The Sheridan Press, P.O. Box 465, Hanover, PA 17331 USA

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From The Editor

Déjà Vu... All Over Again



Just a few years ago—11 to be exact—the food safety community was focused on the *Listeria* hazards in cut cantaloupe. Jensen Farms was a familiar name to everyone involved in fighting this dreadful pathogen in an outbreak that resulted in 33 deaths, hundreds of illnesses (147 officially), and one miscarriage. The numbers don't ever tell the whole story for victims, but at the end of the investigation, many thought we had gained a thorough understanding of what had happened and, therefore, had a good idea of how to prevent future pathogen contamination in melons from happening again. FDA guidance on melons, already widely used by industry, was updated.

Yet, here we are in 2023 with another outbreak tied to this fruit, only this time the culprit is *Salmonella*. Three deaths across the U.S. and Canada have already been attributed to this event. Did we miss something in 2011? Is there a transmission route we didn't identify or a processing step that we failed to recognize, one that could introduce microbial hazards? Or worse, have we simply gotten complacent? Hopefully, this event will serve as a warning to all that we may win a battle here and there, but the war against pathogens is still ongoing. One thing is certain: *Salmonella*, like all pathogens, is always looking for new ways to reach its targets.

On a more optimistic note, *Food Quality & Safety* has announced this year's annual award winners! Every year, we recognize two companies—one large and one small—whose food safety programs meet or exceed expectations for the products they produce. Thanks to everyone who took the time to enter, and to our judges for taking the time to read and score the entries in both categories. We also had our first entry from the pet food sector and hope to see more in the future. The Petsource approach to food safety was comprehensive and thorough—enough to win this small company a first-place award. Our large company award this year goes to Fresh Del Monte, a well-known name in fruits and vegetables, which has a food safety program that encompasses the wide-ranging phases of the growing and processing cycle. Find our feature articles on each company starting on page 24. Congratulations to this year's recipients!

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Printed in the United States by Dartmouth Printing, Hanover, NH.

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NEWS & NOTES



Cinnamon in Applesauce Potentially Linked to Lead Poisoning in Kids

FDA, along with CDC and state and local partners, is investigating reports of elevated blood lead levels in individuals with reported exposure to apple cinnamon fruit purée pouches manufactured in Ecuador and sold under WanaBana, Weis, and Schnucks brands. As of November 16, there have been 34 reports of illness potentially linked to recalled product submitted to FDA, most of whom they agency says are children. The company announced a recall of the products in early November.

The agency and other state partners collected and analyzed additional product samples of fruit purée and applesauce pouches and detected elevated levels of lead in one finished product sample of WanaBana apple cinnamon purée collected from Dollar Tree. The level detected in the sample is 2.18 parts per million, which is more than 200 times greater than the action level the FDA has proposed in draft guidance for fruit purées and similar products intended for babies and young children.

To date, sample analysis of WanaBana, Weis, and Schnucks fruit purée pouches that do not contain cinnamon and are not part of the recall, have not shown elevated levels of lead.

FDA's leading theory is that cinnamon used in these recalled pouches is the likely source of contamination; however, the agency has not yet been able to collect and test samples of the cinnamon used in the recalled products. It continues to work with Ecuadorian authorities to investigate

the source of the cinnamon. At this time, while FDA has no indication that this issue extends beyond these recalled products, it is screening incoming shipments of cinnamon from multiple countries for lead contamination.

In addition to determining the source of cinnamon, FDA's investigation is ongoing to determine the point of contamination and whether additional products are linked to illnesses. As of November 17, the agency says it is not aware of any other reports of illnesses or elevated blood lead level adverse events reported for other cinnamon or cinnamon-containing products.

FQ&S will continue to monitor this situation. ■

EU Sets Stricter Limits on Use of Nitrates as Food Additives

By Keith Loria

The European Commission has released significantly stricter limits for the use of nitrites and nitrates as food additives.

The new limits amend annexes to Commission Regulation (EU) 1333/2008 of the European Parliament and Council, and to Commission Regulation (EU) 231/2012 regarding nitrites (E 249-250) and nitrates (E 251-252).

Nitrites and nitrates are often used in processed meats, cheeses, and other foods due to their antimicrobial properties. The new regulations are aimed at reducing consumer exposure to these substances while also protecting against foodborne pathogens such as *Listeria*, *Salmonella*, and *Clostridium botulinum*.



The updated limits also take into account the diversity of products and their manufacturing conditions across the EU, according to the Commission.

Food business operators within the European Union now have two years to adopt and comply with the new nitrate limits. ■



New Research Suggests Blue Light Can Eradicate *L. monocytogenes* in Food Plants

Researchers at the University of Georgia in Athens have concluded that antimicrobial blue light is a potential intervention to treat *Listeria monocytogenes* contamination on typical material surfaces used in food production. Their research was recently published in the journal *Applied and Environmental Microbiology* (doi:10.1128/aem.01147-23).

The investigators found that blue light kills both dried cells and biofilms of the pathogen; further, they say that the results of the study suggest that the demise of the pathogen occurred most quickly when cells or biofilms were placed on polystyrene, a widely used, transparent form of plastic.

"These results contribute to advancing our understanding of the potential of blue light to treat inert surfaces contaminated with *L. monocytogenes*," said corresponding author Francisco Diez-Gonzalez, PhD, director and professor at the Center for Food Safety at the University of Georgia in Athens, in a statement. Although biofilms of pathogens are generally powerfully

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resistant to being exterminated, the results suggest that blue light could effectively destroy *L. monocytogenes*.

In the study, the investigators deposited liquid suspensions of mixtures of five strains of the pathogen on small, sterile rectangular plates made of six different materials, including polystyrene, stainless steel, and silicone rubber, which were then allowed to dry. The investigators also used similar plates to grow biofilms, which they also allowed to dry. Then, they shined blue light onto the biofilms and onto the dried suspensions of cells on the plates to determine the most effective combinations of doses and wavelengths, as well as the most effective surfaces on which to extirpate the pathogens.

“The application of blue light for controlling microbial contamination has the potential to offer an additional technology that could complement existing methods for disinfecting surfaces in contact with foods,” said Dr. Diez-Gonzalez, noting that while blue light has been used for disinfection in hospitals, but this study represents some of the first research into its use in food processing facility. Additionally, as compared with ultraviolet light, blue light offers reduced risk for the user, he added.

A post-doc in Dr. Diez-Gonzalez’ laboratory, Fereidoun Forghani, PhD, kick-started the investigation when he came across the use of blue light as a potential antimicrobial intervention to sanitize surfaces. Dr. Forghani built some blue light prototypes and produced the first preliminary results treating pure cultures of *Listeria*. ■



FDA Proposes Ban on Brominated Vegetable Oil in Food

By Keith Loria

FDA has proposed revoking the regulation that authorizes the use of brominated vegetable oil (BVO) in food due to concerns about harm to human health. The proposal

comes on the heels of a California law that went into effect in October that banned four food ingredients, including BVO.

In 1958, FDA classified BVO as generally recognized as safe (GRAS), permitting its use as a food-grade ingredient; however, in 1970, the agency removed it from the codified list of GRAS substances and regulated it as a food additive. Opponents of that rule have argued that BVO in beverages poses a harmful risk to human health, citing thyroid and chronic health problems that have resulted from exposure.

FDA made the current proposed ban after conducting a 90-day dietary exposure study in rats, which concluded that, at high doses, exposure to BVO resulted in thyroid damage in the animals. “Based on these data and remaining unresolved safety questions, the FDA can no longer conclude that the use of BVO in food is safe,” the agency said in a statement published November 2.

Other countries, such as those in the EU, Japan, and the U.K., have already banned BVO use in food. Many U.S. food manufacturers have also stopped using the substance and today, few beverages in the U.S. contain the ingredient.

The Institute of Food Technologists was pleased with the proposed ban. “We applaud FDA’s evidence-based assessment of food additive safety, as we believe science is critical for establishing policies to ensure a global food system that is sustainable, safe, nutritious, and accessible to all,” a spokesperson for the organization told *Food Quality & Safety*. “We look forward to seeing the continued evolution of the Human Foods Program.”

The proposed rule will be available for public comment for 75 days, and all comments should be submitted by January 17, 2024, at [regulations.gov](https://www.regulations.gov). ■

Study: High Levels of Heavy Metals Found in Select Chocolate Products

By Keith Loria

An October 2023 report released by *Consumer Reports* found high levels of cadmium and lead in select dark chocolate products, including those from Hershey’s, Trader Joe’s, and other popular brands. The group’s scientists tested 28 dark chocolate bars for heavy metals and detected cadmium and lead in all of them.

The findings revealed that eating just one ounce from any of the 23 bars tested

would put an adult over the limit for both heavy metals that public health experts deem acceptable.

Considering that cadmium and lead are linked to a host of health problems in both children and adults, the study results are worrisome to many. “The metals can cause developmental problems, affect brain development, and lead to lower IQ,” says Tunde Akinleye, a food safety researcher with *Consumer Reports* who led the study. “Frequent exposure to lead in adults, for example, can lead to nervous system problems, hypertension, immune system suppression, kidney damage, and reproductive issues.”



Earlier this year, the National Confectioners Association (NCA) released results of a three-year study of the sources of lead and cadmium in cocoa and chocolate and how levels may be reduced in the future, though they believe the current levels aren’t dangerous. “Chocolate and cocoa are safe to eat and can be enjoyed as treats as they have been for centuries,” Christopher Gindlesperger, senior vice president of public affairs and communications at NCA, tells *Food Quality & Safety*. “Food safety and product quality remain our highest priorities, and we remain dedicated to being transparent and socially responsible.”

Consumer Reports identified and prioritized a list of recommended cadmium and lead reduction measures for the industry to consider implementing, including sourcing cocoa beans from areas with lower levels of the metals. ■



Salmonella Outbreak Linked to Pet Food Infects Seven People

FDA, in collaboration with the CDC and state partners, is investigating seven human cases of *Salmonella* Kiambu infection potentially associated with pet food made by Texas-based Mid America Pet Food.

As of November 9, CDC reports that seven people have been infected with the pathogen in California, Oklahoma, Minnesota, Alabama, Florida, Kentucky, and Hawaii. Six cases involved children under the age of 1 year. Five of the incidents reported exposure to dogs and three reported feeding Victor pet food to their pets. CDC adds that people in this outbreak became sick after touching the recalled dog food, touching objects such as dog bowls that contained the dog food, or touching the feces or saliva of dogs that were fed the product.

Mid America Pet Food issued a voluntary recall in early November, expanding previous recalls made in September and October, for dog and cat food made at its Mount Pleasant, Texas, facility with best by dates before October 31, 2024, due to the products' potential to be contaminated with the pathogen. The recalled products include Victor Super Premium Dog Foods, Wayne Feeds Dog Food, Eagle Mountain Pet Food, and two varieties of Member's Mark pet foods that were sold nationwide in retail stores and online.

"We are taking this matter very seriously, and we have already implemented enhanced cleaning at our facility, additional product testing, and other important quality measures to ensure product safety," the company said in a news release. "As we move forward, Mid America Pet Food is strengthening our commitment to food safety."

FDA warns consumers who have any of the pet food on the recall list to throw it away in a secure container. Requests for comment from Mid America Pet Food were

not immediately returned, and FDA's investigation is ongoing. ■

Researchers Say Food Labeling Isn't Clear About Animal Welfare

By Keith Loria

When it comes to animal products, there are several different claims related to how animals were raised, such as free range and cage free, and then there are also organic labels; however, consumers aren't always clear on what the different claims mean.

A new report led by Marisa Erasmus, PhD, an associate professor of animal sciences at Purdue University in West Lafayette, Indiana, and a specialist in animal behavior and welfare, looked at food labels relating to animal raising, focusing on the different options. "Food labels are a way for food producers to communicate with consumers about the various attributes of the food products," Dr. Erasmus tells *Food Quality & Safety*. "As such, food labels can play an important role in helping consumers make purchasing decisions, and consumers make these decisions based on their perceptions of food safety."

She says it's important to know that if a claim is absent from a product, it doesn't mean that the product is not safe for consumption or that the animals were raised

inhumanely. "Our food production systems here in the U.S. ensure that we have access to safe, nutritious food," she says. "Regardless of labeling, we are fortunate that we can have confidence in our food system and the processes in place, and my colleagues and I continue to work with producers and processors to provide science-based information to support humane production practices."

Earlier this year, USDA said it would focus on claims related to how animals were raised, including claims about the use of antibiotics. As part of this effort, the agency will potentially change their requirements around documentation that companies need to provide when seeking approval for certain claims and USDA will gather information through a project specifically aimed at better understanding claims related to antibiotic use.

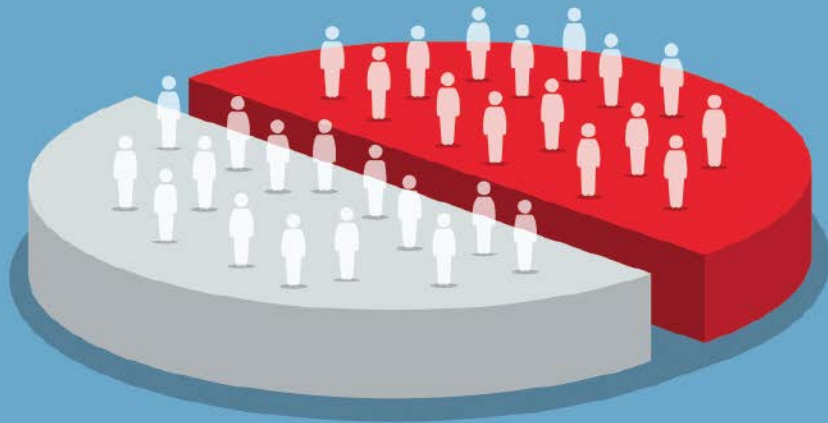
"With the freedom of choice and the different options that are available to consumers today, it will be helpful for the USDA to have information to help guide the development of policies and rules regarding food labeling," Dr. Erasmus says. "It is going to take some time to see what the specific impacts of the USDA's actions on food producers and consumers are."

As the understanding of animal husbandry and welfare evolves with more research, Dr. Erasmus and her colleagues are developing resources for producers and consumers to gain a better understanding of how management and environmental factors influence production animals.

"We are also developing resources to help explain what different food labels mean," she adds. "At the end of the day, consumers who want to find out more about animal products need to seek out information to help them make choices consistent with their personal values." ■



Washington Report



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Jim Jones Talks Priorities, Leadership

In a recent webinar, FDA's new deputy commissioner for human foods outlined his goals for a revamped Human Foods Program

BY KEITH LORIA

Earlier this fall, James “Jim” Jones joined FDA as the agency’s first deputy commissioner for human foods. In his new role, Jones reports to FDA Commissioner Robert Califf, MD, and is tasked with setting and advancing priorities for a proposed, unified Human Foods Program (HFP), which is proposed to include food safety, chemical safety, and nutrition activities.

On November 13, Jones was a guest on a webinar hosted by the Alliance for a Stronger FDA, moderated by Thomas Gremillion, director of food policy at the Consumer Federation of America, and Allison Bodor, CEO and president of the American Frozen Food Institute. During the discussion, Jones focused on some top priorities for the HFP and the planned FDA reorganization, and he gave a peek into what we can expect under his leadership.

“I worked for the Environmental Protection Agency for 30 years before spending some time in the private sector, and that doesn’t make me a food safety expert by any stretch, but it was a good ground for the important challenges that this job presents, much of it really being about how ... you get things done in government,” Jones said at the beginning of the session.

In January 2023, FDA announced it would develop a proposal for a unified HFP and new Office of Regulatory Affairs (ORA) model after carefully reviewing the findings and recommendations of a Reagan-Udall Foundation evaluation, an internal review of the agency’s infant formula response that included feedback from external and internal stakeholders. Jones was a part of the panel involved in the foundation’s investigation. “Usually, there is a fair amount of disagreement and sometimes perspectives 180 degrees

apart, but I will tell you, one of the fastest recommendations I’ve ever been a party to was the recommendation that there be a single individual with decisional responsibility for foods in the FDA,” he added.

And that’s what his new role is all about.

Jones noted that the FDA structure being replaced was designed to fail, and that this had nothing to do with the individuals involved, but was instead a result of the fact that two different people had essentially the same job description. “It was fundamentally a structural issue and not a talent issue ... it’s not about the quality of the people who are here; it’s the number of people who aren’t here,” Jones said. “Those are the resources that were identified by the Reagan-Udall Foundation. It’s been stated by the FDA—and I can assure you, having been here for two months—this is an organization that is under-resourced, and we really need to address that.”

One element made very clear in the Reagan-Udall report was the lack of clarity about where the decision-making authority lies, and that has been addressed through the creation of Jones’ position. “I also think that the Reagan-Udall Foundation identified some cultural challenges that I really do believe come from having this lack

of clarity at the top and that does not by any stretch mean that I'm making every decision for this organization; I'm creating a framework that I'm expecting individuals who can work here to be operating within," he said. "I think some of the cultural issues that were identified relating to decisions taking a long time were a function of the structure."

Priorities: Microbial, Chemical, Nutritional

While the HFP redesign structure isn't set in stone yet, Jones believes it will be released in the next several months, with the new priorities represented in the new organization chart, focusing on preventing foodborne illness. As part of reorganization, there is now an office of microbial safety, an increased focus on improving nutrition, and an enhancement of chemical safety. "The reorg is a means toward helping to bring some improvements into our efforts to prevent foodborne illness," Jones said. "Some of the things that we're doing in the reorg we think will help to optimize the talent pool that we have here. For instance, we're bringing our laboratories together so that they can be more effective laboratories."

Another important element involves risk prioritization, which is part of the new HFP. "Not all foods have created the same risks, not all food processing creates the same risks, and not all geographies present the same risks; we're trying to take the data that exists and build out on that internally to help us figure out where our energy should be going," he said. "And by energies, I mean our programmatic energies, our inspection energies, so that we can prevent foodborne illness before it is manifested in the population."

Both budget and policy authority over the inspectorate, otherwise known as the ORA, will fall within the deputy for foods authority, which will help HFP to implement all the things Jones is describes, including the risk prioritization efforts, bringing greater prevention orientation, and his approach to the work, consolidating around partnerships.

The elevation of nutrition is another big priority for Jones and HFP, and he talked about efforts surrounding labeling voluntary sodium targets and revisions



The earlier and the more engagement you have with stakeholders, the better the decisions. ... Unless you really talk to the affected parties, you just don't know what you're missing."

—JIM JONES

to the healthy label regulation. "Just last week, we had a public meeting to get input into what approach should we take related to added sugars," he said. "There's a lot of meaningful activity in the nutrition space all planned for the coming year. I think it's actually going to be quite a meaningful lift. We feel like we have a meaningful responsibility and role to play in trying to make a difference in that space."

Another big priority is around food chemical safety. Jones noted that one of the most common questions he gets is about the bill that was recently signed by California Governor Gavin Newsom banning the use of four food additives: brominated vegetable oil, potassium bromate, propylparaben, and FD&C Red 3 (red dye No. 3) in consumer goods. "I'm sure many companies will decide to make it a de facto national ban if they can't figure out how to do it in a cost-effective way of managing it for just one state—that being the biggest state in the country," he said. "In my experience, as a chemicals regulator, ... the only way meaningfully that a federal regulator can get in front of an issue like this has to have an ambitious agenda."

He feels that in the commercial chemical space, the chemicals that are regulated by EPA and not FDA, the government took way too long to figure out how to get in front of chemical safety. "The only way for us to get in front of this issue is to have a more meaningful agenda around food chemical safety," he said. "We will be not only the industry organization standing up an office that's got food chemical safety as its focus, but we will become more ambitious in our chemical review agenda."

Among the ways to do that, he noted, are employing separate statutory frameworks affecting supplements, indirect food additives, and food additives and color additives. "The kind of expertise you bring to them are often very similar in terms of what kinds of professionals you have involved in evaluating them," he said. "And so we believe that we can achieve some synergies because the kinds of expertise you deploy to evaluate these kinds of ingredients are the same even though you're dealing with different kinds of industries, different statutory constructs."

Stakeholder Participation

That's going to take stakeholder involvement, something that Jones is very passionate about. "I made a number of mistakes in my career, where I missed opportunities because I wasn't engaging stakeholders soon enough," he said. "The earlier and the more engagement you have with stakeholders, the better the decisions, whether that's someone you're directly regulating or somebody ... who thinks they'll benefit from the regulation—the consumer, for example. Unless you really talk to the affected parties, you just don't know what you're missing."

In that regard, Jones has committed himself to getting out into the field once a month. "I think it's really important for my role as a regulator to see things for myself about the impacts, and also to be with our field staff," he said. "We have at least half the staff working in foods at FDA or in the field and not at headquarters. Having your eyes wide open, you inevitably make better choices."■

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Legal Update



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Outbreak Investigation and Communication

How regulatory and public health agencies move through the investigative steps of a potential foodborne illness

BY SHAWN K. STEVENS, ESQ., AND ELIZABETH PRESNELL, MS, ESQ.

Even before a foodborne outbreak is announced, a substantial amount of investigative work has already occurred. Federal agencies, including FDA and CDC, partner with state and local public health agencies to identify an outbreak, investigate it, and then quickly determine its root cause of the outbreak.

How does this process work? Let's take a look at the steps these regulatory agencies go through during an outbreak investigation.

Testing

Before any outbreak can be identified, consumers who are sickened by consumption of a contaminated product must seek medical care. Because many foodborne illnesses are caused by bacteria or viruses that must incubate and multiply within the body for several days, however, an ill person may not seek medical treatment until many days after consuming the food that caused

the illness. In turn, a healthcare provider must not only suspect a foodborne illness, but also collect a sample from the patient to be sent for further testing and analysis.

When laboratories are asked to assess a sample, they perform tests on it to identify what is causing the illness. Laboratory procedures often require several days for final results. If the testing indicates the illness is caused by a reportable pathogen (such as *Listeria monocytogenes*, *Salmonella*, or *E. coli* O157:H7), the laboratory will report the results to the state or local public health agency as well as the medical provider. The state or local public health agency then notifies CDC.

After initial determination of the specific pathogen that may be causing the individual's illness, an isolate will be sent to a public health laboratory. This public health laboratory will conduct whole genome sequencing (WGS) analysis on the isolate. The WGS results

allow public health agencies to compare the genetic sequence of this isolate to other samples that have been collected in the U.S. and internationally. CDC utilizes GenomeTrackr, a database of WGS results, to determine if any other WGS results are closely related to the isolate being analyzed.

If CDC determines several WGS results are closely related, the agency confirms that a possible outbreak may and begins an outbreak investigation into those illnesses. In addition to illnesses identified as related through WGS, state and local public health agencies may look to other sources of information to identify additional people who may be part of the outbreak, including communicating with health professionals and reviewing emergency room records.

In addition, an epidemiological curve is often created. These curves show the number of illnesses in an outbreak over time. Additional related illnesses that are identified are illnesses will be added to the curve. Public health officials use epidemiological curves to track how quickly an outbreak is growing, whether it is ongoing, and what type of exposure may be causing it. For example, if many illnesses are reported in a short time frame, the outbreak may be tied to a single contamination event; on the other hand, if a curve shows slow growth, the outbreak may be tied to a product with a long shelf life or an ongoing

ing contamination event that involves multiple production days, weeks, or months.

Interviews and Traceback Activities

Interviews and other information-gathering techniques are then conducted with individuals considered to be part of the outbreak. These techniques are intended to gather information about where and how the individual may have been exposed to the illness-causing organism. For example, information about which foods were eaten, where the individual traveled, and where food was purchased, is often collected. From this information, public health officials may begin to create a hypothesis about the root cause of the outbreak, which leads to additional investigation. If several ill people report eating the same foods, or eating at the same restaurant, for example, public health agencies may begin additional investigations into that food or restaurant.

Coupled with the epidemiological investigations, WGS results from ill people are compared to WGS results from environmental and product samples collected by FDA, USDA, and state and local agencies. If the outbreak isolates match or are closely related to a food company environmental or product sample, this is a strong indication that the root cause of the outbreak is linked to that environmental or product sample.

Additional product testing may also be conducted based on the information collected from ill people. For example, if an ill person still has a food item that is potentially involved based on the epidemiological information, that food may be collected and tested by a public health agency.

In addition, traceback activities will be conducted by FDA, USDA FSIS, and state food agencies. These traceback activities involve following the movement of food throughout the food supply chain, including all points of distribution, processing, and production. This traceback may identify a previously unknown link among foods consumed by ill people. For example, the traceback may identify that several brands of a particular food consumed by ill people are processed in the same facility.

Public Alert and Recalls

Based on the investigation conducted, public health officials may be able to identify the root cause of the outbreak. In many circumstances, however, a root cause cannot be identified. In cases where the root cause is identified, public health officials take action to contain the outbreak and prevent additional illnesses. Control activities vary, but typically include requesting a recall of the implicated food.

In some circumstances, the public health agency may issue a public health advisory when the results of the outbreak investigation lead the regulators to conclude that specific steps may be necessary for consumers to protect themselves. Though public health advisories are typically issued when a specific brand of product is implicated, an advisory is sometimes issued when an entire category of food is potentially implicated. For example, FDA has previously issued an advisory related to romaine from certain counties in California. When determining if a public health advisory is appropriate, federal agencies evaluate the level of public health concern and the specificity of the concern. If an outbreak includes severe illnesses and is rapidly growing, an advisory is more appropriate than in an outbreak that appears to be slowing. Similarly, if the cause of the outbreak is known in great detail, an advisory is more appropriate than circumstances where very little is known about the cause.

In addition to product recalls and public health advisories, federal and state food agencies may temporarily close the food establishment tied to the outbreak until corrective actions are effectively implemented. After taking action to contain the outbreak, public health officials will typically continue to monitor the outbreak until it's over and the investigation can be closed. An outbreak may be over when no new illnesses are reported and the contaminated food is no longer available; however, due to a lag in reporting of illnesses and other complications, it is often difficult for public health agencies to determine quickly whether an outbreak is truly over.

Challenges

Though public health agencies work diligently to investigate and respond to

outbreaks, any delay or difficulty in that process may lead to additional illnesses and, as such, continued improvement in the outbreak investigation and response process is critical. FDA has taken action over the last several years to modernize and improve the agency's outbreak investigation and response procedures, and continued improvements are expected. In particular, FDA's Traceability Rule, which becomes effective in

Though public health agencies work diligently to investigate and respond to outbreaks, any delay or difficulty in that process may lead to additional illnesses and, as such, continued improvement in the outbreak investigation and response process is critical.

January 2026, is expected to allow the agency to more quickly and effectively conduct traceback investigations. Similarly, the expanded use of WGS technology during routine inspections of food facilities provides additional data for comparison by public health agencies.

Outbreak investigation and response by public health agencies remains a critical element of public health protection, but existing challenges and delays mean outbreak investigations often take longer than a month—and may take much longer. However, continued improvements in technology and regulatory operations may allow public health agencies to further shorten the outbreak investigation process. ■

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Allergen Control



HARP-C for Food Allergen Control

New draft guidance from FDA focuses on preventive controls; here, we look at how the guidance relates to food allergen residues

BY STEVE L. TAYLOR, PHD, AND JOSEPH L. BAUMERT, PHD

Editor's note: This article is the second of a two-part series focused on the Preventive Controls for Human Foods rule and the segments of that rule that relate to the control and prevention of undeclared food allergen residues. In part one of this series, which we published in the August/September issue of Food Quality & Safety, the authors focused on current good manufacturing practices. Here, the authors cover hazard analysis and risk-based preventive controls (HARP-C).

In the previous article in this series, we described the regulatory history of food allergens in the U.S., including the Food Allergen Labeling and Consumer Protection Act (FALCPA) and the Food Safety Modernization Act (FSMA). As a result of FSMA, FDA and USDA's Food Safety and Inspection Service (FSIS) for most meat and poultry products have promulgated regulations that encourage food manufacturing companies to develop and implement

allergen control plans that reduce the risk to food-allergic consumers. Under FSMA, food manufacturers are required to have a complete allergen management program as an integral component of an overall food safety plan, a program that contains the three key elements of that regulation: current good manufacturing practices (cGMPs), hazard analysis, and risk-based preventive controls.

The previous article in this series covered the food allergen-related cGMP provisions within FSMA. This second article in the series will discuss HARP-C. In September 2023, FDA released new draft guidance relevant to the establishment and implementation of a food allergen program (Chapter 11) within their series of Draft Guidance for Industry on Hazard Analysis and Risk-Based Preventive Controls for Human Foods. Comments on this draft guidance are open now.

When the President Obama signed FSMA into law in 2011, the new regulation transformed the country's food safety system into a focus on the pre-

vention of foodborne illness. The preventive approach to food safety hazards had already been implemented to some degree in the U.S. through hazard analysis and critical control points (HACCP), but FSMA expanded that preventive focus to a wide range of FDA-regulated products.

FSMA was also unique in that it specifically incorporated food allergens within its scope. Since 2011, FDA has finalized nine major rules to implement FSMA. The main focus of this two-article series is on the Hazard Analysis and Risk-Based Preventive Controls for Human Foods rule and the segments of that rule that relate to the control and prevention of undeclared food allergen residues in packaged foods. Considerable detail is contained within the new FDA draft guidance, and it will be impossible to address all of the details in this article, so we encourage readers to obtain, review, and comment upon the guidance directly.

The development of an allergen control plan within an overall food safety plan underpins the implementation of FSMA. Allergens are one of the food safety hazards that requires the implementation of a preventive control. An allergen control plan must be developed for each food manufacturing facility and be specific to the food products or ingredients manufactured within that facility. This allergen control plan must be a dynamic document that adjusts each time that the processes or products within a facility change.

Hazard Analysis

The core principle of the food safety plan is the identification of all possible food safety hazards, both naturally occurring and unintentionally introduced into a manufacturing facility. The hazards can include pathogenic or toxicogenic bacteria, parasites, radiological contaminants, naturally occurring toxicants, pesticides, drug residues, chemicals associated with decomposition, unapproved food ingredients including colorants, and food allergens. Here, we focus strictly on food allergen hazards.

The draft guidance recognizes three primary sources of hazards that should be identified at the hazard analysis stage: ingredients, process-related hazards, and hazards introduced from the environ-

ment. For allergens, the potential hazard associated with ingredients carries the greatest weight. The identification of potential food allergen hazards might, at first, appear to be simple because the major allergen hazards are likely to be intentional ingredients in certain food products manufactured in the facility. If any of the priority allergenic foods recognized by FDA are used in the formulations of food products manufactured in the facility, then these allergens are potential hazards that must be controlled within the facility.

The priority allergenic foods in the U.S. are the so-called “Big 9” (see Table 1, p. 17). If foods are manufactured for export, then it may be wise to include any allergenic foods recognized by the countries that will receive those food products. For example, Canada recognizes molluscan shellfish (clam, mussel, etc.) and mustard in addition to the Big 9. Additionally, ingredients derived from the Big 9, foods such as casein (milk), lecithin (soy), fish oil, fish gela-

An allergen control plan must be a dynamic document that adjusts each time the processes or products within a facility change.

tin, and wheat gluten, should be incorporated into the allergen control plan as identified potential hazards.

The more challenging aspect of the identification of potential allergen hazards involves the sourcing of ingredients. The food industry is global, and ingredient supplies can traverse a complex path to reach a specific food manufacturing facility. Your allergen control plan must recognize the possibility that an allergenic food residue might intentionally or unintentionally be present in an ingredient from one of your suppliers or any of their suppliers. Food manufacturers should obtain full ingredient information from every supplier for each ingredient used in their facility. They should identify all potential allergen sources that might

inadvertently get transferred into one of their ingredients because the supplier has a mixed-use facility. The allergen control plans of each supplier should be scrutinized. For example, your food manufacturing facility might not have any intentional peanut ingredients, but your company must assure that any purchased ingredients will not contain unintended peanut residues.

Over the years, we in the Food Allergy Research and Resource Program (FARRP) have investigated the presence of peanut residues in some surprising sources due to factors such as agricultural comingling (cumin, acacia gum, chocolate liqueur, pickle relish), shared rail cars (wheat flour), and shared processing facilities (honey). In allergen control plans, the identified hazards should be known or reasonably foreseeable but, as noted by the examples above, potentially hazardous situations are not always obvious. The knowledge of past situations that have resulted in product recalls is important for setting priorities, because controls can often be implemented that prevent a repeat of past failures in allergen control.

A supplier approval and verification program will aid in the identification and control of supplier-associated allergen hazards. Such a program should be dynamic, requiring notification when the product portfolios of a supplier change. Re-approval should be conducted on a periodic basis, with a focus on suppliers that have a higher perceived risk, such as those that use shared facilities for ingredients with and without priority allergens. The frequency of supplier audits or verification activities conducted within their facilities is not fixed but must be suited to the likelihood of the risk. For example, if a company sources a specific tree nut from a supplier who handles both peanuts and an assortment of tree nuts in a shared-use facility, the supplier could be required to conduct frequent monitoring of the tree nut ingredient and/or the cleanliness of shared equipment surfaces to assure the absence of detectable residues of peanuts or other tree nuts.

The identification of the potential allergen hazard is only the initial step in hazard assessment. The hazard

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should next be assessed with respect to likelihood of occurrence, dose–response relationship, and severity. Highly refined peanut and soybean oils are exempt from source labeling in the U.S. because such oils contain extremely low levels of the protein fractions of the seeds that contain the allergens. Thus, such oils can be excluded from the allergen control plan. Soy lecithin, on the other hand, is only exempt from source labeling for a few uses and would be identified as a potential hazard; however, commercial soy lecithin in the U.S. contains relatively low levels of soy protein, so, for many uses of soy lecithin, the dose of exposure would likely be below the reactive dose for the vast majority of soy-allergic consumers. The use of quantitative risk assessment approaches in such cases would indicate that the consumer risk is extremely low.

Importantly, FDA does not yet recognize the existence of thresholds for undeclared allergen residues so this approach may carry certain regulatory risk in some situations; however, in the new draft guidance, FDA recognizes (on page 218 of the draft) that some low-dose exposures and the presence of certain allergen-derived ingredients may not elicit allergic reactions in most consumers with that food allergy. In such circumstances, FDA indicates that conducting risk assessments may be useful in determining appropriate food allergen controls. This guidance is not yet final, and limited experience exists in the use of such approaches. Certainly, in cases such as those that involve peanut residues, FDA recognizes the prevalence, potency, and severity of peanut allergy, and the presence of any detectable, undeclared peanut residue in a food product is viewed by FDA as a serious hazard.

In this stage of hazard analysis, the manufacturer uses knowledge about the frequency of occurrence, likely exposure dose (to the extent possible without regulatory thresholds), and the severity of the potential hazard to determine if a preventive control is needed. FDA views undeclared food allergens as a severe hazard, in many cases, because undeclared residues of many of the priority allergenic foods

have provoked fatal or life-threatening allergic reactions in the past. Clearly, the dose of exposure is a major factor in the severity of any episode but, as noted, FDA does not recognize the existence of regulatory thresholds.

Allergen control is unique because allergens are used as intentional ingredients in most food manufacturing facilities, which makes it critical that robust allergen control programs are developed and proper training and communication is implemented across all areas of the business.

Preventive Controls

The need for preventive controls is predicated upon the potential severity of the hazard and the probability of occurrence of the hazard. In terms of severity, FDA recognizes that undeclared allergens are the basis for Class I recalls in most instances. The likelihood of occurrence of an undeclared allergen hazard within a facility can be determined in part by assessing past outbreaks, incidents, and recalls.

Preventive allergen controls have evolved over the past several decades and involve many different aspects of the food manufacturing operation, ranging from ingredient storage to packaging and labeling of finished food products. The situation with allergens is somewhat unique because certain intentional ingredients used in food manufacturing are major allergens. Thus, the potential hazards are deliberately introduced into manufacturing facilities and must be controlled throughout the process to assure that cross contact does not happen. Cross contact occurs when an allergen is inadvertently transferred to a food that is not

supposed to contain that allergen. Cross contact is prevented by a combination of cGMPs and preventive controls.

Food allergen preventive controls typically fall into two categories—labeling/packaging and the prevention of cross contact. Preventive controls require monitoring activities, which distinguishes them from cGMPs.

Scrutiny of the FDA recall database reveals that one of the most common causes of food allergen market withdrawals involves packaging and labeling errors, hence its inclusion as one of the required preventive controls. The product label should correctly identify the food source of all ingredients in compliance with FALCPA. Monitoring label design can be a preventive control. During manufacturing, the correct label must be affixed to the correct product. Clearly, placing the incorrect food product into a package can lead to consumer exposure to very high levels of undeclared allergens. Preventive controls are aimed at assuring the correct match between food formulation, food product, and package label. The use of bar code readers that can be programmed to match product and package in the packaging area of the facility is an example of a preventive control. Label control measures can also include the proper disposal of discontinued label stock.

The intentional ingredients used in the processing facility represent a major opportunity for the institution of proper allergen controls. Supply chain controls can include the monitoring of supplier allergen verification procedures. The company accepting the supplied ingredients has the responsibility to implement allergen control measures upon receipt. Delivery vehicles should be inspected to assure that the ingredients are the proper ones and are appropriately and clearly labeled. With especially high-risk ingredients or situations, such as the manufacturing of free-from labeled foods, manufacturers may require the supplier to test for allergen residues and provide analytical reports/certificates of analysis. Current GMPs, such as well-defined and separated areas in ingredient storage warehouses and a spill policy, also contribute to allergen control.

Shared Equipment

Allergen preventive controls should also be used to prevent cross contact in manufacturing facilities where shared facilities and equipment are used for one or more allergens and other foods or ingredients that are not on the FDA priority list of allergens. The major failures leading to cross contact include the failure to provide adequate physical separation or segregation of allergen-containing materials from other foods or ingredients, the failure to schedule the manufacturing of allergen-containing materials at a time that is distinct from other formulations, the failure to formulate products in a manner that minimizes the potential for cross contact, the failure to properly control the use of rework or work-in-progress materials, and the failure to adequately clean shared equipment between the manufacturing of allergen-containing and other formulations.

The use of shared equipment and facilities between formulations that do and do not contain allergens is a prime target for preventive allergen controls.

Allergen-containing formulations can be separated from other food products in space or time. Segregation must be instituted from storage through formulation and on through processing up to the point where the product is sealed into a package. If allergen-containing formulations are manufactured on lines that are distinct from other formulations, then the distance between the lines and/or the placement of partitions between lines are critical factors in controlling the possibility of cross contact. Food manufacturers often worry about the transfer of allergen residues via dust or droplets. The appropriate use of testing for allergen residues in the non-allergen product manufactured on the separate line will provide confirmation that the distances or barriers are effective. Of course, food manufacturers may worry about testing products for unintended allergen residues because such products cannot be sold if residues are found; however, the swabbing of processing lines (if idle) or the use of sampling devices (e.g., empty petri dishes) near those adjacent lines

Table 1. The U.S. List of Priority Allergenic Foods: “The Big 9”

- Wheat and wheat products;
- Crustacea and products of these;
- Eggs and egg products;
- Fish and fish products;
- Peanuts, soybeans, and products of these;
- Milk and milk products;
- Sesame seeds and sesame seed products; and
- Tree nuts and products of these.

can document the extent or lack of allergen residue transfer.

Segregation should also be practiced during product formulation. Opening, weighing, and handling allergenic ingredient containers or packages should be done in a manner that allows for separation in space or time from similar operations that do not involve the same allergens. The effective cleaning of these spaces between uses also becomes

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essential. Any partially filled containers or packages of allergen ingredients should be re-sealed and returned to the segregated storage spaces in a manner that prevents cross contact. Empty containers require disposal in a manner that does not allow any residual material in containers or bags to cause cross contact with other products or ingredients.

When allergen-containing formulations are made on the same processing lines as formulations that do not contain allergens or that contain different allergens, timing is the most effective way to prevent cross contact. A facility scheduling matrix can be used to assure that the least allergenic formulations are manufactured first, followed by formulations of increasing complexity, minimizing cross contact opportunities.



When shared equipment is used in the processing facility, use of effective allergen cleaning and its monitoring become a preventive control. The shared line must be carefully and thoroughly cleaned before restarting the manufacture of the least allergenic formulation. The effectiveness of a specific sanitation standard operating procedure (SSOP) for the removal of detectable allergen residue from shared processing lines can be validated, and its repeated use can be verified. Visual assessment of the shared equipment is an essential aspect of the cleaning validation and verification processes, and analytical methods can be used to further support the effectiveness of the cleaning procedure.

Qualitative allergen swabs with lateral flow devices (LFDs) can be used to test equipment surfaces or rinse water for allergen residues. If equipment surfaces are the focus for LFD testing, then multiple spots should be selected in the validation phase. Locating harborage spots on equipment can be challenging, but robust testing of multiple spots will likely

identify areas where residues are hardest to remove, and those areas should be the focus of future testing. In some circumstances, such as those involving particulates, a thorough visual inspection of the shared equipment can be an effective preventive control but must be conducted in a manner that can be validated and verified.

In many food processing facilities, the use of shared equipment for the manufacturing of allergen-containing and other food formulations is necessary. The validation and verification of the efficacy of allergen cleaning protocols is a key feature of allergen control plans. The validation of an SSOP for allergen removal will usually be unique to each equipment matrix in an individual processing line. To validate an SSOP, the cleaning procedure should be conducted on the dirty equipment. Visual assessment, LFDs, or other approaches to detect residual allergen residues should be used as noted above to determine if any detectable residues remain. If no detectable residues are found, then the allergen cleaning protocol was effective. The analytical results should be stored as evidence that the effectiveness of the SSOP was assessed. If the same allergen cleaning on the food formulation on that processing line is shown to be effective at removing detectable allergen residues on two or three occasions, then the SSOP can be considered fully validated.

After validation, it's important to establish verification approaches to assure that the same SSOP is performed each time allergen cleaning for that product formulation on that exact processing line is conducted. Re-validation is recommended on some reasonable periodic basis, perhaps semi-annually on a formulation that is frequently manufactured on a particular processing line.

Rework is the incorporation of previously rejected or excess food product into the same or other food products. The rework product is food grade product that may include a portion of the product that did not meet certain weight standards or was broken, for example. When the food product formulation that generates the rework contains a priority allergenic food as one of its ingredients, then a potentially serious hazard exists from the inappropriate use of such rework. In many cases, the

hazard will be serious because the potential dose of the allergen will be quite high if the rework is misused. The preventive control involves assuring that the rework does not end up contaminating any food product that is not supposed to contain that allergen. Many food manufacturers follow a policy of "exact into exact," which means that any rework must be re-incorporated back into the exact same formulation from which it was generated in the first place. Other food manufacturers use "like into like," which would allow, for example, peanut-containing rework to be incorporated into any peanut-containing food product made in the facility. Rework containers in a processing facility should be dedicated to certain allergenic foods and should be clearly labeled. A best practice is to maintain a careful accounting of the number of rework containers that are generated during a shift and match it to the number that are subsequently used. Rework containers can be reused for other food products only after thorough cleaning and validation.

An effective HARP-C allergen control plan must be developed for each manufacturing facility, and it must be focused on each processing line and formulation. Allergen control is unique because allergens are used as intentional ingredients in most food manufacturing facilities, which makes it critical that robust allergen control programs are developed and proper training and communication is implemented across all areas of the business. Hazard analysis allows the identification of potential allergenic hazards in each facility, processing line, and product formulation. Hazard analysis also addresses the likelihood and magnitude of the allergen hazard. Preventive controls are then focused on addressing those hazards by eliminating cross contact opportunities, developing effective allergen cleaning protocols, and avoiding packaging and labeling errors.

Many more details are available in the recently released FDA Draft Guidance for Industry on Hazard Analysis and Risk-Based Preventive Controls for Human Foods, which is available at fda.gov/media. ■

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Aquaculture Food Safety

Modern food safety and sustainability efforts in an ancient practice

BY JESSE B. STANIFORTH

Even prior to President Trump's 2020 executive order expanding offshore fish farming in the U.S., aquaculture was being touted as the future of sustainable fishing. As global fish stocks continue to shrink due to overfishing, fish and shellfish farming seems like an obvious move. It's a far more efficient way to raise meat for protein than farming chickens, pigs, and cows, which currently occupy more than 37% of the earth's habitable land. Done right, aquaculture can help maintain healthy waterways and boost jobs and economies in the areas that serve aquacultural regions.

The history of aquaculture stretches back thousands of years. In North America, indigenous people of the Pacific Northwest region historically farmed herring eggs, octopus, clams, and salmon, while indigenous Hawaiians developed freshwater and intertidal fish ponds. Chinese fish farmers domesticated carp around 3500 BCE. Yet, if aquaculture is the past and the future, it's also the present: Currently, half of the world's fish and seafood is raised through aquaculture and, according to a 2023 whitepaper from the World Economic Forum, the global demand for those foods is expected to double by 2050.

Following President Trump's executive order and a bipartisan bill supporting offshore fish farming in the House of Representatives, many American companies have been willing to bet on, and invest in, fish farming. In 2017, 90% of the seafood eaten by Americans came from other countries, and many feel it's time for American consumers to eat fish and seafood produced and farmed here. Following the 2020 executive order, the Army Corps of Engineers issued permits for aquaculture structures in federal waters.

While the field of fish and seafood farming may be ancient, food safety experts agree that it must be held to exacting modern standards and regulation.

Aquaculture Systems

There are dozens of different approaches to aquaculture. For many, "fish farming" calls to mind offshore net pens—net-cages floating in open water—however, this is only one type of aquacultural technology.

Rome, Italy-based Matthias Halwart, PhD, is the sustainable aquaculture team

There are only a few drugs approved for use in food fish. Strict protocols for their use are in place to ensure they do not impact the safety of the fish as food. Seafood processors must address this potential hazard in their food safety plans and assure that, if aquaculture drugs are used, they are used in accordance with current requirements and best practices.

—MICHAEL CIARAMELLA, PHD

leader for the Food and Agriculture Organization of the United Nations. He says that, given the wide variety of aquaculture possibilities, the choice of system and approach must be decided according to, among other things, the species being grown, the local environment, and the investment available to farmers. "Finfish can be grown in floating cages [net pens] in freshwater lakes and rivers, brackish estuaries, or in marine coastal or offshore areas," he says. "Mussels are grown attached to long ropes in the sea connected to floating buoys. Seaweed is also grown on long lines. Pond culture is the most widely practiced method of aquaculture, and ranges from low-intensity green water ponds with low stocking density, using fertilizer to encourage algae and plankton to grow as feed for fish, to highly intensive with formulated feed and aeration using paddle wheels or air blowers."

Additionally, there are more technical set-ups known as recirculating aquaculture systems (RAS). "With these highly technical systems," Dr. Halwart says, "the operators are able to manage the water temperature, water quality, and filtration, and control the chemical properties of the water through monitoring. [They] can achieve very intensive levels of production. A version of RAS can be connected to hydroponic vegetable production, called aquaponics, in which the waste water from the fish can serve as fertilizer for the plants, while, at the same time, the plants filter the water for the fish." Dr. Halwart adds that each of these farming systems has benefits and disadvantages, and that a good system matches the needs of the farmer and the realities of the local conditions.

Approaches to aquaculture, Dr. Halwart says, break down into water-based systems (such as cages and pens), land-based systems (such as rain-fed ponds, irrigated systems, tanks, and raceways), recycling systems (designed to recirculate water in large, closed vessels), and integrated farming systems that pair aquaculture with livestock or crop farming. Different seafood and fish require different aquaculture approaches. Fish are raised in ponds, molluscs are grown in a variety of styles both on and off the seafloor, crustaceans are raised in ponds and concrete raceways, and seaweeds and minor invertebrates are farmed across a variety of systems.

Aquaculture expert Carole Engle, PhD, former executive editor of the *Journal of the World Aquaculture Society* and adjunct faculty at Virginia Tech's Virginia Agricultural Research and Extension Centers in Hampton, Va., says that in the United States, aquaculture styles are determined by the popularity of the fish that's cultivated. "Aquaculture is incredibly diverse and every aquatic animal or plant has to be raised in a different way because the biology is so different," she adds (see "Top 5 Most-Frequently Farmed and Fished Seafood in the U.S.," p. 23).

Aquaculture and Food Safety

Michael Ciaramella, PhD, is Seafood Safety and Technology Specialist at the Sea Grant organization's Cornell Cooperative Extension in Stony Brook, NY. Due to the breadth of approaches to aquaculture, he finds it hard to generalize about food safety across the sector.

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He does note one potential hazard that separates aquaculture from wild fish: pharmaceuticals. “There are only a few drugs approved for use in food fish,” he says. “Strict protocols for their use are in place to ensure they do not impact the safety of the fish as food. Seafood processors must address this potential hazard in their food safety plans and assure that, if aquaculture drugs are used, they are used in accordance with current requirements and best practices.”



Beyond that, Dr. Ciaramella says that food safety concerns in aquaculture are similar to food safety challenges facing open-water fisheries. He adds that environmental contaminants (e.g., heavy metals, herbicides, and pesticides) and natural toxins (those produced by harmful algal blooms) can be an issue for both farmed and wild fish; however, he says that both contaminants and natural toxins can be controlled at the farm level by knowing the potential hazards associated with the various water bodies, and only growing food fish in water bodies with little to no known contamination, or sourcing waters suitable for aquaculture production in land-based systems.

But, this is more complicated than it may sound. Dr. Ciaramella specifies that contaminants pass into species through the things they eat, including fish meal composed of smaller bait fish. Consequently, he says, it’s integral that farmed fish receive high-quality feed that has been tested for contamination. The same wild bait fish used for fish meal are also consumed by wild-caught fish, meaning that contamination in bait fish threatens wild-caught and farmed fish.

One risk particular to fish-farming feeds, he says, is contamination by terrestrial ingredients. “If there are non-marine alternative proteins and plant-based components to the feeds, these could contribute additional contaminants and be a potential hazard unique to farmed species when pelleted feeds are used.”

American Aquaculture

The good news about American aquaculture, says Dr. Engle, is that its systems are set up to present fewer food safety challenges than in other parts of the world. While regulations vary from state to state, aquaculture is overseen by FDA—and, in the case of catfish, by USDA. Catfish is such a big business, Dr. Engle says, that the industry approached congress to request that their production facilities be overseen by USDA’s Food Safety and Inspection

Service, rather than just by FDA. This means that each catfish processing plant has an in-house inspector.

The same is not true of other aquacultures, though Dr. Engle stresses that because earthen ponds, raceways, and above-ground tanks work with captive water from well-tested groundwater aquifers they reuse for 10 to 15 years, food safety concerns associated with open-water farming are not present. In particular, fish raised in ponds and sold live face few of the food safety challenges associated with processed fish.

Additionally, adds Dr. Halwart, aquatic animals feeding low in the food chain, such as carp or tilapia, typically have fewer problems with accumulation of toxins. “Disease outbreak is usually associated with intensity of farming; the more intensively you produce, the more careful you have to be with health management,” he adds.

Shellfish food safety, however, is both easier to control in some ways, and harder in others. Bill Walton, PhD, is the Acuff Professor of Marine Science and Shellfish Aquaculture and program coordinator at William and Mary’s Virginia Institute of Marine Science in Gloucester Point. “You don’t feed [shellfish],” he says, “which also has the implication you don’t medicate them. You are relying on the food in that environment, which also means when you think about sustainability, I can’t grow more shellfish in an acre than that acre naturally supports.”

The bad news about shellfish is that, because they’re sometimes not cooked, any pathogen that gets into an oyster may be passed directly to the consumer. In many cases, shellfish producers have been able to mitigate those risks through close scrutiny of water. “The areas available to harvest have to be regularly sampled,” Dr. Walton says. “Typically they’re okay to harvest from unless something happens—something as simple as a certain number of inches of rainfall—then we close. We don’t wait for the lab; we don’t wait for somebody to go collect samples. You can just look at the rain gauge and say, preemptively, ‘We no longer meet the conditions to be open right now, so we’re going to close.’ The model has been that it’s easy to close, and the burden of proof is on reopening, and that’s worked pretty well.”

In that sense, Dr. Walton says that regulation has solved the challenge of pollution in shellfish. Unfortunately, bacterial contamination is not as easy. “If it were associated with pollution, we would’ve solved it,” he says. But it’s not; bacterial contamination simply occurs in the water, the same water people might enjoy playing in at the beach.

The Cold Chain

Dr. Walton says that the solution for shellfish food safety has been the cold chain, “Having a clear process where everybody along



Top 5 Most-Frequently Farmed Fish and Seafood in the U.S.

Carole Engle, PhD, adjunct faculty at Virginia Tech's Virginia Agricultural Research and Extension Centers in Hampton, Va., has named the country's top five most-frequently farmed fish and seafood species and describes the way they are managed.



Catfish: Earthen Farms

Catfish farming is the most common form of American aquaculture by far, Dr. Engle says, and is widespread across the U.S. South. Catfish are farmed in closed earthen ponds shored up by levees. “What people do not understand is there’s very little discharge to the environment,” she says. “So they pump up water [from wells or aquifers], and they’ll raise catfish for 10 to 15 years in those ponds before they have to drain the ponds to rework the levees or dikes that hold the water together.”

Shellfish: Off-Bottom Systems

After catfish, shellfish—namely, oysters and clams—are America’s second largest aquaculture harvest. Dr. Engle notes oyster farming has been happening in the U.S. since the late 19th century. “It started out with people planting them on the bottom and then harvesting them when the tide went out. That’s the traditional way, and there’s still quite a few oysters that are raised that way, but in more recent years, they’ve gone to off-bottom. To get oysters off the bottom, you have to put them in something, and so there’s all kinds of gear. There are cages and bags and they have to be suspended either floating on the surface, or on a line with multiple cages to take advantage of the depth of the water and raise more oysters there.” Clams, meanwhile, are all raised on the bottom, often with PVC devices and netting installed to protect young clams from predators.

Trout: Concrete Raceways

Trout are the third most widely produced fish grown in aquaculture, and they’re usually raised in raceways—pairs of narrow concrete rectangles with water flowing through them.

“Trout are cold water animals,” Dr. Engle says. “They do well in areas where there’s a good flow of water—typically mountainous areas, which is what they’re native to.” Raceways are big angular concrete beds and not very high. “They’re three, maybe four feet high, not wide, but they’re long, so the water flows down through it. A hundred years ago, a lot of raceways were dug out of the earth, but they mostly converted all of them to concrete,” she adds.

Tilapia: Earthen Ponds

Like catfish, tilapia, the fourth largest species produced by aquaculture in the U.S., is raised in open ponds. The only difference Dr. Engle notes is that, unlike trout and catfish, American tilapia are mostly sold to live markets in large cities that allow consumers to pick a live fish out of a tank, request a specific cut, and take home extremely fresh fish.

Sturgeon: Above-Ground Tanks

Finally, the fifth most-popular fish raised in U.S. aquaculture is sturgeon, though it’s mainly farmed for caviar. Sturgeon is raised in tanks, which, unlike earthen ponds, are smaller, above-ground enclosures. These are more expensive to operate, but allow farmers to see and monitor fish more easily, and harvest them with a minimum of effort. (Harvesting fish from earthen ponds can involve using a tractor to drag a massive net.)



Dr. Engle focuses on sturgeon production to illustrate another aspect of aquaculture, one that in California is fuelled by limits on water availability. While some farmers simply grow sturgeon in tanks, many fish farmers recycle water from one aquaculture system to others in order to cultivate various different fish at once. Recalling a particular sturgeon farmer, she says, “He puts his water through the sturgeon tanks first, and then it goes to ponds. The next fish in the ponds is large-mouth bass. The water goes through the bass ponds, and then he has catfish on his pond farm, and he has a hybrid carp that he sells in the live markets. That may be the last [species] in the water. But then he puts that water on other crops—almonds and alfalfa. That water is totally reused through a number of different crops, but he puts it through the sturgeon first.”—JS

the cold chain has to document this, there are tags that go from harvest all the way to the final consumer that demonstrate who has it, and there’s a time–temperature log that has to be kept. We’ve found if you harvest shellfish, and you get them cold right away, and you keep them cold, that dramatically limits the risks.”

Dr. Halwart agrees—and not just for shellfish, but for aquaculture products generally. He notes, “A strong cold chain—meaning the product is immediately chilled after harvest and

remains chilled until consumption—is key for many aquaculture products as well. Value addition activities, such as smoking, drying, curing, fermenting, or salting (and good practices associated with these processes) are also good options and traditionally used when cold chain is not available or doesn’t match the market and culinary traditions of the consumer.”

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Cream of the Crop

Fresh Del Monte Wins the 2023 *Food Quality & Safety* Award in the large company category

BY **LORI VALIGRA**

A Florida-based company in a very challenging food sector—fresh produce—has experienced strong improvements in food safety measures in recent years and has been named the winner of the 2023 *Food Quality & Safety* Award in the large company category.

Fresh Del Monte of Coral Gables, Fla., which employs 1,000 people in the United States and more than 40,000 globally, distinguished itself from other businesses with investments in instrumentation and training to assure food quality and safety. The company sells more than 100 fruit and vegetable products globally, mostly value-added fresh cut items, although it does sell whole products such as melons as well.

The award, presented annually by *Food Quality & Safety*, honors the dedication and achievement of an organization that makes significant contributions to upholding the highest food standards supported by quantifiable results. This year, our panel of judges, composed of food quality and safety experts, determined that Fresh Del Monte demonstrated a comprehensive food

safety and quality management program that included a corporate willingness to invest in advanced technology and improvements for food safety. Especially noteworthy were improvements in staff training and food safety measures, along with a focus on sustainability.

Fresh Del Monte is a separate company from canned foods company Del Monte Foods of Walnut Creek, Calif.



The Del Monte brand was established in 1892, but the fresh business separated from the canned business in 1989. Fresh Del Monte was acquired by the current management in 1996. Fresh Del Monte still uses the brand logo, which confuses people at times, says Takashi Nakamura, PhD, MBA, who is vice president of corporate R&D and food safety for the company. The other difference between the companies is that Fresh Del Monte is a publicly traded company, while Del Monte Foods is privately held.

Fresh Del Monte has made incredible efforts recently to elevate its food safety culture globally, Dr. Nakamura says. One aspect the company focused on is having food safety modules



COURTESY OF FRESH DEL MONTE

for different functions. Modules for finance, quality, and food safety that are pushed out globally in the company's Academy. The aim of the program, which is about three years old but is still being honed globally, is to offer training modules that take about 30 minutes to complete so that everyone in certain functions around the world has a good base from which to start. After workers complete a module, they take a quiz and get a certificate from the company if they pass. So far, approximately 300 team members have used the food safety modules.

The company has also looked at different technologies and digitization. It has partnered in a pilot project with food supply chain software company iFoodDS on digitizing its food safety and quality assessments that had been done on paper. Digitization allows Fresh Del Monte to capture, share, and improve quality metrics, Dr. Nakamura says. The company is conducting a slow rollout of the trial with iFoodDS in several of its facilities in North America and will continue to do that for the next few years.

Digitizing paper documents is a priority, but the company also needs to identify digital platforms and suppliers that can help to manage all of its digital documents. Those are two major focuses over the next two years, he adds.

A Shift Away from Chlorine

Fresh Del Monte has been shifting its washwater away from the industry's widely used chlorine sanitizer to peracetic acid, which has fewer disinfection byproducts. The company employs automated controls and management for the sanitizer and solution on its continuous processing lines.

Peracetic acid is a strong disinfectant with an oxidation potential higher than that of chlorine or chlorine dioxide. It also decomposes into biodegradable components and does not create chlorinated compounds or harmful disinfection byproducts. The benefits from using peracetic acid include better effective microbial kill, a long shelf life, and ease of retrofitting it into existing chlorine contact basins.

The shift to peracetic acid is also important to the company from an environmental sustainability standpoint, Dr. Nakamura says. The acid has been used effectively and safely in the poultry industry, and Fresh Del Monte has found it is more aggressive in keeping food safety on its produce lines. While chlorine is very effective, he says, peracetic acid is the next level up in cleaning and sanitizing.

The company also uses turbidity meters to analyze water turbidity while washing vegetables and fruits. Additionally, air samplers collect a known volume of air, making it easy to identify the number of airborne microorganisms and analyze them.

At its facilities in the Middle East and North Africa, the company implemented Allergen rapid test kits to comply with new customer requirements. The AllerSnap Swab rapid test procedure helps it to monitor and verify the cleaning and sanitation process for equipment, uniforms, and workers by ensuring no allergen contamination in the processing area.

At Del Monte Foods UAE, a new metal detector was acquired during the past year to replace an old machine. The new detector reduces the risk of metal contamination, preventing product recalls and reducing production processing time.



Employee processing fruit at Fresh Del Monte.

The company's Asia Pacific region has added robotic arms to perform recurring activities such as secondary packaging, helping to reduce the cost of labor, accelerate packing, and prevent product bruising.

New techniques and training are making a difference. Dr. Nakamura says that Fresh Del Monte has an excellent food safety record over the last four years. "I would say that would be the biggest indicator of our drive for operational excellence and food safety using foundational training," he adds.

Pest Control

The company takes a firm stance on pathogen control, starting in the field. Two years ago, the business instituted a stricter policy on sourcing of high-risk food items. The policy covers seven key food items: romaine and iceberg lettuce, spinach, cantaloupe, green onions, cilantro, parsley, and some low-acid foods. Sourcing those items may require additional screens through food safety documents and possibly visiting to evaluate growers to site audits by a third party.

The company looks for testing in the fields, including checking water sources, determining what the farmer tests, and evaluating the types of sanitizers they use. It strongly encourages drip lines, which Dr. Nakamura says are safer from a food safety standpoint but are also a great sustainability initiative.

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The company also looks at how fruit and vegetables are harvested and whether there are power lines, which could harbor birds, over the fields. “We do not want any harvestable land under power lines, where it can potentially be contaminated by birds or other similar creatures,” he adds. “It all starts with how you are protecting the plants, watering them, conducting environmental monitoring tests, and how often the harvest crew is trained on food safety.”

That includes basics such as having appropriate soap and water available to workers as well as protective gear and other appropriate clothing. The company also monitors knives and other cutting materials where fresh produce is harvested to assure they are sanitized. Different sanitation measures are used for cutting depending on whether it is done by equipment or by hand.

Fresh Del Monte also is also proactive in trying to mitigate the effects of climate change, such as flooding. It has developed internal standard operating procedures for its growers to follow in case of floods. At the same time, the company is looking to expand its supply base to source from other countries and regions. “The Earth is changing, and obviously we need to adapt and change our supply chain strategies,” Dr. Nakamura says. It’s not just weather patterns; political issues can also interfere with suppliers. The company needs to constantly adapt and apply a robust crisis management to its supply chain, he says. Every supplier needs to go through the company’s vendor-approval program. They need to supply a GFSI certificate or the Foreign Supplier Verification Programs questionnaire. They also need to supply additional food safety documents and data on allergens.

Updating Safety Plans

Fresh Del Monte reviews its food safety plans at least once a year. A committee in North America reviews all of the standard operating procedure documents, including harmonizing and standardizing them. North America has the highest number of

fresh cut operations, Dr. Nakamura says, so there are efforts to harmonize and standardize them. The plans are also reviewed for applicability of new research findings or new approaches such as for environmental monitoring or other tweaks. “Our food safety plans have been in place for many years, but they’re not static,” he adds.

The company has focused on ensuring 100% traceability from field to fork and is evaluating technologies to be able to complete traceback faster and more accurately. It said it is ahead of the enforcement date for FSMA 204 requirements in terms of vetting and verifying its suppliers and technology.

Fresh Del Monte also conducts audits at least once a year in its own facilities as well as those of its customers. All 32 facilities worldwide are inspected yearly by third-party auditors using Global Food Safety Standards. Its average score is 97.8%.

Pest issues vary depending on locations and activities. In the packing house, the biggest issue is birds, which are challenging because they can get through some of the netting. The company also uses spikes on ledges as well as music and loud noises. In other facilities, rats and mice are controlled by traps. There are weekly checks by outside companies, and the operations team also makes regular walkthroughs.

The company is also making significant investments in infrastructure that affects food safety, such as flooring and air conditioning. Dr. Nakamura says the company has invested heavily in this area.

Sustainability Efforts

Other than using more efficient wash chemicals with less waste, the company is looking to make its packaging and waste stream more sustainable. It donates a lot of products to charities and food banks, and some are used as animal feed. “We’re definitely trying to do more with waste streams than we do currently,” he says.

With all of the efforts in place to help ensure food safety at Fresh Del Monte, we’re impressed. ■

Valigra is a freelance writer based in Maine. Reach her at lvaligra@gmail.com.



Pet Perfection

Petsource by Scoular wins the 2023 *Food Quality & Safety* Award in the small company category

BY LORI VALIGRA

A small and relatively new Nebraska-based company that produces premium freeze-dried pet food with quality and safety measures approaching those of human foods has been named the winner of the 2023 *Food Quality & Safety* Award in the small company category.

Petsource by Scoular, of Seward, Nebraska, which employs 150 people—14 alone in food safety and quality—distinguished itself from other businesses through investments in high-pressure processing technology, a good environmental monitoring program, and excellent pathogen control.

The award, presented annually by *Food Quality & Safety*, honors the dedication and achievement of an organization that makes significant contributions to upholding the highest food standards supported by quantifiable results. This year, our panel of judges, composed of food quality and safety experts, determined that Petsource by Scoular demonstrated a comprehensive food safety and quality management program that included a corporate willingness to invest in advanced

technology and improvements for food safety. The company scored an impressive 100% on SQF audits in its first and second years of operation.

Since October 2020, Petsource by Scoular has been a contract manufacturer that produces freeze-dried dog and cat products. Created by created by Scoular, a commodity-based, supply-chain business that is more than 100 years old, it uses the largest food freeze dryers in the world. “Scoular was trading pet food ingredients for many years and understood the need for additional capacity in the freeze-dry space, so the company decided to invest in that business sector,” says Brent Turner, food safety and quality manager at Petsource by Scoular. The company has invested more than \$100 million in the Seward facility, including an expansion it is just completing that has tripled its capacity.

Turner says one advantage Petsource by Scoular offers its customers is that it has a primarily end-to-end solution. A pet food



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“Wall of Pets” located in the company headquarters.

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or treat can be made entirely in its factory, and not sent to multiple businesses or locations for the various processes, such as blending, shaping, freeze drying, and packaging. “It was one of our goals to have all of the processes under one roof so companies could have an end-to-end solution, which is rare in the market,” he says. “Any time that you have to transport the product or it goes from business to business, there’s a logistical challenge and a contamination risk factor.”

He says one of Petsource by Scoular’s goals is to have the highest standards of the industry, even for a new, smaller company. That means having control over more of the processes. High standards are also important to customers, he says.

Customers have three size options for products. One is a bulk tote of 400 to 500 pounds that they may use as an ingredient in their finished product. Freeze-dried product tends to be expensive, so it could be used as a mixer or topper with kibble and other pet foods or treats. There is another, smaller box for mix-ins, as well as retail-ready packages from five ounces to three pounds. “Overall, you get a premium, nutritious, and shelf-stable product that dogs love,” he says of the freeze-dried product.

The biggest benefit of freeze drying is that it makes the product shelf stable, saving on the cost of refrigeration or freezing, Turner says. Depending on the product the, shelf life ranges from one to two years. He says the freeze-drying process also is gentler on the ingredients and can prevent the nutritional loss that typically comes from cooking. “It’s raw, freeze-dried meat with the benefits of a raw diet without many of the risks,” Turner says.



Petsource by Scoular food safety and quality employees.

New Technologies

One technology the company has employed that attracted the attention of the *Food Quality & Safety* Award judges is high-pressure processing, a lethality step that employs ultra-high pressure to kill pathogens. Turner says one of its benefits is to kill bacteria without the nutritional loss that typically comes from cooking ingredients.

With raw products, the biggest concern is pathogen control, which is where the high-pressure processing comes in. “The ultimate goal of freeze drying is to have a minimally processed

It was one of our goals to have all of the processes under one roof so companies could have an end-to-end solution, which is rare in the market. Any time that you have to transport the product or it goes from business to business, there’s a contamination or a food safety risk.

—BRENT TURNER

product that’s still safe. High-pressure processing is really the answer,” he says.

Using the technology, the product is exposed to 87,000 psi from three to eight minutes. Turner says that is about six times the amount of pressure at the deepest part of the ocean’s deepest trench, the Mariana Trench in the western Pacific Ocean. The product, which is at that point in a flexible chub, is placed into large tanks where pressure is applied equally all around so the packaging does not tear or explode. The pressure, he says, is enough to kill harmful bacteria or pathogens that might make customers or pets sick.

After the high-pressure treatment, the company tests the product to make sure it is free of pathogens such as *Salmonella* and *Listeria monocytogenes*. Then the product is shaped into the shape and size the customer wants before it is freeze dried. After freeze drying, the product is tested again for pathogens. “It’s really important to always test at the end of the process; our lethality step is fairly early in the process, so we don’t want to contaminate our line with meat that is potentially pathogen positive,” he says. The company has equipment in its 180,000-square-foot factory and applies dedicated sanitation measures, but it’s hard to clean up a packaging line in such a large space, for example, if some meat turns out to contain pathogens. The extra testing the company does, Turner says, is to avoid having products that are potentially contaminated.

High-pressure processing is the only part of the production that is done off site, at a service provider called Universal Pure in Lincoln, Neb., Turner says. That is because the machines are large and intricate, he says. Petsource by Scoular started using high-pressure processing soon after it began production in October 2020.

The company also started using near-infrared (NIR) technology about one-and-a-half years ago to help determine the chemical parameters of a product. The four most important ones to the company are moisture, fat, protein, and fiber percentages. The NIR machine can test all of those parameters on its raw and freeze-dried products. That means, for example, that the company can ensure the chemical requirements of the product that are attached to a packaging noting the guaranteed analysis, such as 35% minimum protein or 25% minimum fat. The Association of American Feed Control Officials sets various chemical standards for pet foods. “One of the ways that we help ensure that the guar-

COURTESY OF PETSOURCE BY SCOLAR.

anted analysis on the packaging is accurate is by testing every single batch that we produce with the NIR machine,” Turner says.

Another key investment was in the company’s nitrogen tunnel, which was part of the \$75 million expansion project. The tunnel is for instant quick-freezing of formed products. One of the main critical quality points on the company’s food safety and quality plan is quickly freezing the product after shaping. Petsource by Scoular’s testing has shown that quickly freezing the product after shaping is important to avoid clumping and to ensure a more consistent freeze-drying cycle. The tunnel uses liquid nitrogen at approximately -300°F to quickly freeze raw, formed meat products. The cascading, tumbling environment inside of the tunnel can freeze formed products in fewer than three minutes, resulting in a final product temperature below -10°F. Speed and low temperature are key for the optimal operation of the downstream freeze-dry systems.



Employees inside the Petsource by Scoular facility.

Software for Quality Checks

The company started using Safefood 360° cloud-based software for food safety and quality checks in 2020. Turner says one of the advantages being a relatively new company is that it’s not burdened with the paper records that have been used by legacy businesses. It is difficult to find what is needed on paper records, which can be misplaced, he says. It’s also more difficult to track trends. “The Safefood 360° software is nice because it allows us to store all of our verifications and checks on a process digitally and allows for easy data analysis,” he says.

The software helps reduce multiple routes of food possible contamination because it requires fewer pens, paper, and staples in the factory. The company can also track a specific product in real-time. All data points recorded in the software can be exported into data analysis software, graphed, and presented for review to auditors, stakeholders, or third parties. The company has invested in significant amounts of training for its food safety and quality management team so that they understand how to interact with the software and customize it.

This investment has come back in time and energy savings and analyzable data. One example of a key performance indicator is that it can track the cleanliness per piece of equipment and per sanitation employee. This allows it to track sanitation processes with a high degree of accuracy and address any issues quickly be-

fore they become a larger issue, such as a specific employee who may struggle to get certain pieces of equipment properly sanitized on the first pass. “Having all of our checks cloud-based is one of the biggest advantages to a modern business,” Turner says. “It’s easier to organize data into meaningful information that we can act upon to troubleshoot problems quicker and ultimately react faster.”

The company also trains employees on processes that test for microbiological content at up to three points: post-high-pressure processing, post-freeze dry (when it is considered ready to eat), and post-packaging. Routine microbiological testing typically includes an aerobic plate count, *E. coli*, total coliform, *Staphylococcus aureus*, *Salmonella*, and *L. monocytogenes*. The company considers the aerobic plate, *E. coli*, total coliform, and *Staphylococcus aureus* to be quality indicators that could be indicative of a processing problem.

The post-freeze dry samples are typically collected by a freeze-dry operations team lead who is trained on aseptic technique by members of the company’s food safety and quality leadership team. The lead is expected to understand the fundamentals of microbiological contaminants, glove control and aseptic sampling technique.

All Petsource by Scoular employees are required to complete food safety and quality training during orientation. They also take monthly refreshers on its Alchemy learning management software.

High Marks on Audits

The company also received high marks from the *Food Quality & Safety* judges for its track record with SQF certification audits. In its first year and second years of production, the company received a perfect score of 100/100. In its third year, it received a score of 97/100, all of which are the highest “excellent” rating.

Turner says the company’s focus on and reputation for quality has allowed it to triple its capacity in only three years. As of October 2023, it was finalizing its expansion project, having added additional freeze dryers, overhauled its raw processing line, and installed an additional forming line.

The company also recently qualified with FDA as a human food facility, Turner says. While it doesn’t intend to make human food for human consumption, the company is aiming to make human-grade pet food. “What that basically means is that human-edible ingredients are only utilized to create the product and the product is stored and processed with the same stringent requirements as human food to ensure the product is at that level,” he says. “It’s just an example of the higher level of quality and food safety that we hold here.”

We couldn’t agree more. ■

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Safety & Sanitation

A 360-Degree Approach to Pre-Harvest *Salmonella* Reduction

Five ways to mitigate *Salmonella* in poultry, before it reaches the processing plant

BY BILL POTTER, PHD



Despite extensive efforts by the poultry industry, the CDC still attributes a large portion of the roughly 1.35 million annual foodborne *Salmonella* illnesses in humans to chickens, turkeys, and eggs (*Emerg Infect Dis.* 2011;17:7-15).

In 2021, to help combat these outbreaks, USDA's Food Safety Inspection Service (FSIS) launched an effort to reduce *Salmonella* illnesses related to poultry, and began to redesign its approach with a proposed three-component initiative, which includes:

1. Testing incoming flocks for *Salmonella*;
2. Enhancing establishment process controls; and
3. Implementing enforceable final product standards.

While components two and three focus on processing plants and final products, the first component focuses directly on the pre-harvest stage. So the question is, what are some practical approaches that can be taken pre-harvest to support this component?

This is where poultry producers, live operations, veterinarians, and quality assurance leaders can play crucial roles. An effective preharvest *Salmonella* reduction program can be described as the “360-degree approach.”

A holistic approach to preventing *Salmonella* pre-harvest can be divided into five major components:

1. *Salmonella* vaccines to build *Salmonella* immunity and offer protection throughout the life cycle, including in the progeny.
2. Intestinal integrity programs to support bird immunity and reduce opportunities for *Salmonella* to colonize.
3. Nutritional supplements to help mitigate *Salmonella* colonization that may also improve bird performance.
4. Pest management programs to reduce external *Salmonella* vectors.
5. Farm best management practices to reduce *Salmonella* proliferation through various means, such as cleaner water, improved bedding material, and cleaning practices.

Let's take a deeper look into each of these components.

1. *Salmonella* Vaccine Programs

A vaccination program in breeders and/or meat birds is the first step in building bird immunity and helping to prevent *Salmonella* colonization. When *Salmonella* is an issue at the plant, it all starts with colonization of the pathogen within birds at the farm. Vaccines are strategically used early in the process to address the “root cause” of the problem. Comprehensive *Salmonella* vaccination programs in breeders and meat birds, when consistently applied over time, have been successfully used in broilers and turkeys (*Appl Environ*

Microbiol. 2010;76:7820-7825; *BMC Res Notes.* 2018;11:431). When *Salmonella* vaccines decrease pathogen loads coming into the plant, in-plant interventions have a lower burden of decreasing quantitative loads and have an improved likelihood of effectiveness.

2. Intestinal Integrity Products

Producers must consistently optimize products that promote intestinal integrity by reducing coccidiosis, necrotic enteritis, and other areas of damage to intestinal strength. The intestinal wall acts as a physical barrier, preventing the colonization of harmful bacteria or otherwise harmful pathogens that could lead to food safety concerns down the line. An effective intestinal integrity program includes careful planning when using various compounds and management strategies.

3. Feed Nutritional Supplements

The advancement of functional feed ingredients in recent years has been a valuable benefit to decreasing pathogens at the farm. These feed ingredients include a variety of different modes of action to reduce *Salmonella*, such as prebiotics, probiotics, competitive exclusion products, acidifiers, gut oxygen modulators, pathogen agglutination compounds, and numerous other roles. One of the most important functions some of these nutritional health products pro-

vide is improving the intestinal wall physiology, which can lead to reduced pathogen colonization, but also can improve nutrient absorption, leading to improved bird growth performance.

4. Insecticide and Rodent Control Programs

The control of insects and rodents is often perceived as a way to manage the wellbeing and performance potential of a poultry flock, but this should also be considered a crucial strategy for reducing *Salmonella* proliferation at the farm. Common pests, such as darkling beetles, mites, flies and rodents, can carry *Salmonella* and other pathogens into poultry barns. An effective integrated pest management (IPM) program can address infestations, create a cleaner environment for the birds, and reduce the potential for *Salmonella* to enter further operations.

5. Farm Management

Other pre-harvest strategies are also important to reduce *Salmonella* proliferation pre-harvest, such as optimal water cleanliness, hygiene and disinfection of the poultry house per a written plan,

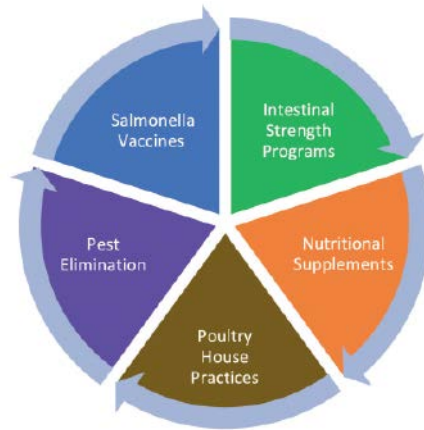


Figure 1. Pre-Harvest *Salmonella* Reduction 360-Degree Approach

litter management, and biosecurity measures. A comprehensive program tailored to control and manage disease will not only help the flock achieve its full potential, but will also help minimize food safety risks originating from the farm.

Validation of Pre-Harvest *Salmonella* Reduction

To validate pre-harvest food safety programs, many companies have increased their emphasis of on-farm food safety through periodic on-farm visual check-

lists and reviews of best management practices that impact pathogens. Additionally, companies may choose to implement an internal testing program for *Salmonella* loads, either at the farm and/or at the time of delivery to the plant, to understand the degree of improvement being made by each poultry farm, from flock to flock.

Salmonella quantification at pre-harvest has gained momentum in recent years due to the advancements and ease of rapid lab technologies, such as quantitative polymerase chain reaction (qPCR). While Component 1 sampling would not be easy, some degree of testing prior to birds being processed can provide valuable insight as to actions that need to be taken at specific farms. Establishing internal microbial baselines helps to identify any “outlier” farms that need special attention.

Ultimately, by reducing *Salmonella* loads in live-bird operations, poultry producers can decrease the likelihood that *Salmonella* will be a problem at the processing plant and beyond. ■

Dr. Potter is Food Safety Technical Advisor at Elanco Animal Health and has spent three decades working in poultry food safety, quality, and pathogen intervention technologies. Reach him at email billpotter@elancoah.com.

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Quality



Cultivating Change

How regenerative agriculture is reshaping the landscape of sustainable food production

BY ANDREA TOLU

Regenerative agriculture has been gaining interest as an approach that can reverse the effects of intensive farming on the climate. A universally accepted definition, however, is still lacking; as the Food and Land Use Coalition (FOLU) wrote in a 2023 report, the term is often confused with (and overlaps) with others such as “organic agriculture,” “agroecology,” or “conservative agriculture.”

What the term “regenerative” indicates is, in fact, its goal: to restore the soil’s structure and organic matter—which includes plant and animal residues and living microorganisms—through a few key farming practices. One of them is to minimize tillage or to eliminate it completely. As Forbes Walker, PhD, professor of biosystems engineering and soil science at the University of Tennessee in Knoxville, says, “When you plow, you aerate the soil, stimulate the soil microbes to break down organic matter, and release a lot of CO₂. And because soil structure has been destroyed, rain can’t percolate, increasing the risk of soil erosion and further soil degradation.”

Another key practice is rotating between different crops throughout farming season or growing two or more crops

simultaneously in the same field. “When you look at nature, you won’t see any monoculture,” says Timothy LaSalle, PhD, co-founder of the Center for Regenerative Agriculture and Resilient Systems at California State University, Chico. “There’s no single type of tree in a forest or one single type of grass in a prairie, but all kinds of plants.”

Other regenerative practices aim to protect the soil from water and wind erosion, either by leaving residues of the main crop on the field after harvesting, or by planting a different crop during farming season breaks, to create a permanent living root system.

Restoring Soil Life and Yield

When applied correctly, a regenerative approach can increase photosynthesis, remove carbon from the atmosphere, and create a more diverse community of living organisms. “The soil is full of life,” says Dr. Walker. “Anything we can do to encourage that life will increase organic matter, improving its chemistry and biology.”

In turn, feeding soil’s life makes more nutrients available to plants, increasing yield even without fertilizers. “A soil scientist might look at a soil and say that it’s

short on phosphorus so it needs fertilizer, or the plant will be weak,” says Dr. LaSalle. “That’s true in a chemical system. But in a biological system, some of the microorganisms will demineralize the phosphorus that’s bound up and release it to the plant.”

The positive effect on yield makes regenerative agriculture a viable solution to food shortages in countries where a demographic boom is expected in the next 30 years. “There are fields in Africa so depleted that even with fertilizers you’ll get almost no response,” says Dr. LaSalle. “You must have carbon in that soil through regeneration. That’s a primary fertilizer nobody talks about, which you can get for a very low cost. Can it necessarily match a heavily fertilized system? Not always, but food security isn’t about producing more corn in the United States. That doesn’t feed Africans. It’s the small local farmers who do. And if you can get a five-time yield increase without depending on fertilizers, everybody’s eating on this planet.”

A Paradigm Shift

The right regenerative practices to use, however, greatly depend on the context. What works extremely well in one field might be less effective—or even counterproductive—in another. “With regenerative agriculture, one size does not fit all,” says Dr. Walker. “A vineyard in Spain is not going to be the same as a soybean field in Tennessee, or a sugar beet field in Minnesota.”

That, in part, is the reason why actors in the regenerative space—farmers, researchers, policymakers—have yet to agree on a definition. For Dr. LaSalle, the first step to finding common ground is to change mentality: “Regenerative agriculture is a paradigm shift from feeding the plant to feeding the soil, which needs to be disturbed as little as possible. Those who don’t understand that and stick to their old mindset are going to hit a brick wall.”

(Continued on p. 38)



COURTESY OF B. SPERLING

Water Quality in Food Facilities

The quality of your plant's water is a key component in enhancing its performance, safety, and sustainability

BY BARRY SPERLING AND MIKE BURKE

In an era defined by the growing urgency of environmental concerns, one resource stands as a profound global challenge: water. As one of the planet's most precious and scarce natural resources, water ranks as a top environmental, social, and governance (ESG) concern. While various industries worldwide grapple with the challenges of resource scarcity and environmental degradation, the food and beverage processing sectors require substantial water consumption for their everyday operations.

The Hidden Costs of Water Consumption

Whether used as an ingredient, an essential component of food preparation and production, or a tool for upholding workplace hygiene, the quantum of water consumed by a processor's operations can quickly add up. According to Food Northwest, poultry processing can utilize anywhere from 3.5 to 7.0 gallons of water for each four-pound bird. For tasks like carcass washing and cleanup, beef processing can require a range of 350 to 550 gallons per animal. Mean-

while, contingent on their respective efficiencies, breweries can use between seven and 10 gallons of water to craft a single gallon of beer, and cold soft drink plants generally require between 1.3 and three gallons of water per gallon of packed soft drink.

The intricacies of the water-energy nexus further compound the cost of water. When water needs to be heated—for activities such as cooking, pasteurization, or cleaning—energy is expended to raise its temperature. This correlation holds true for various processes in the food and beverage industry, such as heating, cooling, pumping, mixing, and more. In essence, the greater the volume of water involved, the higher the concurrent energy consumption will be.

Amidst these complex dynamics, the consequences of substantial water consumption extend not only to food and beverage processors, but also to the environment. As ESG concerns rise to the forefront of many corporate agendas, food and beverage processors find themselves under growing pressures to align their operations with sustainable practices to manage water responsibly.

Safeguarding Operational Efficiency, Food Safety, and Hygiene

As the industry looks for ways to reduce water consumption, the quality of water used in food and beverage processing also has a significant impact on a facility's long-term success. From the perspective of operational efficiency, pristine water quality ensures that equipment remains free of excessive scaling and fouling, which not only helps to extend the lifespan of machinery, but also reduces the need for frequent maintenance. In turn, this can lead to improved process efficiency and minimized downtime.

Additionally, water used for processes such as heating and cooling is more effective when it's free from impurities or those impurities are managed properly. Clean water heats and cools more quickly and requires less energy to reach the desired temperature, leading to energy savings and more streamlined processing. According to the Bureau of Standards, steam boiler systems with only 1/16" scale formation can result in 11% efficiency losses, while cooling systems with biological film as thick as a piece of scotch tape are four times more insulative than mineral scaling and can reduce heat transfer efficiency by 7% to 10%.

Even more critical than operational efficiency is the importance of water quality in upholding the strict standards of food safety. Because water serves as an essential component for cleaning and sanitizing, it's critical to keep this water free from harmful microorganisms. Contaminated water can introduce pathogens into the processing environment, leading to compromised products and the potential for an outbreak of foodborne illnesses—a grave scenario that no processor can afford to overlook. Furthermore, a clean processing environment, supported by high-quality water, contributes to a safer workplace for employees.

Enhancing and Understanding Your Current System

Despite the inevitable need for many water-intensive processes in the food

(Continued on p. 38)

Manufacturing & Distribution



A multi-lane, multi-aperture configuration can help food processors save line space and reduce waste.

Make Way for “Multi-Everything”

Incorporate “multi-solution” equipment into your metal detection and checkweighing lines to improve quality and safety

BY ERIC GARR

Snack, bakery, and food-to-go manufacturers are feeling the squeeze from every direction. Stricter processing regulations, faster production loads, escalating operating and ingredient costs, combined with the rise of factory real estate prices, have left many food manufacturers seeking machines with higher throughput, and a smaller footprint.

Let’s explore a food safety specialist’s approach to “multi-solutions,” and shed some light on the pros and pitfalls of implementing these strategies into metal detection and checkweighing lines at your food processing facility.

The hazard analysis and critical control points (HACCP) approach states that critical control points (CCPs) are the

areas on your production line in which hazards can be prevented, eliminated, or reduced to acceptable levels. The first step in this approach is to identify your main contamination hazards. For most manufacturers, this will be metal—predominantly stainless steel. Metal is commonly used throughout a production line and in processing and packing environments. Tiny pieces may shred off cutting blades or grinders, faulty packaging machinery might discharge small shards into products, or metal fragments can even be unintentionally introduced farther upstream during harvesting.

During risk assessment, factor in the cost of the product at each checkpoint needs to be factored in. For instance, if the only inspection point is located at the

end of a production line, any contamination will be caught at the most expensive phase of the production process.

Ideally, you want to catch the metal contaminant in its largest form and before it has been processed and packaged, where it could potentially break into many smaller fragments and cause many contaminated finished packages. This results in higher quantities of finished product going to waste, and an increased risk of very small, undetectable contaminants reaching the consumer. The most advisable CCPs in the majority of food production environments are prior to processing, checking incoming raw materials, with an additional inspection system as close as possible to the end of the production line, after primary packaging.

Multi-Frequency Metrics

If a risk analysis determines that metal is your highest contamination risk, the installation of a metal detection system is crucial. So, which one is best? Start by determining the optimum detection frequency for the product application being inspected.

There are generally three metal detection frequency options: fixed frequency, multi-frequency, and simultaneous multi-frequency.

With a single fixed-frequency device, the operating frequency is picked to suit the individual product. These fixed frequency devices are ideal when inspecting the same product day in and day out, for example, sliced white bread or a chocolate bar. However, with challenging conductive products such as meat or cheese, or a larger product, the frequency must be set low to overcome the product effect. This makes the system less sensitive to the detection of some metals, especially stainless steel.

Conversely, multi-frequency metal detectors perform well on a range of products passing down the production line, as the machine will dial into a pre-defined selection of frequencies. However, not all

COURTESY OF ERIC GARR

multi-frequency systems are designed equally. Some utilize untuned coils where higher power switching devices are used. This can cause an increase in noise and background signal, which can limit sensitivity in high-performance dry product applications. Machine operators on the production line may have to select the frequency from a menu, raising concerns about the basis of their decision making. Although automatic product learning is not guaranteed to select the right frequency, it does substantially reduce the possibility of human error.

Simultaneous multi-frequency delivers a far higher and more sensitive performance on challenging wet product applications that vary in size and conductivity (e.g., meat cuts, fish, cheese wedges, or prepared chilled and frozen meals). Compared with the traditional approach of tuning into specific frequencies, simultaneous multi-frequency has been engineered to overcome product effect and metal detection performance by combining the signal from each channel.

Masters of Multi-Processes

For snack and food-to-go producers especially, high-speed packing and weigh and fill systems are essential in generating more products to meet consumer demands. Although throughput determines the cost of production, it's not purely about speed; packing and processing lines must also accommodate multiple products in a growing assortment of sizes, packaging, private label, and branded products. This is where flexibility really excels.

Multi-lane metal detectors, checkweighers, and combination systems can cater to these fast product changeovers and support expansion without having to increase physical footprints or employ more people to oversee production.

Commercial real estate in North America has doubled in value in three years, so every inch of floor and vertical space carries economic worth. Often, the under-utilization of vertical and horizontal space that could be making money can be attributed to piecemeal rather than considered machinery investments. Even small changes such as switching out bulky equipment for a combination machine or multi-lane metal detector can quickly add value.

Multi-lane metal detectors, checkweighers, and combination systems can cater to these fast product changeovers and support expansion without having to increase physical footprints or employ more people to oversee production.



Smarter deployment of digital logging and reporting tools can link machinery together.

Singling out and rejecting products from just one conveyor also significantly reduces the volume of good product being wasted. Additionally, if one lane requires unplanned downtime or maintenance, the remaining lanes can continue to run. Different products can also be run side by side, increasing flexibility for production plants that have multiple SKUs and different product flavors and size variants to inspect.

Data Merger

Food processors are surrounded by immense amounts of data. Keeping track of every metal detection event, such as rejects, performance verification results, and parameter changes, can be especially challenging for production managers.

The processes used for extracting and managing data are becoming more streamlined. With the integration of equipment commonplace in production environments—for example, with baggers, gravity hoppers, and checkweighers—it is now feasible to have a single screen setup. Connecting machinery makes it much easier to gather and consolidate data into a comprehensive performance overview that can help to speed up changeovers.

Generally speaking, it's more straightforward to integrate a metal detector with existing weighers, baggers, and factory management systems, particularly the electronics. Some software integrations can be more seamless than others, depending on the complexity of the interface technology.

Making Multi-Everything Work Smarter

Where there might appear to be a need for multiple machines to cope with the increase in upstream output, I recommend closely examining the options. Ask multiple questions. For example, could a multi-lane system offer a better return on investment in a smaller footprint? Is it possible to channel multiple product lanes through a larger aperture? What sort of reject system is required?

Examine how modular your inspection systems are: Do they provide integration flexibility? Can you extract data and merge this information into a common reporting template? Can you upgrade to newer software?

It's always important to challenge the status quo. We have reached an era in manufacturing where no processor should ever need to compromise on any performance criteria, including total cost of ownership, space, and inspection performance.

When it comes to innovation, food processors are usually quick to adapt, particularly when it comes to business models and systems that boost their governance credentials and lower operating costs. The shifts we witnessed during the pandemic are testament to this. Managed well, multi-functional technology can boost operational effectiveness and elevate your food manufacturing business. ■

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The Revolutionary Potential of AI in the Food Industry

The technology could transform the way food manufacturers work, but they'll need to trust it first

BY NEIL COOLE

In a world where the demand for food is projected by the United Nations to rise by 60% by 2050, addressing food security and minimizing environmental impact are paramount global challenge. In this context, artificial intelligence (AI) is starting to emerge in the food and beverage industry, with companies like Walmart using it to manage stock, opening up the possibility of safer, healthier, and more sustainable practices.

A recent global study by BSI, the Trust in AI Poll, found that 42% of respondents said they believe the application of technology can help mitigate the environmental impact of agriculture and food production. But with a confidence gap, building trust is an essential ingredient in the recipe for realizing the benefits of AI.

AI Concerns

Advances in technology have historically played a pivotal role in enhanc-

ing food production. From the plow to refrigeration, innovation has consistently improved the quantity and quality of our food. Today, organizations such as the World Economic Forum (WEF) are actively exploring how AI can contribute to a safer, more secure global food system.

Despite its potential, AI's integration into the food industry remains relatively low. The poll found that only 25% of professionals in retail, food, and leisure report daily AI use in their jobs, which is among the lowest numbers of any sector.

Moreover, general concerns about AI replacing human roles and questions about regulatory oversight persist, with a recent Gallup poll showing that 22% of workers in the U.S. worry about AI making their jobs obsolete, and three-fifths of the Trust in AI Poll respondents (61%) stating that they felt international guidelines to enable the safe use of AI were essential; however, in the same poll, 73% of food industry workers expressed

a willingness to trust AI with their tasks if they received appropriate training.

Amid this confidence gap in the food industry around the integration of AI into their work flows, there is a clear opportunity for industry players who use AI to demonstrate the benefits the technology can bring and to build greater trust in its application.

The AI Era Is Already Here

As the technology spreads, and assuming consumer trust in AI builds, it could help to solve some of the food and beverage industry's biggest challenges. According to the World Health Organization, hundreds of millions fall ill every year due to contaminated food, making it one of the most prominent issues the industry faces.

But AI can comb through data keeping pace with production increases, bringing up the possibility that the technology could significantly reduce the incidence of foodborne illness by eliminating human errors during food production. Others are exploring how AI could expedite the detection of foodborne pathogens such as *Salmonella*, *E. coli*, and *Listeria*, according to a report recently published in the *Annual Review of Food Science and Technology* (2023;14:517-538), leading to quicker and more accurate responses with clear benefits for human health.

The potential benefits of AI could also extend to combatting food fraud, which costs the global food sector billions annually, by replacing opportunities for human error with algorithms capable of detecting anomalies. However, 28% of people say they would not have the same degree of confidence in AI as they would with people in place to detect contamination issues in the food supply—a trust deficit that grows in the U.S. to 34%, the highest of any of the nine nations polled.

A lack of trust risks hampering the industry's ability to capitalize on the potential of AI. Educating employees and consumers about the technology's benefits could help build confidence.

Several organizations are leveraging AI to help their businesses and customers. For example, one start-up,

provides retailers with a tool that practices dynamic pricing to save consumers money as a product gets closer to its expiration date, something that one in two (49%) respondents to the Trust in AI Poll said they wanted AI to be used for. Similarly, Walmart uses AI to keep track of items on shelves; data is captured from inventory scan towers attached to the automated floor scrubbers that are already traveling around the stores regularly. The inventory towers take thousands of photos, which are then analyzed by AI to determine which products need to be replenished for a more efficient shopping experience.

Another driving factor behind AI innovation in food production is sustainability, with 46% of people supporting the use of AI to make the food system more sustainable and health conscious. Agriculture consumes more water than any other industry according to a report from UNESCO on world water development; by using AI, farmers could

Amid this confidence gap in the food industry around the integration of AI into work flows, there is a clear opportunity for industry players who use AI to demonstrate the benefits the technology can bring and to build greater trust in its application.

maximize land use efficiency, reduce emissions and produce more food while conserving resources.

AI's data-gathering capabilities also offer the potential to cater to consumer demand for transparency in nutritional content, ingredient provenance and food production methods.

Looking to the Future

The use of AI in the food industry, as with any sector, does raise vital questions about governance and ethics at all levels of the supply chain. Trust is paramount to navigating this consumer confidence gap; 75% of Trust in AI Poll respondents believe that increasing trust in the technology is the key ingredient for accepting AI in food manufacturing.

By harnessing AI's potential while keeping human values at the core of innovation, we can build greater trust in the technology's capacity to enhance our food systems, reduce risks, and promote health. Ongoing innovation in the industry also holds the potential to align with sustainability goals and boost consumer confidence in the origins and production of food. These outcomes can reinforce trust in AI and, ultimately, help accelerate progress toward a more sustainable world. ■

Coole is director, food and retail supply chain, BSI.

Aquaculture Food Safety *(Continued from p. 23)*

Sustainability

The sustainability of aquaculture—particularly when compared with meat animals raised on land—is a feature fish-farming advocates often highlight. NOAA lists a number of benefits associated with aquaculture—specifically, marine aquaculture operations typically have smaller carbon footprints and require less land and fresh water. Further, they tend to be more effective at converting feed into protein for human consumption than beef, pork, and poultry.

Yet, in 2020, the journal *Global Environmental Change* published a report from a team of researchers from universities in Norway, Australia, and Chile that targeted aquaculture certification schemes (doi: 10.1016/j.gloenvcha.2019.102025). Their research found that the leading challenge to aquaculture sustainability was the certification under which aquaculture was defined as “sustainable.” In general, the researchers found that aquaculture sustainability certification systems tended to reflect mainly “environmental and governance indicators, and only display scattered attempts at addressing cultural and economic issues. [...] The strong bias

implies that these certification schemes predominantly focus on the environmental domain and do not address sustainability as a whole, nor do they complement each other. Sustainability is by definition and by necessity a comprehensive concept, but if the cultural and economic issues are to be addressed in aquaculture, the scope of certification schemes must be expanded.”

Dr. Ciarabella agrees that a truly sustainable operation must be environmentally, socially, and economically sustainable. “Most tend to focus on the environmental aspects of sustainability and neglect the social and economic components,” he says. He also stresses that a closer sustainability challenge to the fish farm itself is sourcing protein for farmed fish. “The main protein source for farmed carnivorous fish has historically been fish meal, which relies heavily on the wild capture of small species of fish to produce fish meal and, ultimately, pelleted feeds. There have been many advances in alternative protein technologies moving toward more sustainable feed production. This includes the use of plant- and insect-based proteins.”

Aquaculture is incredibly diverse, and every aquatic animal or plant has to be raised in a different way because the biology is so different.

—CAROLE ENGLE, PHD

These advances have been paired with new production technology systems such as water filtration tools and an aquaculture technique called integrated multitrophic systems, which Dr. Ciarabella says rely on growing multiple species of different trophic levels together to feed off of one another and limit the overall impact on the surrounding ecosystem.

While aquaculture is not completely without food safety concerns, the method offers a valuable source of seafood and supports global food security. ■

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Regenerative Agriculture *(Continued from p. 32)*

Growing Pains

Regenerative agriculture is making its way into governments' sustainability agendas. USDA is investing \$1 billion to help farmers transition to sustainable practices, while the EU is working on a soil monitoring law; however, we're still far from having a recognized set of standards and certifications like with organic farming.

The commitment of food companies to improving biodiversity and soil health is indeed growing. Two main drivers are the need to meet global sustainability targets and to respond to consumers' concern regarding the sustainability of food products. "Another important but less talked about reason is the need to build climate resilience through biodiversity," says Max Boucher, senior manager for research and engagements, biodiversity at FAIRR, an investor network that focuses on ESG risks and opportunities in the food sector. "By making your supply chain resilient to events such as drought or flood, you lessen your risk of having a shortage of certain ingredients."

Getting started with regenerative agriculture often puts organizations on a

learning curve. "A lot of the pitfalls have to do with forgetting that it's a means to an end and not the destination itself. Before jumping on the bandwagon, you need to be clear about the outcomes. Similarly, some companies seem to approach pilot projects as the goal, rather than a springboard," says Boucher.

Once companies are past these initial, the challenge is "to deploy regenerative agriculture at scale across global operations and commodities," says Boucher. "One issue is traceability: If you don't really know who's farming your grains, you can't give them the means and the support they need to be more regenerative. Other challenges are figuring out the right metrics and what to trace, in order to build credibility with stakeholders."

Here to Stay

Growing pains apart, Boucher believes that regenerative agriculture won't be another passing fad: "In the grassroots regenerative space there's a concern that companies are just jumping on the newest trend and—as has happened before—they will eventually forget about

it," he says. "The reason why this may not happen again is that there are a lot of new regulations and reporting frameworks coming out, where biodiversity plays a big role."

Boucher mentions two examples: the Kunming-Montreal Global Biodiversity Framework, signed by 196 countries, that aims to reverse nature loss by 2030 and sets national targets with a mechanism for achieving them, and the IFRS S1 and S2, a set of requirements for disclosing climate-related risks and opportunities to investors, which has been endorsed by the U.K., Australia, and other countries.

"In the future, companies will have to be more transparent about the agricultural practices in their value chains, if they want to resolve the risks and capture any opportunities that might come from them," says Boucher. "Also, they will need to be more involved with the farmers that they source from, sharing with them the financial benefits of carbon sequestration and biodiversity offsets." ■

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Water Quality *(Continued from p. 33)*

and beverage sector, various methods exist to help processors optimize their water use and, ultimately, consume less over time.

One approach lies in elevating the efficiency of wastewater treatment processes. Since wastewater treatment is already necessary, simply enhancing your current process for reuse in non-potable processes can be a huge advantage. Effectively treating wastewater laden with organic matter often involves methods of filtration, sedimentation, coagulation, and chemical treatment to disinfect and purify the water. Utilizing reclaimed water provides an alternative water supply, enhances operational efficiency, helps cut costs, and strengthens profitability.

The growth of data tracking and analysis presents another method by which food processors can aim to optimize their water use and progressively reduce consumption over time. By leveraging data

tracking, food processors can gain a comprehensive understanding of their current water consumption patterns and identify areas of improvement. Monitoring these insights in real time not only helps processors identify deviations from expected consumption levels but also provides an opportunity to predict and anticipate future trends. By embracing data-driven decision making, processors can track their progress over time, examine real-time cost of water and energy consumption, and develop customized water management strategies to fit their specific needs.

A Path to a More Sustainable Future

As the processing industry looks toward a greener future, the management of water use and water quality is a strategic method for a more sustainable transformation. Much like any systemic shift, the journey toward optimized water use

must begin with a deeper understanding of the current processes in place. Providing a tangible "value advantage" as a supplier is a critical component needed for both customer and supplier to be successful. By integrating advanced water treatment technologies and continually measuring growth and development when it comes to water use, processors can minimize waste, harness their water's potential for multiple cycles of use, and optimize processes to save time and energy, all while quantifying the value of these improvements.

Ultimately, water use for the food and beverage processing industry extends beyond mere consumption; it also comes down to responsible stewardship and maximizing the value of every drop. ■

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NEW PRODUCTS

Automatic Colony Counter

Keysense Corporation of America has released the BC-1000 series high accuracy automated colony counter. The system is designed to automate microbiological testing for a wide variety of samples, including bacteria, testing, and culture media. Unlike traditional manual counting methods, the BC-1000 ensures accurate counts within one second. The system will automatically suggest optimal settings for lighting and use a 20-megapixel CMOS sensor with dedicated counting algorithms for separation/extraction of colonies, core detection, and shape analysis to ensure accurate counts. This all-in-one device also supports high resolution imaging with advanced lighting capabilities and various measurement functions. **Keysense Corporation of America, [keysense.com](https://www.keysense.com).**



Motor Brakes

Force Control Industries MagnaShear motor brakes are maintenance free and require no adjustment, so they help eliminate motor brake downtime and maintenance costs. The brakes employ oil shear technology, which allows longer service life in demanding applications such as those with frequent start/stop cycles or where the motor is reversed each cycle. This eliminates the need to stock spare brakes, friction discs, and other repair components. Oil shear technology transmits torque between lubricated surfaces, eliminating wear on friction surfaces. These motor brakes are available to accommodate a wide range of applications. Spring set torque ratings from 3 to 1,250 foot-pounds are available and are available in multiple torques for the same motor frame. **Force Control Industries, [forcecontrol.com](https://www.forcecontrol.com).**



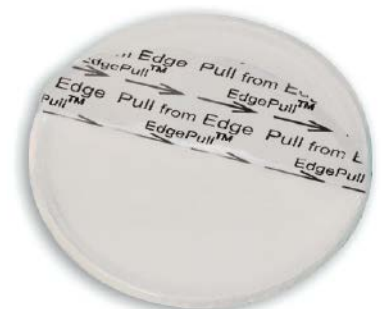
Ductless Hoods

CleanAir II Ductless Hoods are designed to meet DH I requirements as defined by SEFA 9. This hood features a built-in carbon filtration system to adsorb non-toxic fumes and odors and is equipped with an integral blower, vapor proof light, fan, and light switches. The hood superstructure is constructed of chemical and flame resistant, non-metallic, composite resin with a molded one-piece seamless interior fume chamber. A vertical sliding clear acrylic sash protects the user and contains the process fumes. The carbon filter that is included adsorbs the fumes and then re-circulates the air back to the laboratory. The hood is shipped completely assembled and ready for operation. **HEMCO Corporation, [hemcocorp.com](https://www.hemcocorp.com).**

Tabbed Container Liners

TekniPlex Consumer Products has introduced a series of tabbed container liners combining easier opening with product protection, as well as optimized shelf life for reduced product waste. The company's Edge Pull and Simply Tab solutions are compatible with a broad array of bottles and jars. The Edge Pull product is available in half-moon and offset tab configurations, while Simply Tab features a dual tab design. Key to both solutions is a strong bond between tab and liner, providing smooth peel away without delamination. Each features an induction heat seal for barrier protection, and tabs for ease of grip. The products are compatible with a variety

of substrates typically used for containers, including glass, polyethylene terephthalate (PET), polyethylene (PE), and polypropylene (PP). **TekniPlex Consumer Products, [tekni-plex.com/consumer](https://www.tekni-plex.com/consumer).**



Soft Bait for Rodent Fertility Control

SenesTech has released Evolve Soft Bait, which is designed to reduce fertility in rats. The minimum-risk solution is developed to control pest populations using technology that targets the rat population where it starts by restricting fertility in rats through nonlethal methods. The bait is highly palatable to rats, easy to deploy, and offers diverse placement in many different environments including food processing facilities. The product controls the population by controlling the fertility of rats, rather than trying to keep up with the growing numbers of an infestation. **SenesTech, contrapestpro.com.**



Compressor

The Danfoss DSG compressor features a design to enable a smooth transition to low-pressure, low-GWP refrigerants. Specifically designed for low pressure refrigerants such as R1234ze with low global warming potential, the product provides chiller systems with a range of compressor capacities to support unit design requirements. Single compressors are available from 20 to 40 tons of refrigeration, and larger capacities are available in manifolded configurations to offer system design flexibility. The DSG also has an optimized intermediate discharge valve inside the compressor to further enhance part-load capacity operation and energy efficiency. **Danfoss, danfoss.com.**

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FARM TO FORK SAFETY

SCIENTIFIC FINDINGS

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Whiskey Authentication, Discrimination, and Quality Control

To safeguard authentic whiskey products from fraudulent or counterfeit practices, high throughput solutions that provide robust, rapid, and reliable solutions are required. The implementation of some analytical strategies is quite challenging or costly in routine analysis. Qualitative screening of whiskey products has been explored, but due to the nonspecificity of the chemical compounds, a more quantitative confirmatory technique is required to validate the result of the whiskey analysis. Hence, combining analytical and chemometric methods has been fundamen-

tal in whiskey sample differentiation and classification. A comprehensive update on the most relevant and current analytical techniques, including spectroscopic, chromatographic, and novel technologies employed within the last five years in whiskey analysis for authentication, discrimination, and quality control, are presented. Furthermore, the technical challenges in employing these analytical techniques, future trends, and perspectives are emphasized. ***Comprehensive Reviews in Food Science and Food Safety***. 2023;22:4847-4992.



Plasma-Activated Water as a Thermal Treatment for Meat

Meat is a nutritious food with a short shelf life, making it challenging to ensure safety, quality, and nutritional value. Foodborne pathogens and oxidation are the main concerns that lead to health risks and economic losses. Conventional approaches like hot water, steam pasteurization, and chemical washes for meat decontamination improve safety but cause nutritional and quality issues. Plasma-activated water (PAW) is a potential alternative to thermal treatment that can reduce oxidation and microbial growth, an essential factor in

ensuring safety, quality, and nutritional value. This review explores the different types of PAW and their physicochemical properties. It also outlines the reaction pathways involved in the generation of short-lived and long-lived reactive nitrogen and oxygen species (RONS) in PAW, which contribute to its antimicrobial abilities. The review also highlights current studies on PAW inactivation



against various planktonic bacteria, as well as critical processing parameters that can improve PAW inactivation efficacy. Promising applications of PAW for meat curing, thawing, and decontamination are discussed, with emphasis on the need to understand how RONS in PAW affect meat quality. ***Comprehensive Reviews in Food Science and Food Safety***. 2023;22:4993-5019.

Prolonging the Shelf Life of Broccoli

This study introduces a novel absorbent material made from palm wood powder, addressing the need for using abundant waste palm wood in the food industry. The material benefits the safe transportation of vegetables from farms to markets. Its porous structure allows efficient absorption of plai oil emulsion, ensuring pathogen-free and high-quality treated broccoli. The product significantly inhibited the

growth of *Escherichia coli*, *Salmonella Typhimurium*, *Staphylococcus aureus*, and *Listeria monocytogenes* in broccoli for at least 20 days. The reusable sachets benefit farmers seeking to extend the shelf life of fresh produce. This cost-effective method utilizes plai oil vapor, making it suitable for large-scale production. ***Journal of Food Science***. Published November 28, 2023. doi: 10.1111/1750-3841.16855.





Impact of Germination on the Functional Properties of Brown Rice

Rice is a popular grain and forms part of the daily diet of people throughout the world; however, the consumption of rice and its products is sometimes limited by its high glycemic index due to its high starch content, low protein content and quality, and low bioavailability of minerals due to the presence of anti-nutritional factors. This has partly stimulated recent research interest in the use of bioprocessing techniques such as germination as cheap and natural means to improve the nutritional quality, digestibility, and health properties of cereals, including rice, to partially achieve nutrition and food security in the developing

regions of the world. This review highlights the impact of germination on the nutritional quality, health-promoting properties, and techno-functional characteristics of germinated brown rice grains and their products. The review demonstrates that germinated rice grains and their products have improved nutritional quality and digestibility, modified functional properties, and showed antioxidant, anti-inflammatory, anti-diabetic, anti-obesity, anti-cancer, and anti-cardiovascular activities. ***Journal of Food Science*. Published November 24, 2023. doi: 10.1111/1750-3841.16832.**

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High-Pressure Homogenization for Plant-Based Milk Alternatives

There is a growing market for plant-based milk products, but consumer acceptance remains low when compared with cow milk. The aim of this study was to compare the physiochemical and organoleptic properties of plant-based milk made from adzuki bean, adlay and oat, and to investigate the effects of using household and high-pressure homogenizer (HPH) on the physiochemical and sensory properties of plant-based milk. The color, pH, Brix value, suspension stability, total solid content, total soluble protein content, particle size distribution, steady-shear rheological properties, microstructure and sensory attributes of the samples were determined. The lightness and Brix values of the plant-based milk samples were increased 2.9%–9.6%,

and 1%–5% after HPH, respectively, indicating the increase in total soluble protein content and the release of starch granules. The particle size of the samples reduced more than 50%, and the viscosity apparently increased after HPH. Sensory evaluation showed that there was no significant difference in the acceptability of samples prepared by household and HPH, but the samples containing adzuki bean and oat had higher acceptance. HPH could significantly improve food quality of plant-based milk products, more in-depth research can be conducted to develop more acceptable plant-based milk products with HPH technology. ***International Journal of Food Science and Technology*. Published November 9, 2023. doi: 10.1111/ijfs.16822.**



Low-Energy X-Ray for Pathogen Control in Lettuce

Low-energy X-rays can be used to reduce the number of pathogenic microorganisms in fresh produce, but the efficacy of this process against internalized bacteria in leafy greens has not yet been reported. In this study, leaves of iceberg lettuce were cut into pieces and subjected to vacuum perfusion to force the foodborne pathogen cells into the intercellular spaces within the leaves. Sodium hypochlorite washes were not effective in inactivating internalized bacterial cells from lettuce leaves. In contrast, treatment with 1.5 kGy low-energy X-rays reduced *E. coli* O157: H7, *Salmonella Typhimurium*, and *Listeria monocytogenes* levels by 6.89, 4.48, and 3.22 log CFU/g, respectively. Additionally, the maximum dose of X-rays did not adversely affect the color or texture of lettuce. These results suggest that low-energy X-ray treatment can be used to control internalized and surface-adhering pathogens in leafy vegetables without affecting product quality. ***Journal of Food Safety*. Published September 24, 2023. doi: 10.1111/jfs.13094.**

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