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FEBRUARY / MARCH 2024

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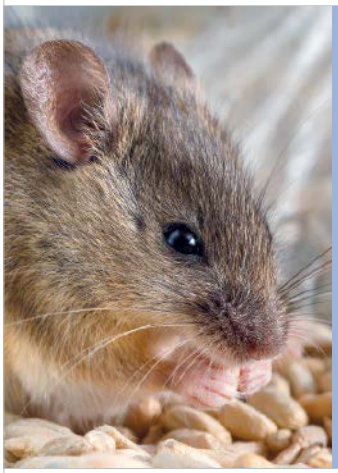

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***Food Quality & Safety* magazine welcomes letters to the editor on any relevant industry topic.**

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(Letters may be edited for space and style.)

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From The Editor

Letters, Words, N/A, and … an Onion?

Bear with me and I'll connect these dots. I promise. To explain, I'll have to give everyone a peek behind the curtain: This time of year, I'm usually trying to identify critical issues that could shape events in the year to come. This may require showing you "how the sausage is made," but I think you get my drift. So, words, letters … and onions?

Quite a few topics on the horizon for 2024 focus on inspections. Then, more "I" words started popping up for me: improvement, instruction. This correlation with the letter "I" may be something! Enforcement needs to be included, but my "I" theory falls apart here unless I invest in some time with a thesaurus.

Over simplified as it is in this parody, the importance of these three "I" words as they relate to food safety isn't exactly rocket science: FSMA identified several areas in inspections for FDA to improve. The pandemic interrupted things, but this appears to be getting back on track. FSMA set targets for capacity and competency that are addressed in part by the agency's new organizational structure, and that's a good thing for food safety.

As for the N/A (never and always) standard, the process to evaluate a situation or event as N/A requires a few questions: Can it be described using phrases such as, "it never works" or, "it always works like this"? To be clear, N/A can mean other things. This sausage making is harder and messier than it looks.

The last dot to connect is the onion. Believe it or not, this one is easy. FDA must realign a major government agency and will likely face some territoriality issues in the process. I'm not sure what they are but, for decades, those who favored the single food agency model said this would be a problem, so for now I'm sticking to that theory. Issues or not, this is the proverbial onion—layer upon layer of overlapping jurisdiction to unwind. That's a prediction I can make without letters or other trend data.

This prediction stuff is hard! My letter theory completely failed, so what are my predictions based on? I predict we'll see more AI in the news. I predict we'll see an increase in capacity-building activities as new inspection resources are identified. I predict that new training options for inspectors will address some of the audit knowledge gaps.

Oh, and another "I" word: I predict I'll need a new prediction system.

Patricia A. Wester
Executive Industry Editor

Food Quality & Safety
FARM TO FORK SAFETY

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NEWS & NOTES

Illinois Bill Would Ban Five Food Additives

BY **KEITH LORIA**

On the heels of a landmark California law that bans the manufacture, distribution, and sale of foods containing certain additives in the state, legislation in Illinois is looking to ban five food chemical additives.

SB 2637, known as the Illinois Food Safety Act, was introduced by Sen. Willie Preston (D), and looks to ban brominated vegetable oil, potassium bromate, Propylparaben, titanium dioxide, and red dye No. 3, which are chemicals often used in candy, soda, and other food items. Some research links these additives to serious health problems, including behavioral and reproductive issues and an increased risk of cancer.

Sen. Preston said in a press release that the legislation is not designed to take away people's favorite foods, but to set a strong precedent for consumer health and safety to encourage food manufacturers to update their recipes to use safer alternative ingredients.

The legislation closely mirrors the California law, including enacting fines of $5,000 for a first violation and $10,000 for each subsequent violation for the manufacture, sale, delivery, or distribution of any foods containing these substances.

Titanium dioxide, commonly found in certain candy like Skittles, was not part of the California legislation, though it was originally in the bill and taken out before the bill was passed; however, it's among the five additives banded by the European Union.

The National Confectioner's Association does not feel that a law like this is necessary, believing that FDA should remain responsible for evaluating the safety of food ingredients and additives. "This bill would replace a uniform national food safety system with a patchwork of inconsistent state requirements created by legislative fiat that will increase food costs, undermine consumer confidence, and create confusion around food safety," the association said in a prepared statement.

The Illinois legislation, if enacted, would take effect January 1, 2027, the same day as the California ban.

Antimicrobial Properties in Tomato Juice Can Kill *Salmonella*

Tomato juice can kill *Salmonella* Typhi and other, according to research published in the journal Microbiology Spectrum. *Salmonella* Typhi is a human-specific pathogen that causes typhoid fever.

"Our main goal in this study was to find out if tomato and tomato juice can kill enteric pathogens, including *Salmonella* Typhi and, if so, what qualities they have that make them work," said Jeongmin Song, PhD, associate professor in the department of microbiology and immunology at Cornell University in Ithaca, N.Y., and principal study investigator, in a press release.

First, the researchers checked to see whether tomato juice really does kill *Salmonella* Typhi. Once they determined that it did, the team looked at the tomato's genome to find the antimicrobial peptides that were involved. Antimicrobial peptides are very small proteins that impair the bacterial membrane that keeps them as intact organisms. The researchers found two antimicrobial peptides in the tomato that proved effective against the pathogen.

The investigators conducted more tests on *Salmonella* Typhi variants that appear in places where the disease is common. They also conducted a digital study to learn more about how the antibacterial peptides kill this and other enteric pathogens.

The researchers concluded that tomato juice is effective in eliminating Salmonella Typhi, its hypervirulent variants, and other bacteria that can harm human digestive and urinary tract health. Specifically, two antimicrobial peptides in the product can eliminate these pathogens by impairing the bacterial membrane, a protective layer that surrounds the pathogen.

Arizona Legislation Aims to Regulate Cell-Cultured Meat

BY **KEITH LORIA**

The Arizona House Committee on Land, Agriculture and Rural Affairs voted 6-3 in favor of making it illegal to label any product grown in a laboratory "meat" or "poultry." House Bill 2244, introduced by Rep. Quang Nguyen (R) on January 22, if enacted, would make prohibit use of any term that is "the same or deceptively similar" to meat or poultry. The lawmakers say the legislation would prevent consumer confusion. The measure now needs approval of the state's full House.

Challengers of the proposed legislation argue that FDA already requires any meat product produced in a laboratory to be labeled a "cell cultured" or "cell cultivated" product, so consumers shouldn't be confused.

A second proposed piece of legislation, House Bill 2121 introduced by Rep. David Marshall (R), aims to prohibit the sale or production of cell-cultured animal products for human or animal consumption. An early version of the legislation sought to impose civil penalties on anyone who offers to sell, sells, or produces a cell-cultured animal product for human or animal consumption, and would create a cause of action for anyone or any company or organization, whose business is adversely affected by a violation of the prohibition.

Last June, FDA approved the sale of cultivated chicken in the United States. While Arizona is the first state in the U.S. to consider a ban on lab-grown meats, in November 2023, Italy outlawed all cultured proteins. If the Arizona bill passes, industry experts expect to see similar bills in additional states. ■

Study: Micro Lasers Could Help Detect Pathogens in Food

BY **KEITH LORIA**

For decades, scientists have sung the praises of lasers and their abilities for observing, detecting, and measuring element in the natural world that are too small for the human eye. The challenge has always been that lasers are expensive and large, making their usage difficult in many situations.

In a study published in the journal Science by Qiushi Guo, PhD, assistant professor at the City University of New York (CUNY) Graduate Center Advanced Science Research Center's Photonics Initiative and a physics professor at the CUNY Graduate Center, establishes a novel approach for creating high-performance ultrafast lasers on nanophotonic chips, which can be used in multiple sectors, including in the food safety environment.

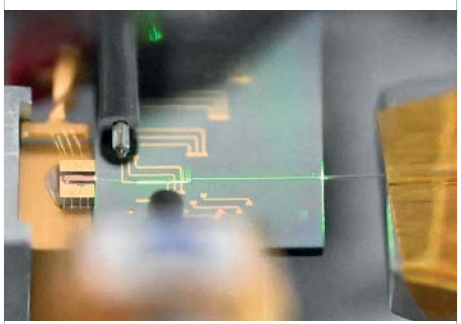
His work centers on miniaturizing the mode-lock laser, which he describes as "a unique laser that emits a train of ultrashort, coherent light pulses in femtosecond intervals," equivalent to a quadrillionth of a second. His research leverages an emerging material platform known as thin-film lithium niobate (TFLN), which allows for efficient shaping and precise control of laser pulses by applying an external radio frequency electrical signal.

Thanks to its compact size, it could mean that these ultrafast mode-locked lasers could one day allow for cell phones to diagnose eye diseases or environments to be analyzed for *E. coli* and other pathogens.

"Revealing the intricacies of unknown substances and understanding their chemical composition necessitates a powerful tool: infrared absorption spectroscopy," Dr. Guo tells *Food Quality & Safety*. "This technique has the capacity to sensitively detect highly characteristic rotational or vibrational transition bands exhibited by a diverse range of molecules and functional groups, i.e. the 'fingerprints' of various chemicals."

He says that when integrated with a nonlinear optical spectral broadening element and a photodetector, the chip-scale mode-locked laser can be used to create an ultracompact infrared absorption spectroscopy spectrometer which can be carried by people. "By directing or the laser's output onto the food under examination and analyzing the reflected light spectrum, we can rapidly decipher and reconstruct the chemical composition present in the food," Dr. Guo says. "Also, compared to other chip-scale spectrometer techniques, our laser can generate very bright signal light, which increases the accuracy of the analysis." This approach allows people to swiftly identify potential hazards, providing a valuable tool for ensuring food safety and protecting public health.

Traditionally, food safety inspections have been confined to laboratories, using sophisticated equipment inaccessible in people's daily lives. Consequently, obtaining a clear understanding of food safety before eating is almost impossible. This new technology transforms this paradigm by miniaturizing the spectrometer to a size comparable to phone cameras. "Now, food safety inspections can be effortlessly conducted at home or in restaurants with a simple click on our phones," Dr. Guo says. "This innovation significantly diminishes the risk of foodborne illnesses, making the [inspection] process more accessible and timely." ■



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BrightFarms Recalls Spinach and Salad Kits for Possible *Listeria* Contamination

BY **KEITH LORIA**

BrightFarms, an Irvington, N.Y.-based salad greens growing company, has issued a voluntary recall of select spinach and salad kit products due to possible *Listeria* contamination, FDA announced. As of January 26, no illnesses have been reported.

The recall is limited to spinach grown by BrightFarms' supplier Element Farms in its Pompton Plains, NJ farm and distributed under the BrightFarms name. A routine sampling conducted by Element Farms yielded a positive result for *Listeria monocytogenes*. Due to a potential cross-contamination at BrightFarms's Selinsgrove, Penn.-based facility, the company also recalled a limited quantity of four select salad kit products.

As such, BrightFarms has temporarily suspended the distribution of Element Farms-grown spinach until it is satisfied that all issues have been fully corrected.

The products included in the recall are BrightFarms Baby Spinach in 3.5 ounces; BrightFarms Mediterranean Crunch Kit in 6.35 ounces; BrightFarms Chickpea Caesar Crunch Kit in 6.5 ounces; BrightFarms Bacon Ranch Crunch Kit in 6.7 ounces; and BrightFarms Southwest Chipotle in 5.8 ounces.

The recalled products were sold in seven states: Connecticut, Massachusetts, New York, New Jersey, Pennsylvania, Virginia, and West Virginia. ■

FDA Increases Staff, Creates New Office to Strengthen Infant Formula Oversight

FDA has released an update on actions the agency has taken, and those underway, to strengthen the safety and resiliency of the supply of infant formula. The update includes release of a progress report specific to actions the agency has taken to meet the recommendations in the FDA's Evaluation of the Infant Formula Response.

The update highlights notable actions, including:

- Hiring and providing specialized training to personnel dedicated to the oversight of critical foods, including formula; this includes setting up a dedicated critical

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foods inspectional cadre and establishing a new Office of Critical Foods.

- Updating and improving the FDA's infant formula compliance program, which outlines the agency's inspectional and compliance approach to infant formula.
- Supporting the Council of State and Territorial Epidemiologists position on elevating *Cronobacter* to a nationally notifiable disease.
- Increasing the diversity of infant formula available in the U.S., especially through the agency's transition plan for firms that had previously received a letter of enforcement discretion.
- Continuing to build on FDA's Strategy to Help Prevent *Cronobacter* sakazakii Illnesses Associated with Consumption of Powdered Infant Formula, which aims to broaden scientific knowledge, improve oversight, and enhance communications and engagement with industry consumers and other stakeholders.
- Issuing warning letters to infant formula manufacturers as part of the agency's ongoing commitment to enhance regulatory oversight to help ensure that manufacturers are producing infant formula under the safest conditions possible.

For a more comprehensive list of actions that the Agency has taken, see the Status Update on FDA's Infant Formula Response Activities. For more specifics on steps the agency has taken in response to the FDA's Evaluation of the Infant Formula Response, see the Progress Update. ■

Salmonella Outbreak Linked to Charcuterie Meats Expands

USDA's Food Safety and Inspection Service (FSIS) has issued a public health alert out of an abundance of caution due to concerns about *Salmonella* illnesses that may be associated with ready-to-eat (RTE) charcuterie meat products in Busseto brand Charcuterie Sampler and Fratelli Beretta brand Antipasto Gran Beretta.

FSIS has been working with the Centers for Disease Control and Prevention (CDC) and state public health partners to investigate a multistate outbreak of 47 *Salmonella*-related illnesses in 22 states with onset dates ranging from November 20, 2023, through January 1, 2024. FSIS will continue the investigation and issue new information as it becomes available.

The Fratelli Beretta brand Antipasto Gran Beretta was sold at Costco in a 24-oz. twin-pack (two 12-oz. trays). The Busseto brand Charcuterie Sampler was sold at Sam's Club in an 18-oz. twin-pack (two 9-oz. trays). Any lot code associated with either product is potentially contaminated. The products are no longer available for purchase at Costco and Sam's Club. Label images can be found in the CDC's food safety alert. ■

New Study Finds Concern for Nanoplastics in Bottled Water

BY **KEITH LORIA**

Researchers at Columbia and Rutgers University have discovered that bottled water sold in stores can contain nanoplastics, plastic particles smaller than 1 micrometer, which is 10 to 100 times greater than previous estimates. The study was published in January 2024 in the *Proceedings of the National Academy of Science* (doi:10.1073/pnas.2300582121). "People developed methods to see nanoparticles, but they didn't know what they were looking at," Columbia graduate student Naixin Qian, the study's lead author, said in a press releases, adding that previous studies weren't able to count these particles.

The researchers used a technique called stimulated Raman scattering microscopy, which involves probing samples with two simultaneous lasers that are tuned to make specific molecules resonate. By targeting seven common plastics, the investigators were able to create an algorithm to interpret the results.

Three undisclosed popular water bottle brands were used for the study. The researchers analyzed plastic particles down to just 100 nanometers in size, discovering an alarming 110,000 to 370,000 particles in each liter, 90% of which were nanoplastics.

By using the algorithm, the study authors determined which of the seven specific plastics they were, and charted their shapes, which they believe will be valuable in biomedical research. The researchers say they will continue measuring nanoplastics, and have plans to examine tap water. ■

Bacterial Test for Raw, Organic Milk May Require More Precision

In a study published in January in the *Journal of Dairy Science* (doi: 10.3168/jds.2023-24330) Cornell University food scientists found that a standard quality test used for raw, organic milk is insufficient for distinguishing between specific groups of bacteria.

The present test, called the laboratory pasteurization count (LPC), looks for thermoduric bacteria (strong enough to endure pasteurization) and does not differentiate whether bacteria form spores or not—a key factor in determining both the quality of milk and how producers need to address milk production hygiene.

Some types of thermoduric bacteria that form spores are ever present in the farm environment, found in bedding, feed, and air. These types of bacteria can cause dairy products like milk and cheese to spoil, which contributes to food waste. Non–spore-forming thermoduric bacteria can be found in improperly cleaned milking equipment and can be addressed by producers with improved maintenance and sanitation. Distinguishing between these two groups of thermoduric bacteria is important to reducing the time organic farmers spend troubleshooting elevated LPC results. Under current standards, if thermoduric bacterial counts are high, the milk can be downgraded or even rejected by the processor.

In the research, the researchers said that, despite the test being used as a proxy for levels of bacterial spores in raw milk, there is limited knowledge of the types of organisms identified by this test in raw milk.

"We're giving organic farmers the knowledge they need to make high-quality raw milk and for it to be economically viable," says senior author Nicole H. Martin, PhD, assistant research professor in dairy foods microbiology and the associate director of the Milk Quality Improvement Program in the Department of Food Science at Cornell University. "It will make a better dairy product in the end." ■

Biodegradable Sensor Monitors Pesticide Levels in Produce

Researchers at the University of São Paulo (USP) and the Federal University of Viçosa (UFV) in Brazil have developed a sustainable sensor that can be placed directly on the surface of a vegetable or fruit to detect the presence of pesticides. Known as "plant wearable," the device is made of cellulose acetate, a material derived from wood pulp.

An article describing the results of the study was published in the journal *Biomaterials Advances* (doi.org/10.1016/j.bioadv.2023.213676) in December 2023.

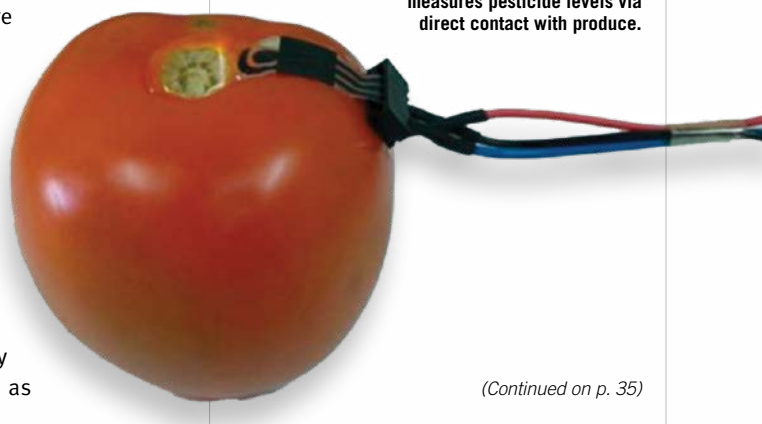
The analytical tools most often used to measure pesticide levels in crops are chromatographic techniques, which are effective but have drawbacks such as the need for sample pretreatment, expensive equipment, and qualified laboratory specialists, as well as the extensive time taken to complete an analysis.

"As an alternative, electrochemical sensors can combine affordability, rapid detection, miniaturization, large-scale production, convenience, ease of use, high selectivity and in situ pesticide detection," says Paulo Augusto Raymundo-Pereira, a co-author of the study and a researcher at the São Carlos Physics Institute. "Our invention has all these features. The analysis is performed directly on the surface of fruit, vegetables, or leaves.

Instead of the usual materials, he added, the researchers used cellulose acetate. This substrate was produced by a casting method in which the material was placed in a space with the required shape, and the full electrochemical system with three electrodes was deposited by screen printing.

The researchers carried out laboratory tests in which a solution containing carbendazim, a fungicide, and paraquat, an herbicide, was sprayed on lettuce and tomatoes in a simulation of real-world use. The sensor was then directly attached to the lettuce and tomatoes, and measurements showed a level of detection compatible with those obtained with polyethylene terephthalate, the sensor material most frequently used for this purpose.

The technology can be useful for sanitary surveillance agencies worldwide, he added, as well as sellers of organic produce to certify absence of pesticides. Farmers generally can use it to monitor levels of pesticides in the field and be sure of applying only the requisite dose to each crop or part of a plantation. Pesticide use could decrease as a result, while yields will still rise, leading to lower consumer prices. ■



The electrochemical sensor measures pesticide levels via direct contact with produce.

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Beyond Borders

Food safety initiatives in developing countries

BY **KAREN APPOLD**

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Unsafe food containing harmful bacteria, viruses, parasites, or chemical substances can cause more than 200 different diseases, ranging from diarrhea to cancers. Worldwide, the World Health Organization (WHO) estimates that 600 million people—almost one in 10—become ill after eating contaminated food each year, resulting in 420,000 deaths and the loss of 33 million healthy life years.

Food safety, nutrition, and food security are closely linked. Unsafe food creates a vicious cycle of disease and malnutrition that affects infants, young children, and the elderly and sick in particular, according to WHO reports. "In addition to contributing to nutrition and food security, a safe food supply also supports global, national, and local economies as well as safe and fair trade, while enhancing the diffusion of sustainable development at large," says Anne Gerardi, senior manager for the Global Food Safety Initiative (GFSI) public–private partnerships and capability building programs at The Consumer Goods Forum in Paris, France. The globalization of food trade, a growing world population, climate change, and rapidly changing food systems all impact food safety.

What's Working

Several approaches to addressing food safety in developing countries have shown success and promise in recent years. These approaches are often rooted in and center around preventive actions and interventions based on science-based standards for the safe growing, harvesting, packing, transport and storage of food, says Tracy Fink, PCQI, director of scientific programs and science and policy initiatives at the Institute of Food Technologists in Chicago.

Some of the most effective methods have included capacity-building and training programs, public–private partnerships, and a farm-to-fork approach. Providing training and capacity-building programs for food producers, processors, and regulators is critical to global food safety. These programs equip individuals and organizations with the knowledge and skills needed to implement food safety practices developed in countries with more advanced scientific experience.

Additionally, training helps bridge the food safety knowledge gap in emerging regions and ensures that best practices are understood and followed across the food chain. This training can cover various aspects of food safety, including good hygiene practices, hazard analysis and critical control points (HACCP) systems implementation, laboratory testing, and risk assessments, Fink says.

Collaboration among government agencies, private sector stakeholders, and non-government organizations (NGOs) is also an effective way to improve food safety, Fink adds. Public–private partnerships can provide resources to promote better practices throughout the nodes of the food supply chain.

A holistic "farm-to-fork" approach considers food safety at each part of the supply chain, from production and processing to distribution and consumption, Fink says. This comprehensive approach also helps identify potential biological, chemical, and physical hazards and risks at various points, allowing for targeted and preventive interventions and risk management.

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WHO and FAO Efforts

In 2019, the Food and Agriculture Organization (FAO) of the United Nations and WHO jointly developed the food control system assessment tool to assist member states in evaluating the effectiveness of national food control systems. The tool's main objective is to provide a harmonized, objective, and consensual basis to analyze the performance of a national food control system, says Markus Lipp, PhD, senior food safety officer at the food systems and food safety division of the FAO in Rome. Countries can use the tool to identify priority areas of improvement and plan sequential and coordinated activities to reach expected outcomes. The tool is based on the Principles and Guidelines for National Food Control Systems adopted by the Codex Alimentarius, often referred to as Codex, an international food safety standard-setting body established by FAO and WHO.

These organizations also work with member countries to develop capacity-building programs, provide technical assistance, and promote best practices to address global food safety issues, Fink says. Furthermore, they support and promote research and data collection to better understand and mitigate food safety risks worldwide.

Challenges Remain

As part of their efforts to improve and enhance their food supply's safety, some countries, including China, Brazil, Thailand, India, and Mexico, have embraced HACCP. Despite these efforts, Fink says that challenges persist and more work needs to be done in implementing and enforcing HACCP in developing countries. One of the main culprits is a lack of communication among various partners, including between regulatory authorities and the private sector. Addressing this communication gap is crucial to overcoming hurdles and ensuring the effective adoption of HACCP principles.

Food systems are experiencing rapid changes in the face of demographic, dietary, and income changes. As food systems transform, food safety problems have become more varied and complex, in many instances overwhelming nascent capacity.

—STEVEN JAFFEE, PHD

According to Steven Jaffee, PhD, a lecturer in the department of agricultural and resource economics at the University of Maryland in College Park, data and knowledge gaps have contributed to a long legacy of underinvestment in domestic food safety capacity in low- and middle-income countries. Structural issues are also represent an impediment. In many such countries, informal food operators and distribution channels still predominate for perishable foods—and likely account for a majority of serious cases of foodborne illness. "Yet, most of this fragmented informal sector is beyond the effective reach of limited government regulatory capacity," he says. "Furthermore, food systems are experiencing rapid changes in the face of demographic, dietary, and income changes. As food systems transform, food safety problems have become more varied and complex, in many instances overwhelming nascent capacity."

Contaminants from various sources continue to bring challenges as well. Microbiological pathogens such as *Salmonella*, *E. coli*, and *Listeria* are among the most prevalent. Aflatoxins—contaminants produced by certain molds found in soil—affect crops such as grains and nuts. Preventing outbreaks is challenging due to a lack of infrastructure for proper food handling and storage, inadequate food safety laws, or insufficient resources to enforce existing regulations, says Greg Heartman, vice president of product management at TraceGains, an organization based in Westminster, Colo., that connects food brands and suppliers worldwide. Additionally, some regions have limited access to clean water, which exacerbates the problem of microbial contamination.

Chemical contaminants also pose a potential threat, Fink says. Examples include pesticide residues, heavy metals (e.g., lead, cadmium, mercury, arsenic, and nickel), and industrial chemicals. These contaminants can originate from natural sources such as soil, rocks, minerals, and water, and may also result from inadequate local regulation on hazardous chemicals, improper pesticide use, and pollution.

Furthermore, biological toxins represent another concern. Fink notes that certain naturally occurring toxins, such as cyanogenic glycosides in cassava and toxic alkaloids in certain wild plants, can contaminate foods if they aren't properly processed or prepared.

Tackling Food Safety Risks

Dr. Jaffee believes that a different approach is needed to better tackle food safety risks in the informal sector. This would entail:

- **Local action, centrally guided.** The bulk of interventions, both regulatory and facilitative, needs to come at the municipal level, and the drive for safer food in the informal sector should be embedded in strategies for healthy, sustainable, and resilient cities. National agencies would still have important roles such as mobilizing resources and providing guidelines and technical backstopping.
- **Multi-sectoral action.** Standalone food safety interventions may not be the best option. Rather, improving the safety of food in the informal sector can be better achieved and better resourced when bundled with interventions to improve nutrition, increase access to potable water and improved sanitation, improve environmental management, and upgrade urban infrastructure.
- **Rebalancing the use of sticks and carrots.** Strict enforcement of regulatory provisions is unlikely to be effective vis-à-vis most informal sector food operators. Rather, gradual and continuous enhancements in practices and/or facilities should be sought. Whenever feasible, greater effort should go into engaging and enabling informal market operators—that is, finding ways to strengthen both their incentives and their capacity to carry out their food businesses in ways that are much more likely to yield safe food. It would be beneficial for cities or local branches of ministries to employ as many food hygiene/food business advisors as they do regulatory inspectors.

Opportunities for Improvement

GFSI maintains that working in silos, which is the status quo for a vast majority of organizations, remains a predominant obstacle to resolving food safety issues. Furthermore, intergovernmental organizations remain reluctant to partner with the private sector and are failing to see the private sector and organizations convening the private sector, like GFSI, as a solution. Instead, they perceive it as an obstacle, Gerardi says.

Developing a favorable ecosystem for safer food by focusing on infrastructure, people, and supply chains that will enhance food safety capabilities is a key to solving those issues. Developing robust, transparent, and delivery-oriented regulatory and national food control systems focused on policy and enforcement is also paramount and a key component of those capabilities, Gerardi adds.

Along these lines, Heartman says that improvements should come about through a combination of government initiatives, international aid, and private sector solutions. "Governments can enact and enforce stronger food safety legislation, while international organizations can provide the necessary technical and financial support," he says. "Countries can gain better governance by negotiating supportive solution deals with global providers. Public–private sector partnerships can introduce innovative software solutions and technologies that help embed food safety into the food supply chain while supporting and solving the global problems that buyers and suppliers face."

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Food Safety Success Stories from Afar

Adversity can be a powerful catalyst for change and transformation. In 2016, Vietnam experienced a severe environmental disaster along its coastline, leading to a massive fish death event caused by industrial discharge. "Since then, Vietnam has made significant strides in enhancing the safety and quality of its seafood products, which has led to increased international trade and consumer confidence," says Tracy Fink, PCQI, director of scientific programs and science and policy initiatives at the Institute of Food Technologists in Chicago.

Vietnam implemented stricter regulations and monitoring systems for food safety, particularly in the seafood sector, the following year. The country established comprehensive measures by the National Agro-Forestry-Fisheries Quality Assurance Department (NAFIQAD), which marked a significant commitment by Vietnam to ensure the safety and quality of its agricultural, forestry, and fisheries products. This contributed to restored trust in its food exports.

Additional success stories include the Global Food Traceability Center and the World Wildlife Fund, which organized the Global Dialogue on Seafood Traceability (GDST) in 2017 as an international, business-to-business platform to advance interoperable seafood traceability. The GDST brought together seafood supply chain stakeholders worldwide to create the first global industry standards for seafood traceability in 2020.

Thailand's Poultry Industry

Another notable success story can be seen in Thailand's poultry industry, which revamped its practices following bird flu outbreaks in 2003 and 2004. By implementing widespread vaccination programs, biosecurity measures, and surveillance, and engaging with international trade partners to maintain standards, Thailand turned its poultry sector into one of the safest and most successful in Southeast Asia, says Greg Heartman, vice president of product management at TraceGains, a Westminster, Colo., organization focused on connecting food brands and suppliers worldwide.—*KA*

(Continued from p. 15)

Fink agrees. "Governments, international organizations, academia, non-government organizations, public–private partners, and food science community have to work together to protect public health, enhance food security and food safety, and facilitate economic development," she says. Furthermore, encouraging individuals and organizations that are independent of the government and businesses and operate to pursue various social, cultural, political, environmental, and humanitarian goals is crucial in shaping and influencing public policy around food safety.

Preventive Measures

Today, focus has been put on proactively preventing problems rather than reactive remediation once undesirable outcomes have been observed. "This has been instituted in many areas for decades and is the current dogma of human health," says Dr. Lipp.

Similarly, a systems approach to food safety is proactive, aimed at preventing food safety problems from occurring in the first place. Once food is rendered unsafe, it typically can't be reused and must be discarded. "Such a reactive approach is unsustainable economically as well as from an environmental perspective," he adds.

Some developing nations are beginning to adopt a more proactive approach to food safety. Initiatives such as the African Food Safety Network promote sharing of information and best practices. "Shifting from reactive to proactive quality controls and food safety management in developing countries requires capitalizing on software while changing mindsets through education," Heartman says. "The key is building a culture of food safety at all levels of the supply chain, particularly between buyers, manufacturers, and suppliers."

The capacities and capabilities required to engage in a proactive, preventative food safety approach are higher than those that are focused on a reactive approach, and investments are urgently needed to confer the knowledge needed to engage in this approach, by proactively designing the agrifood system for the delivery of safe food, Dr. Lipp says.

Newer Developments

In November 2023, the New GFSI GMaP toolkit was launched. The program allows food business operators (FBOs) easy access to a suite of tools to enable self-assessment of food safety proficiencies based on Codex.

Focused on primary production and manufacturing activities, the free toolkit includes a food safety checklist and associated protocols, along with training and competency frameworks, which are intended to support the multiple ways that FBOs can signify their overall food safety capabilities to enhance their ability to trade internationally or domestically.

Some months earlier, in April 2023, GFSI and the United States Agency for International Development (USAID) signed a memorandum of understanding (MOU) to improve food safety and sustainable food systems in Africa. This MOU is an integral part of GFSI's new capability strategy approach and contributes to the U.S. Government Global Food Security Strategy through Feed the Future, a whole-of-government platform that works to end hunger and malnutrition and build sustainable, resilient food systems, Gerardi says.

Under the signed MOU, USAID and GFSI will support small and medium food businesses in Africa to improve their capabilities via more robust food safety management systems by connecting them to technical, educational, and financial resources.

Governments can enact and enforce stronger food safety legislation, while international organizations can provide the necessary technical and financial support.

—GREG HEARTMAN

Potential businesses will be identified to participate in a pilot phase of GFSI's new capability building framework, with a particular focus businesses owned by women, Gerardi says. The framework will focus on facilitating regulatory compliance, information sharing, and market access. Additionally, the partnership will support new research on food safety value chains and provide guidance on measuring the framework's contributions to Sustainable Development Goals linked to food safety. ■

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Food Quality & Safety
FARM TO FORK SAFETY

What's Your Company's Food Safety Culture?

Practical tips to help measure and improve employee focus on food safety

BY **WENDY JOHNSON AND MAT BARTKOWIAK**

From farm to fork, food safety is a topic that everyone in the supply chain should embrace. The regulatory realities of 2011's Food Safety Modernization Act were meant to usher in a new foundation in food safety; however, full implementation was interrupted by the pandemic, and numerous significant challenges remain in the fight for safe food. FDA launched its "New Era of Food Safety" in 2020 to refine food safety practices using technology and engaging a more holistic view of the practice of food safety.

One fundamental yet pragmatic question launched a specific key target in this new initiative: "What do people do when no one is looking?" Your company may have a great food safety plan on paper; it may have checked all the boxes. Your hazard analysis and recall plan may have been inspired by pristine, textbook examples of building a cohesive food safety plan. That's terrific, but what happens on the production floor? What happens in the daily processing environment? What does an employee do when they see something go wrong? It's critical to engage employees—and management—so that they feel supported in taking on food safety and dedicate themselves to following established protocols.

This is where the concept of "food safety culture" comes into play. Food safety culture is, in essence, the values, beliefs, and habits people share to ensure food is kept safe. "Culture" is a concept that requires a great deal of critical self-analysis, as well as a continued dedication to properly foster, support, and maintain it. Building a culture of food safety demands authentic buy-in from all levels of employees, including:

- Those on the front lines who realize their actions can have a direct consequence on the health and safety of their customers;
- The procurement department that feels empowered to make the right choices to get the right products and services to support food safety as a core value;
- A training coordinator who realizes food safety training is a core concept that should be featured during onboarding and in continuous training opportunities;
- The executive level, who should know that food safety can contribute to a healthy bottom line by mitigating significant risk/cost to the organization, as well as creating safe, quality products for their customers.

Everyone has a role to play in the creation and maintenance of a food safety culture in your operation. Here are four practical areas you can target to help measure the wellness of your food safety culture and to determine just how authentically everyone is connected to those values.

1. Provide continuous training: When it comes to establishing and maintaining a culture of food safety, training should be thought of as continuous and holistic in terms of your organization. As opposed to a "one-and-done" exposure in a topic, training is a way to introduce food safety concepts, as well as revisit them, evaluate them, and provide opportunities for continuous improvement. Some training considerations are:

- **Education**: Is training available to employees when they join your team? To embed a food safety culture into your company, all stakeholders should have a foundational understanding of food safety. A fundamental starting point is to be sure that food safety and your food safety culture is a target of your onboarding process for new employees. Who leads your food safety team and has passion for the subject? Target that individual as a key resource to introduce employees to food safety concepts, expectations, behaviors, and importance to the business.
- **Collaboration**: Do you provide training across departmental lines? From the C-Suite to maintenance staff to HR to production employees, the further you engage the diversity of departments and positions, the more that you are universalizing the realities of what food safety requires to be proactively engaged in it: behaviors, standards, goals, materials, and tools. This also provides an opportunity to reaffirm the consequences of not thinking comprehensively about food safety in your operation from all levels and from each person's role.
- **Effectiveness**: How frequently are trainings offered throughout the year? Who do you assign to attend those trainings? Do your trainings reflect your findings in your risk analysis? There is no magic number in terms of training opportunities; more important than frequency is the question of efficacy and applicability. Start with those targets first to help understand how your training program needs to be engaged for your operation, and to push the advancement of knowledge with the advancement of application and practice.

It's critical to engage employees—and management—so that they feel supported in taking on food safety and dedicate themselves to following established protocols.

2. Give regular feedback: The efficacy of food safety culture training can also be tough to measure once you have trainings in place. To holistically understand how effective your training programs are, consider implementing a program of assessments, conversations, and organizational involvement by personnel. For example, consider conducting regular "interviews" with employees, or distributing questionnaires pertaining to safe quality food (SQF), hazard analysis and critical control points (HACCP), key performance indicators (KPIs), and good manufacturing practice (GMP) policies. These tools can help to create opportunities for informal and impromptu mini-training sessions. These meetings are also a chance to build awareness of new procedures and to have open conversations between employees and managers on existing practices.

Within an organization, these are also occasions to empower employees to make informed decisions and become confident in their decision making. Asking them to share any concerns helps to set an understanding that if they see something that concerns them, they should feel comfortable saying something. Active conversations and feedback loops should be supported as parts of daily culture, not treated as isolated events.

3. Build on audit results. Internal inspections should be part of regular compliance when it comes to meeting standards for third-party audits. Similar to conducting feedback loops, having internal inspections can do quite a bit to set a regular, pressing view of food safety. Reviewing warehouse maintenance; cleaning; SQF, HACCP, and GMP-related topics; safety topics; and training materials keeps employees engaged and consistently looking for process improvements. Assigning teams of trained personnel equipped with prepared checklists to thoroughly evaluate each site and ensure that employees are doing what they say they are doing and then sharing that information with the organization creates a chance to take the pulse of commitment and focus. For example, consider how reviewing audit policy documentation each month to ensure it is up to date, verified, and validated would assist with reaffirming food safety practices. Organizations can often help build up more predictable results in their external audits by using the same questionnaires in the internal inspections and keeping those as usable frameworks to judge efforts throughout the year.

4. Take stock of objectives for food safety and celebrate wins. It helps to know what your targets are going to be and how to structure them. Focusing on areas that are most applicable to your facility and production type can elevate those areas for attention and measurement. Preventive controls, standard operating procedures (SOPs), KPIs, corrective actions, and core hazards are great starting points for establishing a program of action and focus. These key areas also provide numerous opportunities to talk about other food safety issues and build conversations that will inevitably lead to other targets.

To help meet these objectives and measurements, remember to clearly create and delineate employee incentive programs that demonstrate behaviors that will adding to the culture of food safety. Forming a cadence of recognition and rewards is a way to celebrate wins for the company while also applauding employee involvement and commitment. These rewards can include interpersonal affirmations, giveaways, postings around the office, annual recognition, and award events.

The more you emphasize the importance of a food safety culture, the more you highlight an appreciation for doing the right thing and the more you reaffirm that food safety is top of mind and that everyone can make a difference.■

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5 New Pest Control Technologies

Protect your food processing facility by maximizing preventive tactics

BY **FRANK MEEK, BCE**

While an effective pest control plan is crucial in all industries, it is especially important for companies that handle food. For food and beverage processors, ensuring that pest control methods are as up to date and comprehensive as possible is paramount for the safety of staff and customers.

Several new and evolving pest control technologies can help improve the effectiveness of existing pest control plans and strategies by providing real-time data on hot spots and trends, reducing invasive treatments, and improving targeted pest management for treatment and removal. These technologies can help support an existing integrated pest management (IPM) plan to support your facility.

New and Evolving Pest Control Technologies

Part of forming a comprehensive pest control strategy is to regularly implement new and evolving technologies at your facility that continuously improve your existing pest control plan. In recent years, several technologies have emerged that can help improve the effectiveness of pest control, as well as the safety of food processing facilities and the goods they produce.

- **Remote rodent monitoring**: This involves the use of wireless sensor networks to collect data on pest activity. These sensors can be strategically placed in key areas to monitor temperature, humidity and other environmental factors that influence pest behavior. By collecting this data, pest control providers can focus on prevention by better predicting and analyzing pest behavior to focus on prevention by finding the root cause of the pest issue.
- **LED insect light traps (ILTs)**: These traps are designed to emit light in specific spectra that are attractive to target pests while minimizing attraction to non-target species. This makes them more efficient and environmentally responsible compared with traditional insect light traps. LED ILTs consume less energy than conventional fluorescent lamps, reducing operational costs. They also have a longer lifespan, reducing the frequency of bulb replacements.
- **Advanced application equipment**: Improvements in the equipment used to apply chemical treatments include changing power sources from gasoline engines and direct electric power to battery-driven devices. This reduces environmental impact and allows for better control over the output of products, making a more effective application service.
- **Insect monitoring and counting technologies**: Many manufacturers are in the development stages of producing ILT devices that can count the number of insects captured and use artificial intelligence (AI) to identify types of insects captured. This technology will provide more accurate analysis of pest activity trending around your facility.
- **Redesigning rodent management**: Legislative changes in some parts of the United States are driving a change to managing rodent populations. Moving away from dependence on traditional rodenticides and using carbon dioxide or carbon monoxide instead to help reduce populations in burrow systems is becoming more common.

These new pest control technologies can help protect your food processing facility by maximizing preventive tactics to help minimize pest issues.

Integrated Pest Management

Now that you understand some of the newest technological advancements in pest control, it's important to establish how these can fit into the overall pest control strategy. Integrated pest management (IPM) programs employ a comprehensive and sustainable approach that combines proactive pest prevention, regular monitoring, and targeted interventions to minimize the use of chemical treatments and help effectively manage

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News & Notes *(Continued from p. 11)*

USDA Launches Remote Grading Program for Beef

In January, Agriculture Secretary Tom Vilsack announced the Remote Grading Pilot for Beef, a pilot program developed by USDA's Agricultural Marketing Service (AMS) that will allow a USDA grader to assess beef carcass characteristics and assign the official quality grade from a remote location. The agency says this access will reduce costs and location as barriers to participation in voluntary grading services.

"On average, a beef carcass that grades as USDA Prime is valued at hundreds of dollars more than an ungraded carcass, but costs for this voluntary USDA service often prevents smaller scale processors and the farmers and ranchers they serve from using this valuable marketing tool," Secretary Vilsack said. "This remote grading pilot opens the door for additional packers and processors to receive grading and certification services allowing them to access new, better, and more diverse marketing opportunities."

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USDA offers services for official grade standards—grades such as prime, choice, and select—to packers and processors on a user-fee basis. While more than 90% of America's fed beef supply is officially graded by USDA, most is from large beef packing operations. USDA's meat grading and certification services are significantly underutilized by small, independent processors, the agency says, in large part due to the expense of paying for a trained USDA grader to travel to their facility to perform the service in-person.

In this pilot, trained plant employees capture specific images of the live animal and beef carcass. These images are submitted electronically to a USDA grader already stationed elsewhere in the U.S. who reviews the images and accompanying plant records and product data, assigns the USDA quality grade and applicable carcass certification programs, and communicates the official grade back to the plant to be applied to the carcass. Plants can then use this information in their retail marketing and transmit carcass performance information back to producers.

This pilot is limited to domestic beef slaughter facilities operating under federal inspection and producing product that meets the eligibility criteria for the USDA grading program. For more information about program, visit ames.usda.gov. ■

5 New Pest Control Technologies *(Continued from p. 20)*

pest populations in your facility. In an all-inclusive, ongoing, proactive cycle focused on prevention for your facility, providers will implement the most effective customized pest control measures to benefit the needs of the facility. Providers then continue to monitor the program's effectiveness and perform check-ins as needed to ensure the facility is cared for.

With a focus on innovation and prevention, IPM is one of the most promising ways to bring in new technologies regularly and intentionally. A successful IPM program:

- Is environmentally responsible and intentional in its measures;
- Involves the entire staff in the operation through group training and instruction;
- Keeps detailed records of all pest activity and pest control operations;
- Educates and partners with facility managers to understand the business operations comprehensively;
- Addresses pest hot spots inside and outside the facility; and
- Inspects the property and focuses on exclusion techniques that help keep pests out of the building.

> Part of forming a comprehensive pest control strategy is to regularly implement new and evolving technologies at your facility that continuously improve your existing pest control plan.

For optimal partnership with your pest control provider, always provide documentation of pest sightings and spotting trends in your facility. Implementing a process for staff to report any signs of pest activity can help keep employees aware. Always maintain open lines of communication with your pest control provider and communicate the importance of preventive measures internally.

Navigating pest control in your food processing facility requires looking toward the future and investing in new and innovative pest control technology to help develop the best possible protection and treatment plan for your facility. By fostering an environment of collaboration and forward thinking, you can help safeguard your facility, which in turn protects your customers and employees, preserves your business's reputation, and helps you deliver the best possible product. ■

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Beyond the Oven

How vision inspection technology can safeguard baking quality

BY **ANDREW MCGHIE**

Today's industrial bakery looks much different than it did 40 years ago. Baked goods that were once mixed, proofed, shaped, and decorated manually by the baker are now meticulously produced by automated machines. Several factors compel bakeries toward automation; a growing competitive landscape and diverse consumer demands are only part of the industry-wide drive to innovate and automate.

While much of the baking process is mechanized, most bakeries today still employ manual inspectors as their core line of defense to ensure top-quality baked products that are safe to consume. Despite these production innovations, quality assurance teams face the difficult task of accurately inspecting products for brand-specific traits and detecting unwanted foreign materials at full-line speeds.

Manual inspection was much more reasonable in the bakeries of the past, which produced products at smaller volumes than today's operations. Access to baking quality assurance experts was also different back then. Even so, relying solely on manual inspection presents more challenges than solutions for a modern industrial bakery.

Vision Inspection Technology

Many companies have started integrating vision inspection technologies to optimize product flow and help streamline final product assessment. Vision inspection systems incorporate high-speed cameras with imaging software and advanced algorithms to directly detect and measure food products for important visual traits on the production line.

Vision inspection technologies are commonly grouped into two inspection categories: final product inspection (FPI) systems and vision process control (VPC) systems.

Many early adopters of vision inspection technology used it to assess final products before packaging, helping them apply objective data to enhance their quality assurance programs. These types of vision inspection systems fall into the FPI category.

Next, bakeries began integrating automated rejection and recirculation capabilities into their FPI system to discard out-of-spec products based on programmed criteria. These criteria range from universal product traits such as overall product size, shape, and color to more detailed or brand-specific features like split height and length of a loaf of bread, topping coverage such as seeds, chocolate chips, and others.

More recently, as bakeries began adopting automated technologies to produce their products at higher volumes, processors began exploring different ways vision inspection could close the loop on their overall process control. While FPI applications could accurately assess product results, these processors needed more information to determine why their results occurred and how to correct them.

This data gap led to the introduction of VPC systems, which are typically installed at key production process stages at any point before packaging. Data visualization and real-time feedback, connected with process machinery, help enable a "smarter" manufacturing line, one in which bakers and operators can make data-driven decisions on process adjustments.

Combining VPC with FPI is how bakeries achieve 100% unbiased online inspection free from human interpretation. Through this integration, bakeries

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can wholly understand and control the processing capabilities of their production facility to align better with compliance standards.

How Vision Inspection Helps

While each bakery is unique, there are essential steps in the baking process where vision inspection has helped companies improve quality, consistency, and safety.

Pre-baking inspection. The dough-forming process, for instance, ensures products achieve an ideal final size and shape. Take hole doughnuts, for example, which should have a uniform diameter and center. Many doughnut manufacturers utilize automated shaping equipment to place dough onto a conveyor belt and into individual product lines. Over time, however, this application can run out of alignment. Using a VPC system directly after the shaper can help the production team monitor the uniformity of dough shapers across the belt. The system objectively detects the size and diameter of the overall product and center area. If the dough shape begins to drift outside specifications, the system can alert the operator to any changes in the consistency of the process.

Similar applications have been achieved after the proofing or dough-scoring process. Several outside variables can affect dough proofing, such as the external environment (temperature and humidity), dough hydration, the amount or quality of yeast used in ingredients, and mechanical factors. Again, installing VPC capabilities after the proofing and scoring can ensure this process is happening correctly.

Post-baking inspection. Many mass-produced baked products enter the oven in individual lanes. Within the oven and above these lanes are individual heating elements controlled by the production operator, who oversees whether products are baked uniformly across the entire belt width. Assuming dough forming and proofing processes maintain visual standards, which are managed by VPC systems, another vision inspection checkpoint at the oven exit can monitor the baked color of each unit exiting the oven.

COURTESY OF A. MCGHIE

If the system detects a change in bake color over time—generally by evaluating the color of the outside crust of the final product—it can alert the production operator as to whether a specific lane or collection of lanes may need adjustment or repair. A manual alarm or automated control accomplishes this in an in-line rejection system. Additionally, because the FPI is analyzing products in real time, the operator can review the timeline of data to determine whether a protocol may be necessary to adjust their processes for routinely checking their oven performance.

> Many bakeries consider vision inspection technology a black box solution: install the equipment, apply a product code and, just like that, you have achieved 100% control of every aspect of your product line. Unfortunately, this is not the case.

Some baked goods have ingredients applied to the outside the product before or after baking. Examples include seeds, chocolate chips, glazes, colored seasonings, meats, vegetables, and many others, all of which come at a cost to the baking operation. As a result, ingredient and topping control is vital for managing operating costs.

Additionally, some products may have branded designs, logos, and other cosmetic features stamped onto the product at certain stages. Automated machines apply these features under tight constraints and require high repeatability. Over time and for various reasons, these applicator machines can clog, run out of alignment, or over-apply ingredients, resulting in an out-of-spec product.

Integrating a VPC system directly after applicators and product stampers can help operators keep tabs on the performance of these machines. This vision application can help companies avoid fatal errors in their process and control ingredient costs by capturing insights that may go unnoticed by human inspectors.

Food safety efforts. As with most food production processes, bakeries are susceptible to unwanted foreign objects finding their way into their products at any point before packaging. Some companies employ foreign material detection equipment—primarily metal detection X-ray systems—to identify potentially hazardous items on or within products. These methods are great for identifying dense materials, but most low-density objects, such as paper, hair, films, and like-colored objects, tend to proceed unnoticed.

Hyperspectral imaging technology used for advanced foreign body detection and classification is one of the more recent innovations in vision inspection. Hyperspectral imaging acquires images of the products at different wavelengths by incorporating spectroscopic measurement capabilities, thereby providing a better

way to detect and classify foreign bodies on the outer surface of baked products. This advanced application benefits baked products with toppings, including muffins, cookies, snack cakes, frozen pizza, and others, where color inspection cannot provide the complete picture.

Artificial intelligence (AI) also has a growing role in inspection. AI models trained to identify typical defects and anomalies help companies expand their inspection capabilities while improving their ease of use. The automated learning of product features and specifications reduces complexity and promotes continuous operations, helping systems to function for longer periods of time and at pristine accuracy.

Implementing Vision Inspection

The vision implementation process at a baking operation may seem daunting at first, but the effort put forth in the beginning will help companies achieve a faster payback in the long run. It is essential to start the planning process simply, remain patient, and choose a dependable vision inspection expert who will work closely on your objectives, which will be the cornerstones to success.

Above all else, aligning the goals of your quality assurance (QA) and production teams is essential to a favorable outcome; however, despite working closely together in a baking operation, QC and production teams have different and, at times, contrasting performance metrics. The QC team is measured on their ability to implement processes to ensure high product quality standards that meet consumer expectations. On the other hand, the production team's focus is to maintain an efficient production process to create, package, and ship baked goods in the demanded volumes and time frames.

> Vision inspection technology aims to improve quality, not create waste; setting standards too high will lead to too many rejected products, while too low will introduce too much variation in quality.

Many bakeries consider vision inspection technology a black box solution; Install the equipment, apply a product code, and, just like that, you have achieved 100% control of every aspect of your product line. Unfortunately, this is not the case.

The best route is to begin by considering the most critical individual traits of your products, the ones that matter most to your consumers. It may be the baked color of your cookie, the uniform diameter or height of your bagel, or the distribution of toast marks on your tortilla; those one or two features may be where to begin your journey. Again, input from your QC and production teams during this process is vitally important.

Remember, vision inspection technology aims to improve quality, not create waste. Setting standards too high will lead to too many rejected products, while standards that are too low will introduce too much variation in quality. Operating environments and ingredient quality can also affect the final product's appearance. Baking during the hot summer months may yield a vastly different product than during the winter, or a flour delivery from one harvest may produce a noticeably different product than the next. If you purchase ingredients from other suppliers, take samples from those formulations and determine where any differences may occur.

Collaboration is critical at every step of the vision system integration process. All stakeholders play an integral role in the process; however, selecting a trustworthy vendor who can set realistic expectations, offer guidance, ask the right questions, and promptly respond with answers to your questions while keeping to the negotiated budget and timeline is what makes success attainable. ■

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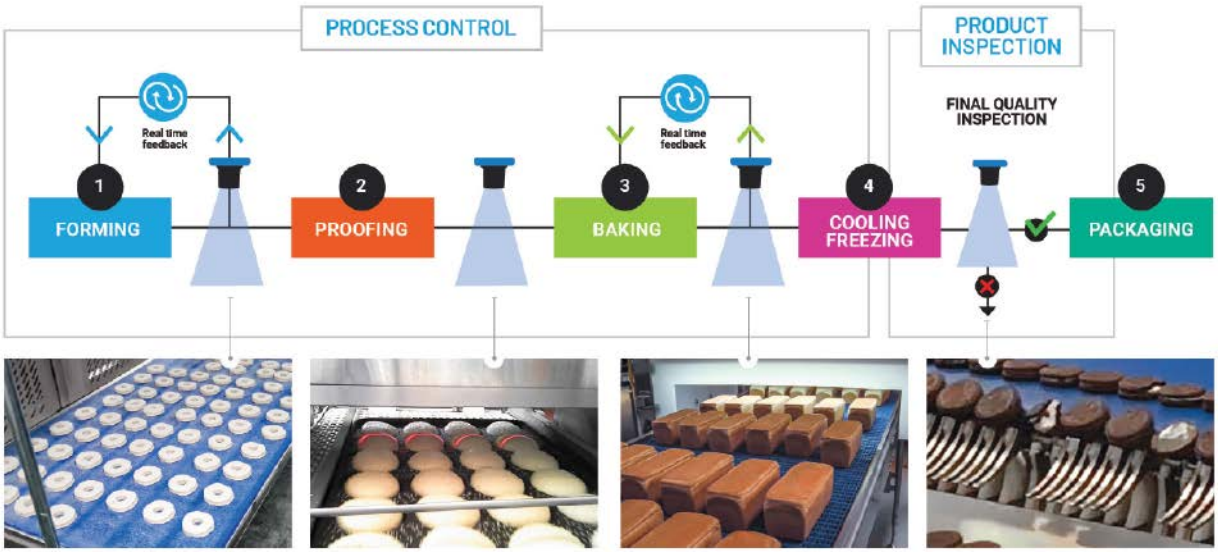

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More bakeries have discovered uses for vision inspection technology to monitor the quality of their process (Steps 1-4). This emerging technology falls into a category called vision process control.

New Product Development in the Food Industry

Compliant design can help your company through regulatory hurdles

BY **WES FRIERSON**

The food and beverage landscape is rapidly evolving, driven by shifting consumer preferences, emerging market opportunities, and changing trends. Food and beverage manufacturers in the U.S. and worldwide face a host of pressures that demand a fresh approach to stay competitive.

New product development (NPD) and reformulation are pivotal in keeping these companies at the forefront of the food industry; however, the journey from concept to consumer is complex, marked by a failure rate ranging from 30% to 40%, according to a 2022 report published in the *Journal of Marketing and Consumer Behaviour in Emerging Markets*. (doi: 10.7172/2449-6634.jmcbem.2022.1.4) To launch to market quickly, companies must rapidly translate consumer insights into innovative products, source safe ingredients, and navigate the commercialization process while avoiding compliance issues that erode consumer trust.

Embedding compliance insights throughout the product development process can not only enhance innovation but also increases speed, collaboration, data utilization, productivity, and resilience. Additionally, taking a proactive approach to compliance can lead to stable and future-proof products that are capable of meeting ever-evolving regulations and customer requirements.

Navigating Product Development Challenges

Guarding against safety and compliance risks is critical for food and beverage brands, and the stakes are high; compliance issues can erode consumer trust and result in substantial costs, both as an immediate financial impact and for a brand's reputation. The average cost of a product recall, including notification, product retrieval, storage, replacement, and destruction, can reach up to $10 million, while larger recalls can exceed $100 million.

The complexities of the global market have further amplified these risks. As supply chains expand and become more interconnected across borders, the integrity and transparency of these networks are tested. Natural disasters, geopolitical events, cyberattacks, and other disruptions are increasingly commonplace, with 56% of companies worldwide suffering some form of supply chain disruption each year, according to a 2022 report published in the *Annals of Operations Research* (doi: 0.1007/s10479-020-03912-1). Risks now cascade worldwide through supply networks, emphasizing the need for agility and resilience in product development, procurement, and compliance.

In this pressurized environment, the U.S. food and beverage industry is experiencing a surge in workload. This increase is straining processes and tools that were once effective. To adapt to this new landscape, innovative solutions are required to handle the heightened volume and complexity while providing superior quality, efficiency, and insights.

The Power of Regulatory Insight

Regulatory insight is the key to navigating this challenging terrain. In the current product development model, organizational silos often hinder efficient innovation. Compliance is viewed as an obstacle rather than an enabler, while manual processes slow down data sharing and impede productivity. Outdated systems are ill equipped to handle the ever-increasing complexity of requirements.

In addition, legacy workflows can also struggle to support the industry's evolving needs. Rigid hand-off sequences between functions create bottlenecks that prolong development cycles, increase risk exposure, delay product launches, and affect revenue generation. Meanwhile, the late-stage discovery of compliance issues frequently leads to expensive modifications that eat into profit margins.

Compliant Design

To address these challenges, the food and beverage industry is turning to an approach called compliant design, which involves proactively embedding compliance checks and data-driven insights into the product development process—from the concept stage onward. Compliant design not only accelerates innovation but also reduces risk and improves opportunities for collaboration, leading to more stable and future-proof products.

By understanding today's key regulations and anticipating those of tomorrow, brands can begin to think in the longer term, avoiding decisions that could lead to product reformulation shortly after launch. Improved tools and enhanced compliance visibility empower teams to make decisions that satisfy initial requirements, while also ensuring the ease of future compliance and increased sales through additional claims that enhance market opportunities.

For example, when choosing flavorings or colorings, manufacturers can simulate product scenarios to ensure that compliance is met in multiple markets. This strategy guarantees informed choices that maximize resources and opportunities. Plus, it prevents costly late-stage redesigns that occur when compliance issues are discovered at the last minute, and fosters faster, more resilient innovation cycles that are driven by real-time data.

Shift Left to Achieve Efficiency

Inspired by the world of software development, shifting left moves testing and QC processes to a point earlier in the development cycle so that manufacturers can tackle unforeseen issues before it is too late or added costs occur.

Considering compliance during design stages also offers several organizational advantages, including reduced time to market through faster, informed decision-making that reduces costly holdups that can occur when regulatory input is provided later in the process. Additionally, by empowering non-regulatory stakeholders to access compliance insights independently, organizations can reduce issues with prototypes while minimizing back-and-forth communication during the process.

A shift-left approach also enables product developers to take multiple market formulations into consideration by including potential additional markets' regulatory requirements from the outset. This subsequently improves second-round innovation speed by ensuring the early selection of appropriate ingredients and suppliers. The early identification of potential ingredient risks can help mitigate issues involving safety, quality, or scarcity caused by factors such as supplier quality, geopolitical conditions, or climate. Insights into changes in consumer trends and the regulatory landscape can also help prevent unnecessary reformulations.

Compliant design not only accelerates innovation but also reduces risk and improves opportunities for collaboration, leading to more stable and future-proof products.

Improve Collaboration

Compliance in design helps to break down organizational silos between teams such as R&D and regulatory affairs, promoting greater organizational efficiency. This, in turn, reduces churn and disconnect across these teams, minimizing iterations and latency throughout the process. By integrating compliance intelligence into product design and fostering cross-functional transparency, R&D teams can make supported decisions early on, creating innovative prototypes that are highly compliant from the outset.

This approach provides the various business functions with improved visibility into all processes and constraints, promoting cross-departmental understanding and connection. It also reframes the regulatory team as an essential collaborator rather than a roadblock, shifting the focus toward creating more value-added opportunities that drive innovation and transformation for the business, while reducing the time spent on monotonous validation exercises, such as searching for regulations, inputting data, and manually assessing compliance requirements. By capturing organizational knowledge within a centralized hub integrated with product lifecycle management (PLM) and enterprise resource planning (ERP) tools, decision makers can leverage organizational standards and historical insights to drive continuous improvement, resulting in higher quality products.

Centralized, up-to-date regulatory and product data repositories also reduce the time spent scanning fragmented information sources. Proactive alerts on regulatory and supply chain issues enable a "manage by exception" approach to risk mitigation, replacing the effort required for manual issue monitoring. R&D teams can dedicate more time to "Big I" innovation, as opposed to reworking products to meet compliance requirements. Regulatory teams spend less time trying to connect the dots; instead, they create the space to pursue important objectives, including policy feedback, advocacy, and stakeholder education.

An essential success factor for compliant design is having these capabilities thoughtfully integrated into the process. Integrating compliant design solutions into current PLM and ERP systems fuels transformation without disruption, enhancing existing development and NPD processes and leading to high-value

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realization for the effort. Integration for ease of adoption is crucial, as it minimizes the need for retraining and keeps change management minimal. Organizational buy-in is the natural result, as teams watch the technology take on many more tasks and improve outcomes.

Harmonize AI and Human Expertise

Compliant design harnesses machine learning and artificial intelligence (AI) alongside human expertise to unlock the true value of compliance data. AI can not only accelerate assessment and identify risks but can also alert teams to issues that might be difficult to identify manually. Advanced algorithms, often trained on your specific historical data and best practices, can generate profound and actionable insights throughout the product development lifecycle.

Machine learning technology supports proactive risk mitigation by detecting patterns and trends that can predict regulatory or supply chain issues. This data is then validated by human experts for accuracy and contextual meaning, facilitating proactive engagement with regulatory bodies for official guidance on their interpretation.

AI has the ability to generate trend insights in relation to specific ingredients, applications, and consumer sentiment, helping manufacturers to better understand their market and leverage this understanding to gain competitiveness. This technology can also simulate and scenario test virtual formulations, accelerating development and supporting successful launches. By adopting an expertise-augmented approach, organizations can achieve better insight quality and forecasting than either human experts or AI can achieve in isolation.

Organizational Evolution through Compliant Design

With the evolution of the food and beverage industry progressing at an unprecedented pace, embracing innovative approaches to product development is key for both competitive advantage and consumer trust. Compliant design is transformative, modernizing product development lifecycles by providing relevant insights to the right people at each stage, identifying issues faster, and supporting more effective and decision making. Compliant design not only accelerates innovation but also establishes product stability and compliance in a changing regulatory landscape.

By shifting left and breaking down silos, manufacturers can streamline processes while leveraging the combined power of AI and human expertise, achieving greater efficiency and value. The future of the industry belongs to those who can adapt, innovate, and respond swiftly to the complex challenges it presents. ■

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Testing

Multi-Pathogen Enrichment Media

This valuable tool can enhance efficiency, accuracy, and sustainability in food testing

BY **SERGIY OLISHEVSKYY, PHD**

Detecting foodborne bacteria has never been easy. Pathogenic bacteria are often sparsely distributed throughout food batches and can be present in very low numbers in randomly collected food samples. Further, the diversity of normal flora found in various food matrices creates a complex and dynamic microbial ecosystem that could interfere with the detection of target pathogens. Microbial dynamics are also influenced by food's microstructure and chemical composition, which adds additional complexity to the detection process. Consequently, the detection of foodborne pathogens requires, first and foremost, accurate and reliable techniques to effectively maintain food safety.

Conventional culture-based methods, which were developed and implemented several decades ago, continue to deliver a reliable but conservative solution, capable of detecting as few as one target cell per 25g to 325g food sample. These methods are still widely regarded as gold standards for detecting foodborne pathogens, due to their precision and accuracy; however, these traditional methodologies are time-consuming, taking more than a week to provide a final result. Moreover, each identified pathogen requires independent protocols, which is neither convenient nor compatible with today's intense production needs.

To address the shortcomings of traditional detection methods, numerous molecular techniques have been developed and used effectively in the past decade to detect foodborne pathogens. The development of real-time quantitative polymerase chain reaction (qPCR) has revolutionized microbiological analysis by enabling the detection of pathogenic microorganisms in food without the need for the labor-intensive and time-consuming procedures of isolation and identification. This method has dramatically reduced the time-to-result, which is a critical performance standard used to evaluate the effectiveness of a detection tool, alongside assay sensitivity.

The qPCR method not only provides faster, more sensitive, and specific results than traditional PCR methods, but also offers the potential for multiplexing, which means it can simultaneously detect multiple pathogens in the same reaction, enhancing operational efficiency and reducing overall costs. Numerous food commodities, including shellfish, fresh fruits and vegetables, dairy, and meat products, have been found to be contaminated with multiple pathogens of concern, such as *Salmonella enterica*, *Listeria monocytogenes*, and *Escherichia coli*, along with diverse species of *Shigella*, *Campylobacter*, and *Vibrio*. Consequently, simultaneous detection of multiple pathogens on a single-assay platform aligns with contemporary food industry trends and could also mitigate industry and regulatory needs in the mandatory testing of food products for a range of pathogens prior to distribution.

The Enrichment Step

While the potential advantages of qPCR multiplexing may seem apparent, it's important to consider the sensitivity of these detection platforms. To guarantee the achievement of legal limits (absence in 25g for most bacterial pathogens), an enrichment step using microbiological culture media is still required prior to qPCR detection. Integrating both traditional microbiological enrichment and molecular pathogen detection serves as a useful bridge that links traditional and molecular microbiology. This approach offers combined benefits while also

reducing some of the limitations associated with each method.

If performed appropriately, a short enrichment step is typically sufficient to "produce enough DNA" for subsequent qPCR detection. Moreover, the enrichment process not only increases the concentration of target pathogens in the sample but also revitalizes physiologically stressed or injured microbial cells. Selective enrichment is also crucial for suppressing the naturally occurring background microorganisms, enhancing detection efficiency, and preventing false positive outcomes; however, some of the drawbacks of selective enrichment media include the inhibitory nature of selective agents, which may slow down the growth or even suppress recovery of healthy or stressed target pathogens, ultimately impacting the detection process.

Numerous microbiological culture media with optimized selectivity have been validated and commercialized for short, single-step enrichments for the detection of foodborne pathogens such as *Salmonella*, *Listeria*, *E. coli*, and *Campylobacter*, across a variety of simplex qPCR assay platforms.

Multiplex qPCR Assays

When a multiplex format is desired, the situation becomes significantly different. Most multiplex qPCR applications are non-commercial and developed in house and open assays, which require standardization and quality assurance for molecular diagnostics. Additionally, multiplex diagnostics are only effective at detecting all target pathogens if they are properly enriched to detectable levels. Overcoming this challenge is difficult since the optimal conditions for detecting one pathogen may not benefit another, and competition among microflora can negatively affect the detection of other pathogens.

Currently, two different approaches are used to enrich food samples prior to detection by multiplex qPCR assays. The first approach involves using non-selective media, such as buffered peptone water (BPW) and universal pre-enrichment broth (UPB), for simultaneous enrichment of multiple foodborne pathogens, including *Listeria*, *Salmonella*, and *E. coli*, in food and environmental samples, followed by detection

Simultaneous detection of multiple pathogens on a single-assay platform aligns with contemporary food industry trends and could also mitigate industry and regulatory needs in the mandatory testing of food products for a range of pathogens prior to distribution.

using multiplex qPCR. However, these broths may recover and enrich target pathogens along with background flora, which can lead to false negative detection results, particularly when complex interfering flora is present in the tested food samples. Therefore, using traditional non-selective enrichment media may not be appropriate for samples with high levels of background microflora, such as raw or unprocessed samples from animal and plant origins.

The second approach employs traditional selective enrichment broths, which help to eliminate interference from background flora in food samples; however, this method necessitates separate enrichment for each type of bacteria being tested. Once each bacterium is individually enriched, small aliquots of the samples are combined into a single diagnostic run. Nevertheless, as multiplex detection platforms evolve to handle several pathogens in a single assay format, it is also important that the enrichment procedures evolve accordingly. Ideally, a single enrichment medium should be used to fully take advantage of multiplexing capabilities.

Desirable for multiplex detection, a multi-pathogen enrichment broth should have the capability to recover sublethally injured cells and selectively enrich all target pathogens from complex background flora in each single or composite food sample. The development of a universal multi-pathogen enrichment medium has become urgent for enabling the simultaneous recovery and concurrent growth of multiple types of bacteria in a single step, making multiplex testing more efficient and cost effective.

Media Development

Developing universal multi-pathogen media requires the careful consideration of several crucial features to guarantee optimal effectiveness and functionality. One such essential characteristic is the ability to simplify the testing process by reducing the required enrichments. Hence, the media should be designed to support multiple bacterial types in a single broth, allowing for greater versatility in testing various food commodities for different target bacteria. This flexibility can streamline the workflow in a food safety testing lab by eliminating the need for multiple culture media preparations and minimizing the risk of errors. Consequently, multi-pathogen media should be formulated with specific nutrients and inhibitors to promote the growth of target bacteria while inhibiting the growth of other bacteria. Such selective enrichment increases the concentration of target bacteria in the sample, improving the sensitivity of subsequent multiplex detection assays, thus ensuring more reliable and accurate outcomes and reducing the risk of false positives or false negatives.

Additionally, multi-pathogen media can enhance the recovery of stressed or sub-lethally injured bacteria that may not grow well in traditional enrichment media, thereby eliminating the possibility of false negative results. The ability to detect stressed or injured pathogenic bacteria is highly desirable in the safety testing of various processed food commodities, such as pasteurized dairy products, deli meats, canned food products,

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and others. This is because the presence of such bacteria can pose significant risks to consumer health. By identifying these harmful microorganisms, appropriate measures can be taken to prevent their proliferation and minimize the chances of foodborne illness.

Another notable feature of multi-pathogen enrichment media is their ability to support the concurrent growth of different types of bacteria with varying nutritional requirements. Traditional enrichment media are often formulated with specific nutrients to support the growth of a particular type of bacteria, which may not be suitable for other types of bacteria. In contrast, multi-pathogen enrichment media must be formulated with a broad range of nutrients that can simultaneously support the growth of different types of bacteria. Adding specific repair-stimulating and growth-boosting factors, such as siderophores, amino acids, phospholipids, vitamins, and minerals, can help improve recovery and reduce adaptation period for slow-growing bacteria, making multi-pathogen enrichment media versatile and adaptable for various food safety testing applications.

A food sample ready for enrichment with a liquid culture medium.

Moreover, multi-pathogen enrichment media can be tailored to specific food matrices, which may vary in their composition and characteristics. Different food types, such as meat, poultry, dairy, fresh produce, and processed foods, may require different enrichment media to facilitate effective recovery of target bacteria due to variations in pH and osmolarity, nutrient content or preservatives, etc. Multi-pathogen enrichment media that contain buffering systems, and osmoprotective and neutralizing molecules can provide optimal conditions for the growth and recovery of specific pathogens in different food matrices. This can result in more accurate and reliable food safety testing outcomes, ultimately enhancing the safety and quality of food products.

Using multi-pathogen enrichment media not only provides optimal growth conditions for specific pathogens in different food matrices, but also reduces the cost and storage space required to manage them in a food safety testing lab.

Recent investigations into multi-pathogen enrichment media for multiplex foodborne pathogen testing have shown great promise in developing a universal selective enrichment broth. By balancing concentrations of different selective agents and optimizing selectivity levels, it is now possible to achieve simultaneous enrichment of some of the most prevalent foodborne pathogens, such as *L. monocytogenes*, *Salmonella*, *Shigella*, *E. coli*, and *Staphylococcus aureus*. While these media formulations have primarily been tested using in-house multiplex qPCR detection platforms, they are not yet commercially available.

As an alternative, in the case of difficult-to-culture foodborne pathogens such as *Campylobacter* spp., which have unique growth requirements and cannot be enriched in a universal multi-pathogen medium, multiplex testing can be achieved through the combination of enrichment aliquots into a single multiplex run sample.

Multiple Benefits

Using multi-pathogen enrichment media not only provides optimal growth conditions for specific pathogens in different food matrices, but also reduces the cost and storage space required to manage them in a food safety testing lab. This is particularly beneficial for labs with limited resources or space constraints. In addition, multi-pathogen enrichment media can also contribute to sustainability efforts in food safety testing labs. Traditional enrichment media often generate a significant amount of waste, including leftover liquid media and disposable plastic containers. In contrast, using multi-pathogen enrichment media can reduce waste by requiring fewer media formulations and packaging materials. This can promote an environmentally friendly approach to food safety testing, aligning with the increasing focus on sustainability and eco-friendly practices in the food industry.

While multi-pathogen enrichment media offer numerous benefits and features, they require careful validation to ensure compatibility with different multiplex detection platforms. Each multi-pathogen enrichment medium must be validated for its ability to effectively enrich the target bacteria and meet the sensitivity requirements of multiplex assays in detecting these bacteria. This validation process ensures that multi-pathogen enrichment media are reliable and accurate for use in food safety testing, enabling the detection of multiple pathogens in a single assay.

Incorporating universal multi-pathogen media into the enrichment process before testing complements the multiplex detection platform as a comprehensive package technology that evolves to handle multiple pathogens in a rapid, single assay format. The use of the media is a valuable tool in food safety testing, providing numerous benefits and features that can enhance the efficiency, accuracy, and sustainability of the testing process. As food safety remains a top priority in the food industry, the adoption of multi-pathogen enrichment media can significantly contribute to more efficient and reliable multiplex detection methods, ultimately protecting consumer health and well-being. ■

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Total Waste Management

Incorporate innovative solutions for food waste to reach your sustainability goals

BY **KURT WIRGAU**

For more than two decades, the total waste management (TWM) concept has been credited with successfully shaping sustainability programs for some of the world's largest and most influential brands. This model is designed to consolidate indirect services and implement fiscally responsible practices for moving material up the Environmental Protection Agency's (EPA's) waste hierarchy. Although not yet widely adopted across the food and beverage (F&B) industry, the model is an approach that could be part of a food manufacturer's journey to both environmental and financial sustainability.

The EPA Wasted Food Scale has been set forth as a specific set of guidelines for the F&B industry to follow (see image, p. 30). By using this scale of recommendations, food manufacturers can reduce the environmental impacts of wasted food through upcycling, animal feeds, composting, or anaerobic digestion; however, this path toward greater sustainability can be daunting and many companies are ill equipped to tackle it on their own.

With constraints on landfill capacity and more food waste legislation popping up across the country, the need for broad implementation of TWM within the F&B sector is more prevalent than ever before. Furthermore, organizations and manufacturers that adopt a TWM plan often find additional support in the wide range of ancillary services offered through these comprehensive programs.

Assess the Situation

One significant ancillary service is the initial site assessment process. It is not uncommon for reputable TWM providers to offer no-cost assessments as a means of understanding where each facility currently sits along their sustainability journey. It is anticipated that each facility's path toward success will be as unique as the products they manufacture. Having experienced personnel who can engage with manufacturers to help understand their waste and recycling aspirations and hurdles can be a beneficial first step. Seeing firsthand process flows of all byproducts is critical in shaping how a TWM program can generate the enduring value that manufacturers desire.

Although it's not uncommon for food manufacturers to feel the immediate impacts of a well-managed TWM program, it is important to keep in mind that sustainability journeys are not completed overnight. Creating a roadmap for success and executing that vision is only possible with a strong partnership and aligned expectations.

Vetting Waste Outlets

The key to finding a total waste solution is identifying outlets that serve a higher purpose for otherwise discarded materials such as cardboard, plastic, drums, or food byproducts. Vetting your waste

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outlets means locating permitted facilities that can not only handle the intake of material but can do so in a safe and compliant manner. In the F&B space, this routinely results in food waste being converted into sellable products.

This is where the EPA Wasted Food Scale comes into play. You can use the sliding scale of most-preferred to least-preferred methods while vetting your waste outlets to determine the best course of action for each byproduct. Many asset-based waste providers are limited in their ability to manage materials, whereas the correct TWM provider will consider all available solutions to help your company select the optimal disposal (or repurposing) method for each and every material while adhering to the corporate guidelines of each manufacturer.

Product Recall Support

One of the most challenging tasks for any manufacturer is the sudden need to dispose of product as waste. Most F&B companies experience this in the form of product recalls resulting from contaminated products or products that no longer meet brand standards. The impact of a recall often spans multiple facilities, and a TWM partner can be critical in coordinating efforts across numerous sites.

It's important to understand how sensitive a recall is and how the responsiveness with which it's addressed can make all the difference for a successful program. Having an experienced TWM partner that can streamline the logistics, labor, and supporting documentation demands of these recalls is invaluable. The ability to engage with regulatory agencies on behalf of the generator, and to proactively discuss and address potential concerns, will ensure that protocols are followed in a safe, compliant, and effective manner.

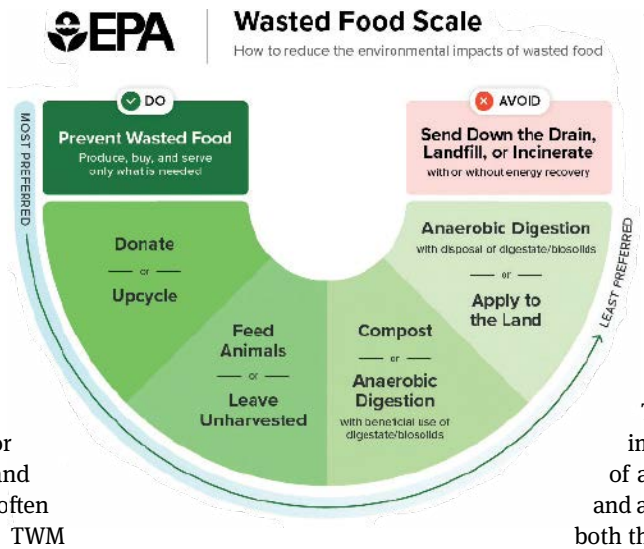
Regulation

The F&B space is a highly regulated industry, and application of FDA's Food Safety Modernization Act (FSMA) is a big part of what an experienced TWM partner brings to the table. FSMA, enacted in 2011, is intended to shift the focus of food safety from responding to foodborne illnesses preventing them. A TWM plan can aid companies in navigating this directive.

There are countless aspects in the F&B space that must be monitored and regulated for both customer and employee safety. Companies are constantly examining how their products are handled and stored. Evaluating how products move around a facility provides confirmation that codes and regulations are met while also minimizing events that could threaten the saleability of the product.

Food safety also requires careful evaluation of employee practices in an effort to eliminate contamination events. TWM partners can elevate those assessments by digging more deeply to proactively identify and manage potential threats.

A TWM program can help alleviate both the financial burden and rigorous regulations surrounding routine byproduct disposal and any necessary product destruction that may occur.



COURTESY OF EPA

Transparency and Traceability

Each step in a sustainability journey relies on the transparency and traceability of company decisions. When making changes to the way a byproduct is disposed of or repurposed, there must also be a plan for how those changes are documented and reported. An ancillary benefit to TWM is the ability to consolidate all waste and recycling services under one streamlined data tracking and reporting platform. A platform that can transform data into useful information can be used by both TWM providers and manufacturers to drive efficient process changes. These records not only hold a wealth of knowledge and insight but can and should be used for external audits and environmental, social, and governance reporting.

There is room for improvement in every plant and warehouse across the country; however, there is substantially more space for growth and change in the F&B sector, an industry that has yet to fully realize the benefits of a TWM program. There are countless variables that impact the day-to-day operations of a food manufacturing company, and a TWM program can help alleviate both the financial burden and rigorous regulations surrounding routine byproduct disposal and any necessary product destruction that may occur. By adding an extra layer of knowledge and experience, TWM plans inevitably create safer and more efficient workspaces.

From the auto industry to pharmaceuticals, manufacturers have found highly sustainable solutions through their partnership with TWM providers, and we are starting to see more and more F&B companies reap the benefits of these comprehensive programs. Having a strong program can give this sector the ability to focus on their core business of making quality products for their consumers, while leaving the dirty work to the waste experts. ■

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Supercooling Technology

This process can help minimize food loss, all along the supply chain

BY **CHRIS SOMOGYI**

Food waste is a serious and growing problem that affects all aspects of sustainability: the economic, the environmental, and the humanitarian. It's an overarching societal issue with global reach. Nearly one-third of all food produced each year is squandered or damaged before it can be consumed. While this spoilage can happen at any node along the food supply chain, the vast majority of food loss happens when perishable items spoil as they move through the cold chain.

In the U.S. alone, more than 119 billion pounds of food are discarded between harvest and the family dining room table. That equates to 130 billion meals and more than $408 billion in food thrown away each year, according to the latest statistics from Feeding America. There are solutions available to help address this global challenge that can and should be implemented at every point along the cold chain.

Food Waste Along the Supply Chain

From the moment a food item is plucked from the ground, picked from the tree, or pulled from the sea, the clock starts ticking on its lifespan. Each stop from harvest to table has a limited time allotment that affects the overall longevity of the product. If each stop along the way meets its time allocation, whether it's hours or days, the food arrives at its last stop—your plate—in time to be eaten and enjoyed. Food waste occurs when food is delayed at any point and it either doesn't make it past a particular stop or it creates a time crunch that cannot be overcome at the remaining stops along the chain. The result is a staggering $1 trillion dollars' worth of food being lost or wasted every year, according to statistics from Feeding America.

Here are some ways food loss can occur along the supply chain.

- **Farming**. Food loss at the farm level depends on many variables and differs significantly based on geography and the effects of mother nature. The majority of food waste at this stage happens at harvest time. Perishables such as fruits and vegetables need to be moved to appropriately cooled storage areas or transported quickly, or there can be pest infestations, mold, or spoilage. Nearly half of all fruits and vegetables produced globally are wasted each year due to inadequate post-harvest cooling and storage during their journey through the food cold chain. The effect of food wasted at the farm level can ripple through all of the resources used to grow the food, which magnifies the loss exponentially. Irrigation water, fertilizer, pesticides, herbicides, and agricultural labor are also lost. An estimated one billion acres of farmland are planted, fertilized, watered, and tended each year to grow crops that are, ultimately, wasted.
- **Manufacturing and transportation**. Human error, a lack of adequate standard operating procedures, processing time, and inefficient storage are the main causes of food waste at the manufacturing level, which account for more than 10% of food waste. Streamlining food processing, providing additional training for workers, and implementing more effective storage solutions could eliminate significant waste at this level. An estimated $5 billion of food is lost in the U.S. during transport throughout the food cold chain. Even refrigerated transport from farm or sea is not always enough to preserve the quality and safety of perishable food items. Millions of tons of food are discarded each year because they do not arrive at their intended destination before spoiling. Furthermore, it's not just the food that is wasted; 30% of all transport journeys and the fuel that drives them, as well as the human hours of driver labor, is also wasted (United Nations).
- **Retail**. The bulk of retail-level food loss occurs at grocery stores and restaurants. Waste happens when grocery retailers remove dented cans, misshapen or blemished produce items, overstocked specialty foods, and spoiled or expired foods from their shelves. Food waste in restaurants occurs at both the pre-

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paratory stage, primarily from overcooking and improper storage, and when the customer leaves uneaten food on their plate. Extra food that is not consumed at a buffet can also contribute to restaurant food waste. Wasted food from the retail sector is valued at about twice the amount of profit from food sales.

- **Consumer**. Consumer food waste is the food that is thrown away by households, restaurants, and retail outlets. According to a global report by the United Nations, consumer food waste accounts for 17% of the food available to consumers. The majority of this waste comes from households, which discard 11% of the total food available to consumers. The average household of four people wastes $2,760 per year on food that goes uneaten. Americans discard more food than any other country, nearly 40 million tons, wasting approximately one pound of food per person per day. Food that is prepared but left uneaten, or food that spoils in our fridges and cabinets, contributes to the 1.3 billion tons of food wasted each year globally.

Societal Implications

Food waste is a societal issue that affects food security, food quality and safety, economic development, and the environment.

- **Economic**. Food waste creates economic loss for all involved along the food cold supply chain, including consumers. Lost money resulting from food waste pushes up the price of food at each space along the supply chain.
- **Environmental**. Food is the single largest category of material placed in municipal landfills, according to FDA research. Wasting food has irreversible environmental consequences: It wastes the water and energy it took to produce it and generates greenhouse gases such as methane, carbon dioxide, and chlorofluorocarbons, which contribute to global warming and climate change. Wasted food contributes to 11% of the world's greenhouse gas emissions. According to the World Wildlife Federation, the production of wasted food in the United States is equivalent to the greenhouse emissions of 37 million cars. If we continue along this same path of food loss, the environmental impact could be disastrous.
- **Humanitarian**. Approximately 2.3 billion people (29.3% of the global population) were moderately or severely food insecure in 2021, according to the United Nations. But global hunger is not about a lack of food; right now the world produces enough food to nourish everyone on the planet. We need to find a way to drastically reduce food waste by keeping perishable foods fresh longer. According to the U.N. Food Agriculture Organization, reversing the current food waste trend would preserve enough food to feed 2 billion people. That is more than twice the number of food insecure people around the globe.

Supercooling technology can preserve perishable foods longer than traditional freezing.

Supercooling Technology

To reduce food loss and waste, we need to take action at all levels of the food system, from production to consumption. Preserving perishable foods longer at every spot along the food cold chain can extend shelf life by days and even weeks and significantly reducing the amount of food wasted.

Supercooling technology developed at the University of Hawaii in Honolulu and the Xerox Palo Alto Research Center in Palo Alto, Calif., is providing an effective alternative to traditional refrigeration and freezing. When produce is frozen during traditional freezing, water forms ice crystals and expands by 9%, bursting the cell walls allowing water to purge when thawed. This reduces the quality and value of produce. It's also why some foods can't be frozen and why others leach their goodness when they thaw (drip loss). Billions of dollars are lost each year as a result of produce that can't get to market because it can't be frozen or is damaged by freezing. It's an expensive problem for the food industry globally. The solution? When water is exposed to an external electric field, it undergoes polarization that re-orients and vibrates water molecules. In our process, we use an electric field and add an applied magnetic field, leading to the rearrangement of water molecules that prevents ice crystals from forming. It does this in temperatures well below the typical freezing point of water.

Using supercooling technology to store items below 0°C without freezing can dramatically extend the shelf life of foods, enabling preservation of food that could not previously be cold stored.

Using supercooling technology to store items below 0°C without freezing can dramatically extend the shelf life of foods and enables the preservation of food that could not previously be cold stored. This technology allows foods to be kept in a natural state, with the same taste, texture, nutrition, and moisture the foods had prior to storage, thereby maintaining product quality. This technology can be employed across the entire food cold chain system, independently or collectively, to preserve the integrity and quality of fresh foods.

Supercooling technology has the potential to revolutionize the way food is stored and transported. It's time to disrupt the process of freezing to improve food quality and preservation and stop wasting a precious resource that we rely on to survive. ■

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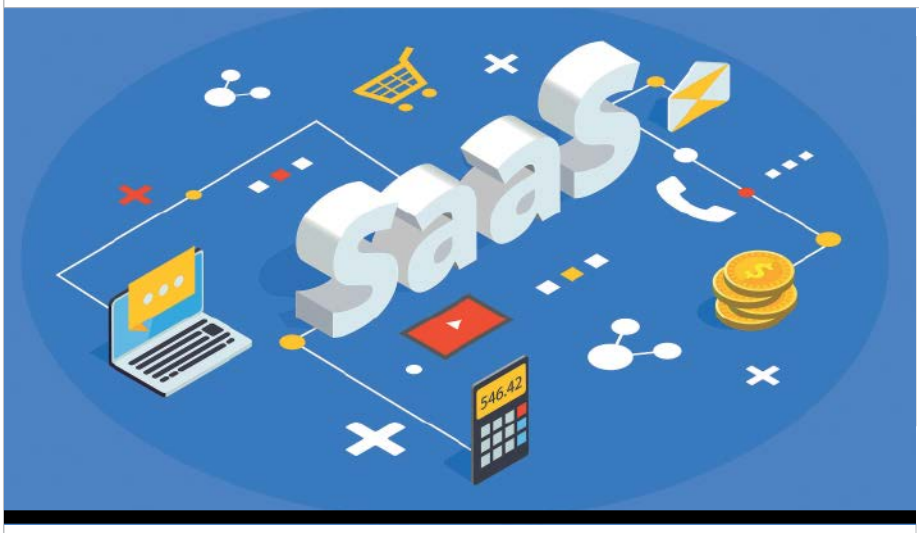

SaaS Solutions for Food Delivery

How software as a service can help improve food safety during the last mile

BY **ANAR MAMMADOV**

Food delivery is entering a new era. Improvements in online platforms, triggered in large part by the COVID-19 pandemic, have made it easier than ever for consumers to order groceries and prepare food. This new accessibility means that delivery needs have increased at a rapid pace.

For companies that provide food delivery services, food safety is a top concern. Improving the efficiency and affordability of deliveries while also ensuring food safety is a complex challenge, especially as companies seek to scale their operations. To meet the challenge, a growing number of companies are relying on the tools provided by software as a service (SaaS), which is a software licensing and delivery model in which software is licensed on a subscription basis and is centrally hosted.

Embracing a New Food Safety Blueprint

As the field of food delivery was scaling up during the pandemic, FDA issued an initiative aimed at guiding the food industry in what the agency dubbed a "new era of smarter food safety." This "blueprint" introduced four foundational principles that FDA hopes will "create a safer and more digital, traceable food system," in part by encouraging food delivery companies to leverage technology solutions.

The four pillars proposed include:

- **Tech-enabled traceability**: Key to this pillar is the standardization and digitalization of the data and processes used to track the movement of food.
- **Smarter tools and strategies for preventing and responding to outbreaks**: FDA highlights the value of AI-driven tools for driving this component of food safety.
- **Modernization of business models**: Encouraging and exploring the use of innovative digital tools is highlighted as critical for bringing business models into the modern era of food delivery.
- **Food safety culture**: Developing strategies that help consumer to understand and use tech tools that drive greater food safety is seen by the FDA as an important step in establishing a food safety culture among businesses and consumers.

Leverage SaaS to Build New Systems

Companies seeking to implement these food safety pillars will find SaaS platforms to be invaluable tools. Essentially, these platforms give businesses access to powerful digital tools without the burden of maintaining, upgrading, or making a long-term commitment. They are developed by third-party companies that provide support and ongoing development.

Food delivery service providers can access SaaS platforms via the cloud or by integrating them into their existing systems, giving employees seamless access from essentially any location. These platforms can lead to cost savings, scalability, security, and support.

In the food delivery space, optimizing delivery processes is one of the practical applications of SaaS platforms. SaaS can integrate with delivery management tools to power delivery route efficiency. By drawing on traffic, weather, and order data, SaaS platforms can dynamically map out the most efficient routes, and by cutting down on delivery times, businesses can lower the risk that food will spoil during transport.

SaaS can also contribute to delivery optimization by facilitating enhanced

(Continued on p. 34)

(Continued from p. 33)

customer communication. Miscommunication can lead to delivery delays that result in food spoilage. SaaS can reduce miscommunication by providing customers with easy access to communications channels and by automating the process of getting delivery updates to drivers.

Leveraging these systems for data analytics is another way to optimize delivery services, as the data gathered can be mined for insights into busy delivery zones, peak order times, driver performance, and other key metrics. By revealing inefficiencies in the delivery process and recommending changes, SaaS platforms can help companies develop more effective delivery strategies.

These platforms can also empower contactless delivery options, which minimize the risks of food contamination. By enhancing communication between customers and delivery services, SaaS can facilitate curbside pickups and lobby drop-offs. SaaS can also empower contactless payment systems.

In addition to ensuring that food is delivered with less risk of spoilage, SaaS platforms can also be used to improve driver safety by facilitating driver monitoring, which can be used to gather data on driver performance and road safety. AI-driven platforms can be used to analyze the data and develop safer routes and processes.

SaaS can also drive automated communication between delivery drivers and customers. As delivery times are updated, the system can notify customers, which allows drivers to stay focused on driving. Additionally, SaaS can be integrated with communication systems to provide drivers with hands-free communication, converting text messages to voice messages and enabling voice-activated commands.

New Levels of Flexibility

A key lesson learned from the COVID-19 pandemic is that customer needs can change rapidly and without warning as they did in the food delivery industry, in which the need for enhanced delivery capabilities and protocols increased dramatically in a very short period of time.

SaaS platforms provide companies with the versatility, agility, and efficiency to shift rapidly with evolving needs. By integrating them into current strategies, food delivery companies gain the capability to keep pace with consumer demands while also meeting key safety concerns. ■

Mammadov is CEO of Senpex Technology, a research and delivery service based in San Jose, Calif. He is a software development professional with more than 18 years of experience in enterprise solutions and mobile app development.

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WILEY

NEW PRODUCTS

Gear Oil

Renewable Lubricants has released the biodegradable Bio-Food Grade gear oils, which perform like synthetics but are odorless, tasteless, and have a USDA H-1 rating so they are safe for incidental food contact and can be used in food and beverage processing plants. They are recommended where DIN 51517 Part 3 or AGMA Mild-EP gear oil specifications are required for lubricating bearings, reduction units, and gear sets. The oils are well suited for gear drives and right-angle gear drives, as well as in filling machinery, cartoning, pick-and-place equipment, mixers, and more. Formulated from renewable agricultural biobased resources, the oils are non-toxic and zinc-free and contain no heavy metals. They are available in 1- and 5-gallon pails, 55-gallon drums, 275- and 330-gallon totes. **Renewable Lubricants, renewablelube.com.**

Fruit Inspection System

Neolithics has launched the Neolithics Light, an automated, portable produce inspection system. The technology eliminates inspection waste, improves productivity, and increases the volume of saleable product. Retailers, distributors, and food processors can eliminate manual, sample-destroying inspections using the system. The platform uses hyperspectral optics and AI frameworks to deliver insights such as nutrition levels, Brix sweetness, project shelf life, maturity, anomalies, and detection of different organic compound distribution both internally and externally. The hardware delivers spectral analysis of various organic materials while the software provides data management for grading and prediction. The system integrates with third-party logistics, supply chain, and processing hardware and ERP software. **Neolithics, neolithics.ai.**

Fiber-Based Egg Packaging

TekniPlex Consumer Products has launched the Fiber ProPlus Egg Cartons. Recyclable wherever paper and cardboard recycling is available, the cartons can provide product protection and perform on industry-standard packaging equipment. Bi-fold Egg Cartons comprised of 100% post-consumer recycled PET. Scheduled for market introduction in Q2 2024, the new cartons will be more than 15% lighter than tri-fold PET constructions. **TekniPlex, tekni-plex.com.**

LED Lights

Smart Vision Lights has introduced the RHI200-DO Lightgistics series light, which features 64 LEDs in a 205 mm x 205 mm ring light for intense uniform lighting at long working distances of up to 2000 mm. Equipped with hidden strobe technology, the light delivers the advantages of strobing without the disturbance and disorientation often linked to LED strobe lights. The hidden strobe technology allows the LEDs to automatically trigger thousands of times per second, pulsating at speeds imperceptible to the human eye and generating the appearance of uninterrupted illumination. The technology helps maximize the abilities of machine vision systems while safeguarding employees from the disorienting effects commonly associated with flashing lights. **Smart Vision Lights, smartvisionlights.com.**

Measuring Instruments

Khrone has launched a line of measuring instruments including the OPTIFLUX 6000, OPTISYS 8100, OPTISWITCH 6700, and the OPTIMASS 6400/1400. The OPTIFLUX 6000 electromagnetic flow sensor can serve hygienic applications. It combines with signal converters to form electromagnetic flowmeters that can measure the flow of liquids in food processing plants. The OPTISYS IND 8100 is a hygienic inductive conductivity measuring system for food and beverage applications. The compact stainless steel device also features a response time that makes it well-suited for applications such as monitoring liquid food processing, media separations, and cleaning operations. **Khrone, krohne.com.**

COURTESY OF RENEWABLE LUBE / TEKNIPLEX / NEOLITHICS / SMART VISION LIGHTS / KHRONE

FTIR Spectrophotometers

Shimadzu Scientific Instruments has introduced the IRSpirit-X series Fourier transform infrared (FTIR) spectrophotometers: the entry-level IRSpirit-LX, the high-sensitivity IRSpirit-TX, and the moisture-resistant IRSpirit-ZX. Housed in a small, lightweight design, they are equipped with the IR Pilot analysis navigation program, which enables operators unfamiliar with FTIR analysis to obtain data, and a spectrum advisor function that judges the quality of the measurement results and proposes how to obtain favorable data. The IRSpirit-X series features the smallest Shimadzu FTIRs, with an installation space the size of an A3 sheet of paper or smaller and a weight of 8.5 kg. The sample installation space is in accordance with industry standards, enabling the use of third-party attachments. The IRSpirit-X series is equipped with a spectrum advisor function that supports data acquisition. All parts except for the initial consumables in this series are guaranteed for 10 years to maintain instrument condition. **Shimadzu Scientific Instruments, ssi.shimadzu.com.**

Laboratory Fume Hood

The UniFlow CE AireStream is a full-duty fume hood that comes in a compact size, which offers 50% energy savings over conventional hoods. This hood is equipped with the the vector-slotted rear VaraFlow baffle system. CE fume hoods are offered in 30”, 36”, 48”, and 72” widths and can be equipped with a wide selection of accessories to meet specific process needs. The hoods are constructed of composite resin for chemical resistance and can be supplied with or without an exhaust blower in standard or explosion proof models. **HEMCO Corporation, hemcocorp.com.**

Custom Mixing System

Custom mixing systems from Indco are engineered to optimize processing projects including batch size, material properties, and agitation levels to achieve desired process results. The company can develop a mixing system that includes mixers and tanks from open-top designs to ASME jacketed vessels. Whether temperature is controlled to ensure viscosity of materials, to utilize heat as a catalyst, or for other reasons, jacketed tanks are often a crucial element of custom mixing system designs. The company can provide a fully integrated mixing tank and mixer design that includes tank jackets and other features such as polished and electropolished surfaces and dip tubes and drain valve designs. **Indco, indco.com.**

X-Ray Inspection Systems

Eagle Product Inspection has launched a hygienically constructed inspection system designed to maximize product throughput while ensuring that safety standards are met. The machine is equipped with image analysis software, SimulTask PRO, and enhanced dual energy detector, PXT, to deliver bone and metal detection, reduce false rejects, and minimize operational challenges related to manual labor. Its dual lanes can run up to 120 pieces per lane per minute. **Eagle Product Inspection, eaglepi.com.**

SCIENTIFIC FINDINGS

For access to the complete journal articles mentioned below, go to "Food Science Research" in the February/March 2024 issue at foodqualityandsafety.com, or type the headline of the article into the website's search box.

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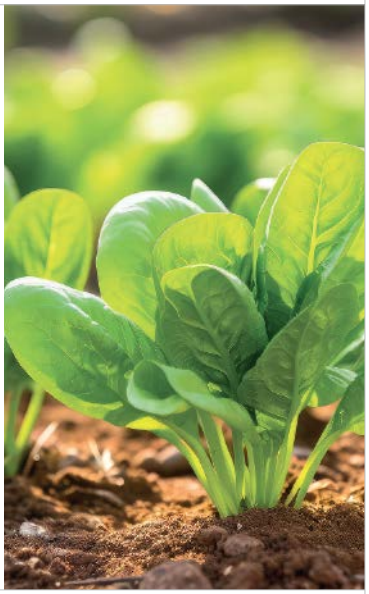
Milk Composition Is Key to Achieving Consistent Casein, Fat Retentions in Cheddar Cheese

Cheesemaking offers the opportunity to exploit the unique nutritional, sensory, biological, and other functionalities of both cheese and whey-derived products. Milk standardization is one of the essential cheesemaking operations designed to preserve the intrinsic cheese quality and may also improve whey composition because of its impact on partitioning of milk constituents between the two coproducts. The effectiveness of cheese milk standardization in controlling constituent partitioning depends on the method and ingredients selected. This review explores how and why cheese milk standardization affects the partitioning of casein and fat in cheddar cheese and provides some perspective on a better approach. ***International Journal of Dairy Technology.*** **2024;77:35-49.**

Alternative Biocontrol Strategies for Controlling Foodborne and Plant Pathogens

In the last decade, it has been observed that some zoonotic pathogenic bacteria can use plants as secondary hosts. Contamination with foodborne bacteria becomes relevant in foods that are regularly eaten raw, such as lettuce, cilantro, fenugreek, rocket leaves, basil, and some fruits such as tomatoes, melons, and green peppers; because the elimination of these pathogenic bacteria is difficult to achieve with conventional sanitization processes. Contamination of produce can occur throughout the entire production chain. In farmlands, pathogenic bacteria can contaminate the seed, mainly when contaminated water is used for irrigation. Later, bacteria can reach other plant tissues such as the stems, leaves, and fruits. Another form of contamination is when the produce is in contact with feces from domestic, production, or wild animals. Additionally, poor handling practices during harvest, packaging, distribution, and sale can contaminate produce. Studies have shown that foodborne pathogens can adhere to produce, sometimes forming a biofilm, and can also be internalized into the plant or fruit, which protects them from sanitation processes. The authors of this article suggest three biocontrol strategies such as bacteria, lytic bacteriophages, and some fungi, as an alternative approach for the control of both foodborne and plant pathogens. Additionally, the use of these biological agents can represent an advantage for the development of the plant, making them a good strategy to favor yield. ***Journal of Food Safety.*** **2024;44:e13100.**



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Microwave Pasteurization May Reduce Pathogens in Cooked Rice

Microbial contamination in cooked rice-based foods poses a global concern due to rice's widespread consumption. This review aims to consolidate information on harmful microorganisms associated with such foods from various countries and their adverse effects on consumers. Additionally, it explores the reported causes of microbial contamination in cooked rice-based dishes and proposes an intervention strategy for safer consumption. The findings highlight that ready-to-eat cooked rice-based foods may harbor unsafe levels of microorganisms like *Bacillus* cereus, *Staphylococcus aureus*, and *Aspergillus* spp. A recommended solution is the application of microwave pasteurization. This method involves cooking rice in pasteurized packaging, minimizing human contact, and effectively controlling harmful microorganisms. Microwave pasteurization emerges as a promising approach to ensure the safe consumption of cooked rice-based foods by reducing microbial contamination levels. ***Journal of Food Safety*****. 2023;43:e13090.**

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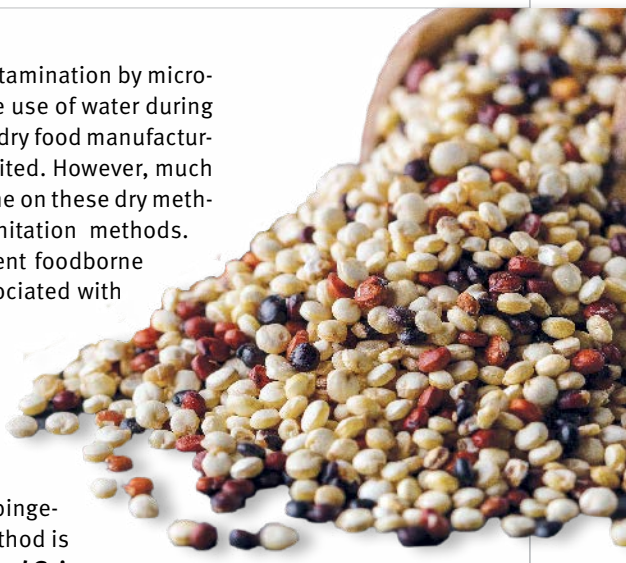
Food Safety for 3D-Printed Food

The rapid advancement of three-dimensional (3D) printing (i.e., a type of additive manufacturing) technology has brought about significant advances in various industries, including the food industry. Among its many potential benefits, 3D food printing offers a promising solution to deliver products meeting the unique nutritional needs of diverse populations while also promoting sustainability within the food system. However, this is an emerging field, and there are several aspects to consider when planning for use of 3D food printing for large-scale food production. This comprehensive review explores the importance of food safety when using 3D printing to produce food products, including pathogens of concern, machine hygiene, and cleanability, as well as the role of macronutrients and storage conditions in microbial risks. Furthermore, postprocessing factors such as packaging, transportation, and dispensing of 3D-printed foods are discussed. Finally, this review delves into barriers of implementation of 3D food printers and presents both the limitations and opportunities of the technology. ***Comprehensive Reviews in Food Safety*. 2024;23:1-22.**



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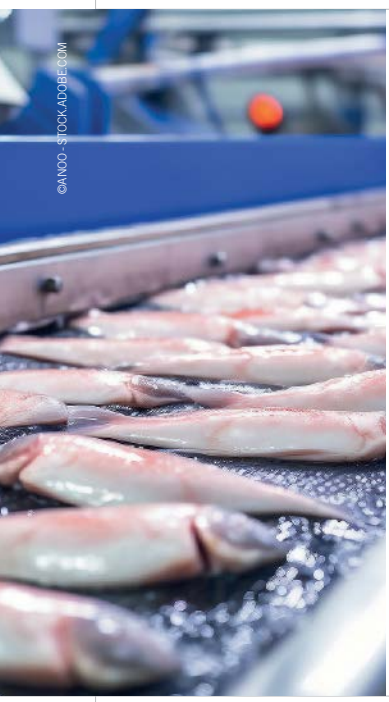
Dry Cleaning Methods for Low-Moisture Foods

Historically, low-moisture foods have been considered safe for human consumption due to the limited amount of moisture for microbial activity. Recalls of these foods due to pathogens such as *Salmonella* and undeclared allergens have brought attention to the need for improved cleaning and sanitization in dry food manufacturing facilities. In the food industry, cleaning and sanitation activities are the most efficient methods to prevent microbial contamination; however, water is most often required to deliver cleaning and sanitation agents. A well-written and properly implemented sanitation standard operating procedure can take care of microbial and allergen cross-contamination. Nevertheless, there are unique challenges to cleaning and sanitation processes for low-moisture food manufacturing facilities. The introduction of moisture into a low-moisture food environment increases the likelihood of cross-contamination by microbial pathogens. Hence, the use of water during cleaning and sanitation of dry food manufacturing facilities should be limited. However, much less research has been done on these dry methods compared to wet sanitation methods. This review discusses recent foodborne outbreaks and recalls associated with low-moisture foods the accepted methods for cleaning and sanitation in dry food manufacturing facilities and the limitations of these methods. The potential for air impingement as a dry-cleaning method is also detailed. ***Journal of Food Science*. Published online ahead of print on January 14, 2024. doi: 10.1111/1750-3841.16920.**



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Emerging Technologies in Seafood Processing

Seafood processing has traditionally been challenging due to the rapid spoilage rates and quality degradation of these products. With the rise of food science and technology, novel methods are being developed to overcome these challenges and improve seafood quality, shelf life, and safety. These methods range from high-pressure processing (HPP) to edible coatings, and their exploration and application in seafood processing are of great importance. This review synthesizes the recent advancements in various emerging technologies used in the seafood industry and critically evaluates their efficacy, challenges, and potential benefits. The technologies covered include HPP, ultrasound, pulsed electric field, plasma technologies, pulsed light, low-voltage electrostatic field, ozone, vacuum cooking, purified condensed smoke, microwave heating, and edible coating. Each technology offers unique advantages and presents specific challenges; however, their successful application largely depends on the nature of the seafood product and the desired result. HPP and microwave heating show exceptional promise in terms of quality retention and shelf-life extension. Edible coatings present a multifunctional approach, offering preservation and the potential enhancement of nutritional value. A SWOT analysis indicates that, despite the potential of these technologies, cost-effectiveness, scalability, regulatory considerations, and consumer acceptance remain crucial issues. As the seafood industry stands on the cusp of a technological revolution, understanding these nuances becomes imperative for sustainable growth. Future research should focus on technological refinements, understanding consumer perspectives, and developing regulatory frameworks to facilitate the adoption of these technologies in the seafood industry. ***Comprehensive Reviews in Food Safety*. 2024;23:1-30.**

Profiles

IN FOOD SAFETY

Frederick McKinley Jones Revolutionizes Food Transportation

BY **MARY BETH NIERENGARTEN**

Frederick McKinley Jones in front of a truck outfitted with a mobile refrigeration unit, circa 1950.

Frederick McKinley Jones was the definition of a self-made man. Born May 17, 1893, Jones would, in his lifetime, garner more than 60 patents for technological inventions as diverse as a movie-ticket dispenser, two-cycle engines, and, most notably, refrigeration technologies that for the first time allowed for the safe transportation of perishable foods and other products.

Without much formal education, he taught himself engineering and mechanical skills through extensive reading, hands-on experimentation, hard work, and a tenacity to solve problems. One such problem was how to transport perishable foods without spoilage.

The solution was Jones's invention of the first portable air-cooling device for trucks, for which he received a U.S. patent in 1940. This innovation led to the founding of the U.S. Thermo-Control Company—known today as Thermo King—in partnership with Minneapolis entrepreneur Joseph Numero. The device not only transformed the food industry, but profoundly impacted critical needs during wartime. In World War II, the U.S. military parachuted the air-cooling devices into combat areas to provide refrigeration for products such as plasma, drugs, food, and water that were critical to soldiers in the field. The devices were also used to cool B-29 bomber cockpits, ambulance planes, and field hospitals.

The invention launched a 15-year career for Jones as chief engineer and vice president of engineering at Thermo King, where he worked on additional refrigerator-related designs such as refrigerated containers that allowed for easy transport of food and other products from trucks to ships to planes and rail. "The innovative spirit of Frederick McKinley Jones is the reason the transport refrigeration industry exists," says Adam Wittwer, president of Thermo King Americas.

Early Life and Career

Calling out Jones's spirit is apt. He became an orphan at age 9 and, after a few years of being raised by a priest in Kentucky, Jones struck out on this own and made a livelihood for many years doing odd jobs, during which he developed and showed a knack for mechanics. After serving in the U.S. Army during World War I, he moved to Hallock, Minn., to perform mechanical work. He further educated himself in electronics and, by age 20, had earned the highest-grade engineering license in Minnesota available in the state.

During his years in Hallock, Jones contributed to the community with numerous inventions, such as a wireless transmitter used to broadcast programming for a new radio station in town, a portable X-ray machine, a snow machine (skis attached to the undercarriage of an old airplane body and an airplane propeller attached to a motor) for physicians to make house calls, and several devices that improved cinema.

It was through these innovations that Jones met Joseph Numero who, as head of Ultraphone Sound Systems in Minneapolis at the time, hired him as an electrical engineer. At age 38, Jones moved to Minneapolis to work for Numero and, within a decade, the two would move into the refrigeration business after Jones's seminal invention of the portable air-cooling device for trucks.

Legacy

In 1944, Jones became the first African American member of the American Society of Refrigeration Engineers and, in 1953, he received an award from the Phillis Wheatley Auxiliary "for outstanding achievements which serve as an inspiration for youth." In his acceptance speech for the award, Jones cited three traits for achieving success: lack of fear in getting your hands dirty, reading for self education, and believing in oneself.

Jones applied all three these tactics to his life, to great success. Recognition of his work continues long after his death in 1961. In 1977, he was inducted into the Minnesota Inventors Hall of Fame and, in 1991, he was awarded the President's National Medal of Technology. ■

Nierengarten is a freelance writer based in Minnesota. Reach her at mbeth@mnmedcom.com.

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pittcon.org

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futurefoodtechsf.com

12-16
National Products Expo West
Anaheim, Calif.
expowest.com

21-22
Future Food-Tech
San Francisco, Calif.
futurefoodtechsf.com

26-27
American Food Sure Summit
Atlanta, Ga.
americanfoodsure.com

APRIL 2024

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GFSI Conference
Sinagpore
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MAY 2024

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Western Food Safety Conference
Salinas, Calif.
thewesternfoodsafetyconference.com

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Food Safety Summit
Rosemont, Ill.
food-safety.com

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Vienna, Austria
iaea.org

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Food Sure Summit Europe
Madrid, Spain
foodsureeurope.com

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