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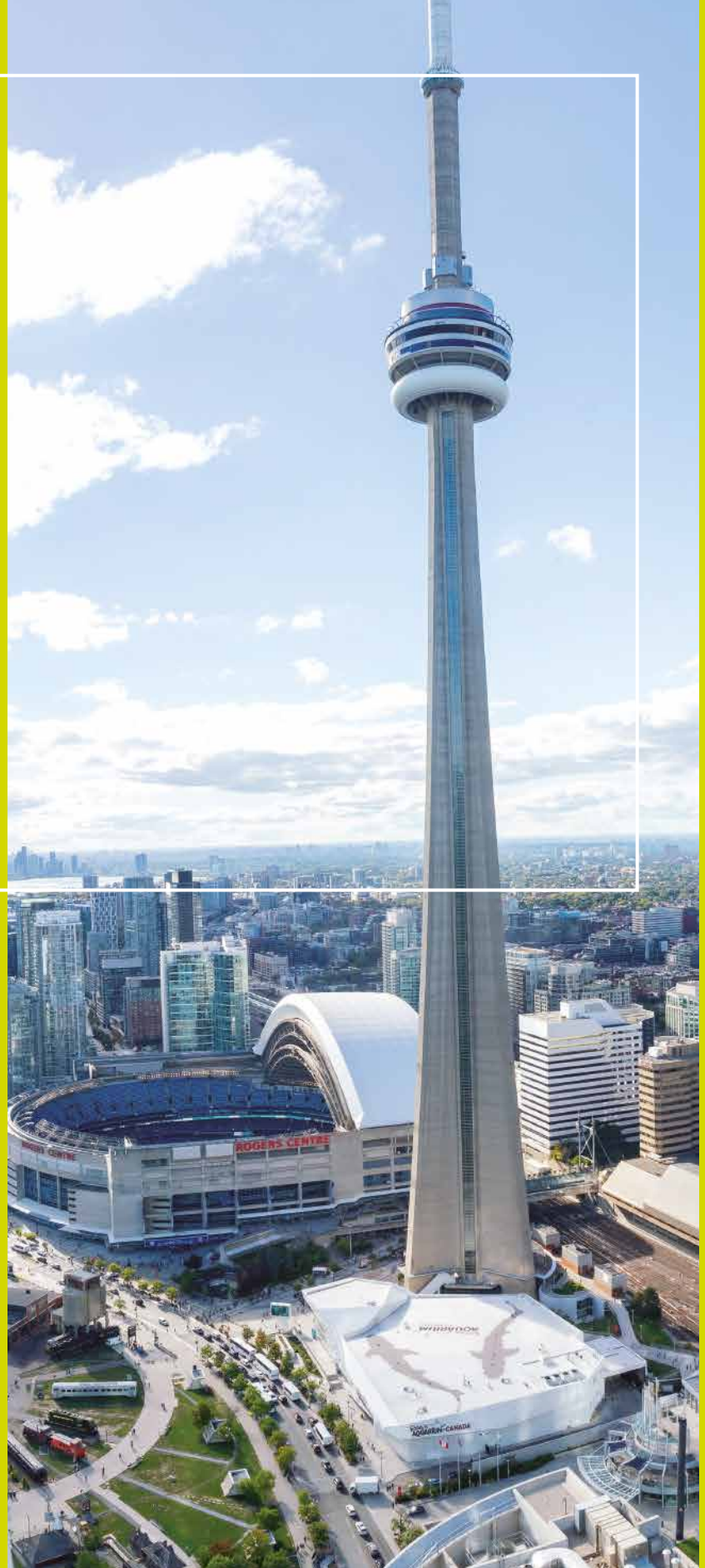
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# From The Editor

## The No. 1 Answer to Food Safety Questions

Over the years, I've been asked a lot of questions about a lot of different things in food safety, especially during the years I worked in the lab sector. Initially, I thought I should be able to answer all of them, and it was truly overwhelming.

Eventually, I noticed that there was one answer that I gave far more than any other. That answer was, "It depends."



Depends on what? Well, "it depends" usually requires more information about all the variables covered by the question and the amount of data available on the subject.

For example:

*What internal temperature is needed to kill Listeria in my product?*

It depends ... on how long you plan to maintain the product at that temperature.

*How much time is needed between sanitation cycles?*

It depends ... on how dirty your process and plant get and whether you use wet or dry sanitation. And by dirty, I mean actual microbial counts.

*How much testing is needed to prevent Listeria contamination?*

It depends ... on too many things to list here, but let's say it takes enough testing to find it and then eliminate it, which likely means more testing than most currently want to do, or they wouldn't even ask the question.

You get the idea. There are few absolutes in food safety. None of us know all the answers, but we do know where to look for them.

Now, if I could just figure out how to get a crystal ball, I could answer questions more specifically, but it would still include the phrase "it depends." New questions come up every day, e.g., will FDA complete the plan to separate food from drugs and medical devices?

But, as I said before, it depends ...

**Patricia A. Wester**

Executive Industry Editor

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# NEWS & NOTES

## California Bill Aims to Remove Some Additives from Food

BY KEITH LORIA

A bill introduced in California aims to require manufacturers to omit certain food additives, barring five chemicals from candy, cookies, and other food items.

Jesse Gabriel, a state assembly member who is located in the San Fernando Valley and chairs the Assembly Committee on Privacy and Consumer Protection, introduced the bill last month. If passed, the legislation would ban the manufacture, distribution, and sale of foods containing certain additives in California.

The proposed legislation would ban the use of five food additives: brominated vegetable oil, potassium bromate, propylparaben, FD&C Red 3, and titanium dioxide. Each of these additives is an approved food additive under FDA's current regulations, although some, like titanium white, do have limitations or restrictions on use.

"Though some of these food additives have largely been phased out of foods, several are still widely used," says Shawn K. Stevens, an attorney with the Food Industry Counsel, LLC, and a member of the *Food Quality & Safety* editorial advisory board. "If California passes this bill, the industry would likely need to either reformulate products or stop distribution in California."

There are more than 10,000 chemicals and additives allowed in food in the United States, often in small amounts; however, many haven't been evaluated by FDA in decades. Many were initially approved under the FDA's Generally Recognized as Safe (GRAS) program.

Stevens notes that the bill would serve to modify FDA's food additive regulations for products sold in California so food additives approved by the FDA would no longer be permitted in foods sold in the state. "Unlike

other California regulations that regulate the distribution of food, such as proposition 65 [which requires the state to maintain and update a list of chemicals known to the state to cause cancer or reproductive toxicity], this bill would require a total ban of the targeted food additives," he says. ■

## Researchers Target Antibiotic-Resistant Salmonella in Food

BY KEITH LORIA

A study conducted at the University of Connecticut in Storrs and recently published in *Food Microbiology* found that protective bacterial cultures offer a promising mechanism for combating antibiotic-resistant *Salmonella* in food.

Dennis D'Amico, PhD, associate professor of dairy foods in the University of Connecticut's College of Agriculture, Health and Natural Resources, led the study as part of his ongoing work involving the use of protective bacterial cultures to prevent illness from foodborne pathogens. He has previously studied the use of bacterial cultures to control the growth of pathogens in food products and to impede their ability to cause sickness.

Dr. D'Amico says that some microbial strains, including many strains of *Salmonella*, have developed resistance to many of the antibiotics used in human medicine, so the goal of this study was to find an effective way to target those pathogens without using antibiotics. The study authors considered the ability of a protective culture called *Hafnia alvei* B16 to prevent infection by two *Salmonella* serovars.

Previously, Dr. D'Amico's lab had identified *Hafnia alvei* B16 as effective in inhibiting the growth of both *E. coli* and *Salmonella* in milk, and it also successfully stopped the growth of *Staphylococcus aureus*, preventing it from producing toxin levels sufficient to cause disease in humans.

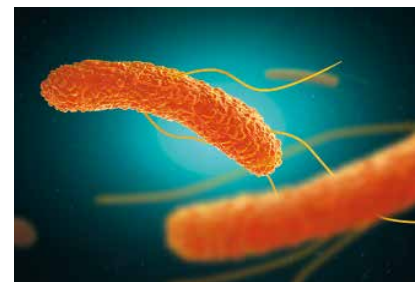
"Protective cultures like the commercial products we have tested in the lab work against other bacteria in various ways, typ-

ically through competitive exclusion and the production of antimicrobial metabolites such as organic acids and bacteriocins," Dr. D'Amico tells *Food Quality & Safety*. "They are typically added to products to inactivate or suppress the growth of unwanted microbes. We have shown this [result] with several cultures against several pathogens in food."

Once ingested, certain pathogens must continue to grow in the gut until the population is large enough to cause disease. Other microbes such as *S. aureus* produce a toxin that can cause severe disease if they are allowed to grow unchecked.

The report explains that these cultures can also reduce the virulence of certain pathogens when present together in a food, much like other cultures labeled as probiotics. These cultures can improve food safety by controlling pathogen growth and survival in a food product, thereby attenuating their virulence in food and/or providing protection against colonization in the host.

"In this case, we see these effects even against antibiotic-resistant strains," Dr. D'Amico says. "The most important takeaway is that these cultures, which are typically used only to control the outgrowth of pathogens in food, have additional functions to provide a multi-pronged approach to improving food safety and public health." ■



## FDA Releases Draft Guidance on Labeling of Plant-Based Milk Alternatives

FDA has issued draft guidance to help ensure appropriate labeling of plant-based products that are marketed and sold as alternatives to milk, dubbed "plant-based milk alternatives"

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(PBMA). This draft guidance will provide the food sector with recommendations that will result in clear labeling and clarify that the common or usual names of some PBMA have been established by common usage.

The agency recommends that PBMA products labeled with the term “milk” in their names, such as “soy milk” or “almond milk,” and that have a nutrient composition that is different from milk, include a voluntary nutrient statement that conveys how the product compares with milk based on USDA’s Food and Nutrition Service fluid milk substitutes nutrient criteria. FDA hopes that these statements will help consumers understand certain nutritional differences between plant-based products and milk.

If a PBMA is not labeled with “milk” as part of its name but is instead labeled using another term such as “beverage” or “drink” and does not make a claim comparing the product to milk, then the voluntary nutrient statement recommendations in the draft guidance do not apply.



In 2018, FDA issued a notice soliciting comments from the public to gain insight into how consumers use PBMA products and how they understand the term “milk” when included in the names of products made, for example, from soy, peas, and nuts. The agency received more than 13,000 comments.

After reviewing these comments and conducting focus group studies with consumers, the agency determined that consumers generally understand that PBMA products do not contain milk and choose them because they are not milk; however, many consumers may not be aware of the nutritional differences between milk and these products. For example, almond- or oat-based PBMA products may contain some calcium and be consumed as a source of calcium, but their overall nutritional content is not similar to milk and fortified soy beverages and, thus, they are not included as part of the dairy group in the dietary guidelines.

Comments on the draft guidance can be submitted through April 24, 2023, at [regulations.gov](https://www.regulations.gov). ■

## Second Cultivated Chicken Product Cleared by FDA for Human Consumption

BY KEITH LORIA

GOOD Meat, the cultivated meat division of San Francisco-based food tech company Eat Just, Inc., received a “no questions” letter from FDA on March 20 that declared the company’s cultivated chicken product safe to eat.

FDA noted that the safety and quality validations submitted to them by GOOD Meat demonstrated that harvested cultivated chicken met poultry microbiological and purity standards, with microbiological levels significantly lower than in conventional chicken. Additionally, a product analysis revealed that the company’s cultivated chicken contains a high protein content and a well-balanced amino acid profile and is a rich source of minerals.

The letter follows a November 2022 FDA decision that allowed Berkeley, Calif.-based Upside Foods to proceed with its own lab-grown chicken, the first-ever go-ahead for cultivated meat in the U.S.

Two years ago, GOOD Meat received regulatory approval for its cultivated product in Singapore, but now it is closer to having its product appear in U.S. restaurants and retail stores as well. The company is working closely with USDA on final approvals and is expected to be on the menu at a restaurant in Washington, D.C., later this year.

As of now, GOOD Meat is the lone cultivated meat producer in the world with the ability to sell to U.S. consumers. “Since Singapore approved GOOD Meat for sale, we knew this moment was next,” says Josh Tetric, co-founder and CEO of GOOD Meat and Eat Just. “I am so proud to bring this new way of making meat to my country.”

Some analysts forecast that cultivated meat could become a \$25 billion global industry by 2030 as more companies get involved in developing product. “Consumers and future generations deserve the foods they love made more sustainably and in ways that benefit the public good—ways that preserve our land and water, that protect our climate and global health, ways that allow for food security,” says Bruce Friedrich, president of Good Food Institute, a think tank focused on alternative protein innovation. He

adds that, with global demand for meat expected to increase significantly in the coming years, it makes sense for governments to prioritize alternative proteins as a solution.

Robert Rankin, executive director of the Association for Meat, Poultry and Seafood



Innovation (AMPS Innovation), an alliance of food companies dedicated to developing products directly from animal cells, called the “no questions” letter a momentous milestone and validation for the cell-cultured/cultivated meat, poultry, and seafood industry. “GOOD Meat is among the visionary start-ups advancing the food sector with new methods of producing high-quality, safe products that will help to meet the growing demand for meat, poultry, and seafood through delicious, healthy, and sustainable food options,” he says. “AMPS Innovation members continue to work closely with government agencies to create a safe, robust, and transparent pathway to market for cell-cultured/cultivated meat.” ■

## Study Examines Gaps in U.S. Regulation of Toxic Metals in Baby Food

BY KEITH LORIA

A study conducted by researchers at the University of Buffalo in New York and recently published in the journal *Current Problems in Pediatric and Adolescent Health Care* looked at gaps in the U.S. regulation of toxic metals in baby foods such as rice cereal, formula, purees, and puffs.

The researchers determined that the U.S. doesn’t have the kind of strict regulations for commercially produced baby foods that parents might expect. “It is concerning that there are gaps in food contaminant federal guidelines, particularly for baby foods. Parents might expect and trust that their infant’s commercially produced baby food is automatically protected by tightly regulated guidelines, but that is just not the case,” says the study’s lead author, Sarah J. Ventre, MD,



MPH, clinical assistant professor in the department of pediatrics in the Jacobs School of Medicine and Biomedical Sciences at the university.

Gauri Desai, PhD, MPH, a clinical assistant professor in the department of epidemiology and environmental health at the university and part of the study's research team, notes that there are few clear, evidence-based guidelines on the maximum tolerable limits of toxic metals in foods and little understanding of toxicant exposure or adverse health effects attributable to dietary exposure in the current regulatory guidelines. "Several foods consistently appear in the literature as potential sources of toxic element exposure," she says. "Both homemade as well as store-bought foods are found to contain toxicants. Contaminated drinking and cooking water, including water used to prepare infant formula, could also be a major exposure source."

The researchers found that while there is an increase in the number of studies focused on the presence of contaminants in foods consumed by children, there is still a dearth of information on the topic. The researchers were also struck by the scarcity of clear guidance that takes into account the complexity of issues—that multiple toxic element exposures may be occurring and

that these stem from the same diets that provide health-promoting nutrients. "First, we do not have a comprehensive picture on the extent of exposure to toxic elements in young children," Katarzyna Kordas, PhD, associate professor of epidemiology and environmental health at the university's School of Public Health and Health Professions and senior author of the study, tells *Food Quality & Safety*. "Second, we do not know how exposure to toxic elements through the diet is affecting child health. We know that toxic elements are bad for children's development and health, but healthy foods in themselves are good because they provide beneficial vitamins, minerals, bioactive components, etc. Will that counterbalance the effects of toxic elements? While that is the hope, there are no studies to allow us to say this for sure."

She adds that clearer recommendations are needed for parents, but this is not an issue they can be expected to address alone. There is a need for broader, systemic protections supported by well-developed research studies to address the knowledge gaps. "More frequent inspection of manufactured foods [and] better labeling, combined with public messaging on what the labels mean, should be part of the strategy to limit exposures in young children." ■



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# Washington Report



## Will FDA's Proposed Restructure Work?

Experts comment on the planned revamp of the agency's Human Foods Program

BY KAREN APPOLD

**A**s FDA continues its mission to develop food safety into a separate agency, some vested organizations have doubts about the success of the proposed structure.

On January 31, Robert M. Califf, MD, FDA's Commissioner of Food and Drugs, announced a plan that calls for the functions of the Center for Food Safety and Applied Nutrition (CFSAN), the Office of Food Policy and Response (OFPR), and certain

functions of the Office of Regulatory Affairs (ORA) to be unified into a newly envisioned organization called the Human Foods Program. According to an FDA press release, the new program will be run by a single leader who reports directly to the commissioner. The agency says that this will unify and elevate the program while removing redundancies, enabling it to oversee human food more effectively and efficiently.

Critics of the plan say that it doesn't follow the advice of a report conducted by the Reagan-Udall Foundation, an independent group of experts that Dr. Califf commissioned in 2022 to review the Human Foods Program following the powdered infant formula crisis; the report called for an overhaul and reform of the entire agency. "While we were first pleased by Dr. Califf's announcement to advance an agency restructure, the details released on February 28, 2023, fall short of what is needed," says Donna Garren, PhD, executive vice president of science and policy at the American Frozen Food Institute. "The plan fails to implement recommendations from the Reagan-Udall Foundation, including making bold structural changes to mitigate systemic cultural challenges within the organization." She adds that FDA has indicated that it will continue to allow a divided and siloed organizational and lead-

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If [FDA inspectors] remain separate from the Human Foods Program, with different leadership, FDA would remain siloed, which would prevent FDA from fully embracing and achieving the preventive vision of FSMA.

—EMILY MOYER, PhD, International Fresh Produce Association

ership approach, which she says will ultimately impact the agency’s ability to set mission priorities and allow for quick and effective decision making regarding food safety.

Mitzi D. Baum, MSc, CEO of Stop Foodborne Illness, a nonprofit public health organization based in Chicago, also has concerns about the proposed restructuring. “The commissioner’s proposed incremental changes don’t get to the root of deeply embedded cultural issues,” she says. “The insularity of the ORA is of specific concern because it operates separately from science and policy areas. The plan will allow ORA to continue to have a culture of reaction rather than shifting to a proactive approach as mandated in FSMA.”

### Specific Concerns

In particular, Baum says that in the proposed changes don’t go far enough to provide consumers with the confidence that FDA leadership is doing everything possible to fix the fractured leadership and prevent another disaster like the powdered infant formula crisis. “Moreover, it’s essential to focus on the broader issue of food safety and prevention in today’s modern food system,” she adds. “It seems the commissioner chose the items and issues of least resistance to create this plan.

He has ignored the experts he enlisted to provide recommendations and has continually dismissed the calls for change from external stakeholders. It’s a half measure that will not lead to safer food for consumers.”

Emily Moyer, PhD, vice president of regulatory compliance and global food safety standards at the International Fresh Produce Association in Washington, D.C., says that it’s unclear which functions of the ORA will become part of the Human Foods Program. ORA is the compliance arm that houses FDA’s inspectors and those who handle import safety, and it also oversees regulatory laboratories. “If they remain separate from the Human Foods Program, with different leadership, FDA would remain siloed, which would prevent FDA from fully embracing and achieving the preventive vision of FSMA,” she adds.

If the deputy commissioner’s role is to be truly empowered, this person needs to have a direct line of authority over the entirety of the Human Foods Program, Dr. Moyer says. Dr. Califf stated in a February 28 press release that the newly created deputy commissioner would set the strategic direction for food inspections and have budget authority, while also acknowl-

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edging that he is still “determining how to best empower the deputy commissioner, leaders of other programs, and the associate commissioner for regulatory affairs.”

Dr. Garren says that FDA, consumers, and the regulated community are best served by an empowered deputy commissioner of foods who has direct management authority over all components of FDA’s human and animal foods program, including CFSAN, the Center for Veterinary Medicine, and the food-related components of ORA. “Unfortunately, FDA’s current vision doesn’t pursue this bold approach to implement the needed structural changes to eliminate the existing inefficiencies and lack of transparency and collaboration,” she adds.

Tyler Williams, MS, chief technical officer at ASI Food Safety, a third-party food safety consulting agency based in St. Louis, Mo., is concerned about how the restructuring will impact FDA’s budget. Currently, FDA’s drug division already has a significantly higher budget when compared with food. “When politicians decide to increase FDA’s budget, more is always allocated to drugs and medical devices over food safety,” he says. “Currently, FDA

doesn’t have the resources to inspect every food facility every two years as [FSMA] requires. I hope that when the restructuring comes to fruition, there’s not an increased difference between the food safety budget compared to drugs and medical devices.”

### Some Positive Aspects

Despite its shortcomings, Dr. Moyer says that Dr. Califf’s restructuring plan is a significant step in the right direction because the foods program needs a single, empowered decision maker. “An external group of subject matter experts could provide great value in establishing a stronger collaboration between regulators, industry, and academia to address emerging food safety issues,” she says.

Williams says that having a split leadership team is one of the biggest potential benefits. Currently, most of FDA’s leadership comes from the drug and medical device industry. “Although clear roles are still undefined in FDA’s recent statement, food safety experts will be a part of the proposed Human Foods Advisory Committee to ensure that all of the agency’s decision-making activities are scientifically grounded, keeping emerging issues of our industry at the forefront,” he adds.

### Ideal Outcomes

Dr. Garren hopes that any meaningful restructuring at FDA would result in a more unified foods program with a single chain of command and a prevention-focused approach to food safety as required under FSMA. “This would result in a more predictable regulatory process and an agency that could respond quickly and effectively on food safety matters,” she says.

As a result of creating an Office of Integrated Food Safety System Partnerships, Williams hopes that oversight will be more streamlined. This would unify FDA’s work with state and local regulators. “This is a step in the right direction, but I would like to see an actual plan on how it’s going to be implemented and what responsibilities will be held at local, state, and federal levels,” he adds.

While there might not be more oversight from a quantitative standpoint, Dr. Moyer says that, depending on the final structure, there’s an opportunity for FDA to become more targeted in its oversight, which would benefit public health.

FDA hopes to finalize its reorganization proposal this fall. ■

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## Moving Forward without Frank Yiannas



When Frank Yiannas, MPH, FDA’s deputy commissioner of food policy and response, left his post on February 24, 2023, he stated his support for creating a single food safety agency with its own oversight. In fact, in his resignation letter, Yiannas urged Robert M. Califf, MD, FDA’s commissioner of Food and Drugs, to “consider transferring the small, yet exceptional staff comprising the Office of Food Policy and Response (OFPR) to a

new office of the Deputy Commissioner for Foods.”

Food industry experts touted Yiannas’ insight and achievements during his tenure of more than four years. In addition to supporting FDA restructuring, he championed the agency’s “New Era of Smarter Food Safety,” a plan that builds on foundations set down in FSMA and that focuses on technology and traceability. “The expertise of the staff of OFPR deserves to be housed within the foods program, under a single empowered leader as Yiannas recommends,” says Mitzi D. Baum, MSc, CEO of Stop Foodborne Illness, a nonprofit public health organization based in Chicago. “Yiannas used his food safety expertise to try to move the agency forward. He has left a legacy with ‘New Era,’ which provides a roadmap for the future by giving guidance on how to modernize the system to work for consumers.”

Emily Moyer, PhD, vice president of regulatory compliance and global food safety standards at the International

Fresh Produce Association in Washington, D.C., says, “In only two years, the ‘New Era’ initiative has made impressive progress under Yiannas’s leadership. While our organization is disappointed to see him go, FDA has a dedicated staff that we’re confident will continue to push for progress,” she adds.

Donna Garren, PhD, executive vice president of science and policy at the American Frozen Food Institute, says her organization applauds Yiannas’ leadership and his efforts to modernize FDA’s food safety program through initiatives such as ‘New Era’ and 21 Forward, a new data analysis tool. “Yiannas recognized the importance and need for continuous food safety improvement and incorporating technology and using big data,” Dr. Garren says. “We also thank Yiannas for his work to drive agency risk-based decision making and transparency. He welcomed stakeholder input and recognized that food safety policies must evolve to reflect evolving scientific research and understanding.”—KA

# Legal Update



## When Food Safety Violations Turn Criminal

The criteria for DOJ's prosecution of food companies, and how to mitigate risk

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

**W**hen foods make people sick, the U.S. Department of Justice (DOJ) often partners with FDA to investigate and prosecute violations of food safety laws that appear to involve willful failure to follow regulatory requirements. When the DOJ elects to get involved, the alleged food safety violations are typically egregious and have caused significant harm to the public. In these circumstances, DOJ may pursue civil penalties, criminal charges, or both.

Abbott Laboratories recently confirmed that DOJ had opened a criminal investigation into operations at the company following the infant formula recall

and ensuing crisis in 2022. It was reported that DOJ previously entered into a consent decree with Abbott to allow the company to resume operations as long as they complied with certain requirements imposed by the decree. Reports released about the operations at Abbott assert that senior management at the facility and company may have been aware of the alleged conditions that led to the recall and failed to correct the conditions. FDA additionally alleged that Abbott infant formula may have caused the death of two infants.

Other companies have been targeted by DOJ in the past. DOJ has previously, for example, pursued criminal charges against Kerry Inc. for insanitary plant

conditions that were linked to a *Salmonella* outbreak. Blue Bell Creameries and individuals responsible at the corporation were also the focus of DOJ investigations and ultimate charges for *Listeria* contamination of ice cream. DOJ also used its authority to charge and convict individuals responsible at the Peanut Corporation of America for their conspiracy to distribute *Salmonella*-contaminated peanut products into interstate commerce.

When the U.S. Congress passed the laws that give FDA authority to regulate food products, Congress expressly included penalties for violations by food companies. The Federal Food, Drug, and Cosmetic Act provides for criminal and civil penalties for violations of the act's requirements. Specifically, the legislation sets the penalty for an initial violation of certain provisions of the act as imprisonment for no more than one year, a fine of no more than \$1,000, or both—for each count. When a violation occurs after a previous conviction for a violation of the act, or if the violation is committed with the "intent to defraud or mislead," the penalty can

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be imprisonment for no more than three years, a fine of no more than \$10,000, or both imprisonment and a fine (21 U.S.C. § 331(a)). Again, this is for each alleged count.

When a violation is identified, DOJ is responsible for investigating the violation and determining whether civil or criminal penalties should be pursued. Because possible violations are identified every day by FDA, DOJ must evaluate each violation to determine if DOJ's resources would be best used under those circumstances. Typically, cases are referred to DOJ by FDA after a review of the violation by the agency to determine if a criminal investigation is recommended. FDA has stated that, among other factors, it will consider the likelihood and severity of harm associated with the violation and whether the violation reflects a pattern of behavior or the disregard by the company of prior warnings. DOJ then conducts its own investigation after receiving a referral from FDA, and will consider similar criteria, in addition to evaluating the likelihood of successfully prosecuting the violation.

### Voluntary Self Disclosure

Notably, DOJ recently announced a voluntary self-disclosure program that will be applicable to any corporate misconduct prosecutable by a U.S. Attorney, including violations of the Federal Food, Drug, and Cosmetic Act. The program allows DOJ to enter into more favorable resolutions with companies that voluntarily self-disclose misconduct may constitute a violation.

To qualify as a voluntary self-disclosure under the program, the disclosure must be voluntary and not required by a regulation, contract, or DOJ resolution. It also must be prompt and not in response to threat of disclosure or government investigation and must include all relevant facts known to the company. Even when a disclosure does not meet each of these requirements, DOJ has stated that it will, nevertheless, still consider the disclosure favorably.

When evaluating the violation, DOJ will consider the disclosure, among other factors, when determining what resolution to seek. For example, DOJ will consider whether the company fully cooperated with DOJ. Additionally, timely and appro-

prate remediation by the company will be positively considered by DOJ. Finally, DOJ will also consider factors such as the pervasiveness of the conduct throughout the company, its impact on public health, and the knowledge of executive management.

When a company becomes aware of misconduct, DOJ seeks to encourage disclosure. The policy allows DOJ to rec-

**When evaluating the violation, DOJ will consider the disclosure, among other factors, when determining what resolution to seek.**

ommend a reduced fine when a voluntary self-disclosure occurs. In addition, DOJ can utilize resolutions other than a guilty plea in such circumstances, which may allow the company to better remedy any violation and recover after the misconduct is resolved.

### Deferred Prosecution

There are favorable resolutions that are available when a voluntary self-disclosure occurs. These include entering into a deferred prosecution agreement (DPA), which requires the company to institute certain procedures and protections to ensure future compliance with requirements. Under a DPA, DOJ agrees not to prosecute the underlying violation further if the company continues to comply with the additional requirements outlined in the agreement.

Indeed, in 2020, Chipotle entered into a DPA with DOJ. Under that agreement, DOJ agreed not to pursue a guilty plea based on the 2015 outbreaks associated with Chipotle and the underlying concerns with the company's illness policy and training. In exchange, Chipotle was required to develop, implement, and maintain an improved food safety compliance program. In addition, the company was required to use independent experts to evaluate its approach to food safety. Ongoing certification of compliance by Chipotle was required for the duration

of the agreement, and the company paid a criminal fine of \$25,000,000. Had DOJ pursued charges, however, Chipotle might have faced much more significant penalties than were included in the DPA.

### Individual Accountability

In addition to potential criminal and civil liability for a food company, responsible individuals within the company can also face liability. The Responsible Corporate Officer Doctrine, also referred to as the Park Doctrine, allows DOJ to expand criminal prosecution to companies and officers of the company, even without any intent to violate the law or awareness of the violation. In fact, DOJ attorneys have been directed to ensure that individuals are held accountable, as well as corporations, when misconduct occurs. To successfully prove a case against a corporate officer under the Park Doctrine, DOJ must demonstrate that the individual was in a position of responsibility relevant to the violation, that the individual was able to prevent or correct the violation, and that the individual failed to prevent or correct the violation.

A strong food safety culture throughout an organization can prevent corporate misconduct that could lead to investigations by DOJ. Recent DOJ resolutions with food companies, for example, have included criminal charges against individuals who knowingly and willingly covered up contamination of foods in commerce. When a violation of requirements becomes known to a company, rapid and effective action to prevent illness in consumers and to correct the underlying causes of the violation must be taken to reduce the risk of prosecution. In addition, any time a company learns that a consumer may have become ill as a result of consuming its products, company leadership should consult immediately with legal counsel to ensure it is taking appropriate actions in response. Doing so could make the difference between going to prison or staying out of jail. ■

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# Cannabis Corner



## FDA Declines to Regulate CBD

The agency asks that Congress create a regulatory framework for these products

BY LORI VALIGRA

**I**n January 2023, FDA announced that it would not regulate cannabidiol (CBD) edible products under the existing regulatory frameworks for dietary supplements, citing health concerns and a lack of safety data for the substance.

The agency said it had not found adequate evidence to determine how much CBD can be consumed and for how long before causing harm, so it would not pursue rulemaking for the substance in dietary supplements or conventional foods.

“Given the available evidence, it is not apparent how CBD products could meet safety standards for dietary supplements or food additives,” Janet Woodcock, MD, Principal Deputy Commissioner at FDA, said in the statement.

Consumers eat food for reasons other than to take CBD, and they may end up taking more CBD than they meant to, according to an FDA spokesperson. They might also confuse eating CBD-infused food with non-CBD food, which the agency says is es-

pecially concerning for children when CBD takes the form of a candy or snack.

FDA did state that it is prepared to work with Congress to develop a new cross-agency regulatory framework to oversee these products. Until then, regulation in the U.S. is in the hands of each state. Seventeen states plus the District of Columbia have fully legalized CBD products, with the remainder offering varying degrees of conditional approval (see “The State of CBD Legalization in the U.S.,” p. 16).

The FDA news was disappointing to many in the CBD industry, but not entirely unexpected. Industry experts say they were waiting for FDA to proceed with federal oversight following the 2018 Farm Bill, which legalized hemp-based CBD. “The FDA has been dragging its feet for four years now,” says Jonathan Miller, general

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counsel for the U.S. Hemp Roundtable in Washington, D.C. “This was just another way to kick the can down the road.”

He agrees that Congress needs to step in to implement a regulatory plan, but he doesn’t want to wait years for that to happen. He would like to see CBD regulated in the same way FDA regulates other dietary supplements, with strict good manufacturing practices and labeling requirements. Miller adds that FDA’s inaction continues to be damaging for everyone—from the farmers planning their crops to the companies that sell products.

### What Should Regulations Cover?

CBD products should be screened for any impurities or contaminants, says David Vaillencourt, CEO of The GMP Collective, a Denver-based organization that works with cannabis and hemp businesses. He adds that these products should also be screened for microbials and toxins produced by microbials, and labels should

## The State of CBD Legalization in the U.S.

The question of whether the possession and use of CBD is legal comes down to regulations in the state in which someone resides, with no umbrella federal policy that covers all U.S. states.

Seventeen U.S. states and the District of Columbia have fully legalized the possession and use of CBD. These states are Alaska, Arizona, California, Colorado, Connecticut, Illinois, Maine, Massachusetts, Michigan, Montana, Nevada, New Jersey, New York, Oregon, Vermont, Virginia, and Washington.

The remaining 33 states have various degrees of conditional approvals. Even in states with conditional approval, broader use may not be enforced.

## CBD by the Numbers

**\$1.9 billion** Expected market size of U.S. CBD in 2023.

**\$3 billion** Projected value of U.S. CBD market by 2027.

**41** Percentage of U.S. consumers who said they would try cannabis-infused foods.

Sources: *CannIntelligence*, A.T. Kearney

give an accurate and full disclosure of what is in the product and in what quantity. He says that there should also be a standard for the laboratory certificate of analysis, and that, ultimately, the products should be reasonably expected to be safe. “Consumers should go to reputable stores like Whole Foods or major retailers rather than gas stations or convenience stores, which could be risky,” he says. “Otherwise, they take a risk every time they buy a product.”

Right now, the lack of federal oversight leaves the CBD-infused food and beverage market as a “wild west” of food safety. States have moved to their own regulatory patchwork, making it difficult for companies to develop a national brand, says Steve Mister, president and CEO of Washington, D.C.-based Council for Responsible Nutrition, which represents the dietary supplement industry. “The FDA decision has stifled a market that was supposed to take off after 2018,” Mister adds.

### Drug Preclusion Provisions

Other than safety concerns related to the lack of research data on CBD, there are drug preclusion provisions in the federal Food, Drug and Cosmetic Act that say if a drug company gets an ingredient to the market first, it has a monopoly over that ingredient. The drug Epidiolex, which contains CBD, is an FDA-approved treatment for epilepsy care that is on the market.

Two bills re-introduced in mid-March by U.S. Representatives Morgan Griffith (R-Va.) and Angie Craig (D-Minn.) would exempt CBD from the preclusion provisions. The Hemp and Hemp-Derived CBD Consumer Protection and Market Stabilization Act of 2023 would subject hemp extract products to the regulatory framework for dietary supplements, and the CBD Product Safety and Standardization Act of 2023 would establish regulations for CBD as a food and beverage additive.

### Be Careful What You Wish For

FDA’s actions have been predictable, says Chris Fortes, CEO of Trojan Horse Cannabis, which sells infused seltzers that include both CBD and THC. “The FDA doesn’t really want to get involved unless they’re forced explicitly through Congressional action,” he says.

The industry would have been helped if FDA came up with even minor safety

guidelines for products, such as child-resistant containers, he adds, but that would mean that the agency also is condoning that the product is acceptable. “They’re not willing to do that, but I’m disappointed that they haven’t put some

**FDA has been dragging its feet for four years now. This was just another way to kick the can down the road.**

—JONATHAN MILLER,  
U.S. Hemp Roundtable

safety precautions in place for consumers,” he says.

However, he admits that he is “semi-terrified” of asking FDA to regulate CBD-infused products, however, because he doesn’t think the agency understands them well. “You may get what you ask for, but you may not get what you want,” he says. He thinks a new cross-agency framework is a better option, and he would like to have USDA, the U.S. Drug Enforcement Agency, and the Alcohol and Tobacco Tax and Trade Bureau involved alongside FDA. He says the agencies should hold CBD companies to good manufacturing practices and truth-in-labeling standards.

Gabe Parton Lee, general counsel for Wyld, a cannabis edibles company based in Bend, Ore., says he expects a cross-agency framework would include USDA, because all cannabis products come from plants, but he thinks that any ingestible product clearly falls under FDA’s jurisdiction.

With the CBD market regulated at a national scale, he said products could be standardized to make sure they are clearly marked so that consumers know they are not buying an intoxicating product. Wyld also is working with state legislatures to develop standardized programs. “States are the laboratories of democracy,” he says. “There’s a real opportunity to develop regulated programs that the federal government can model after.” ■

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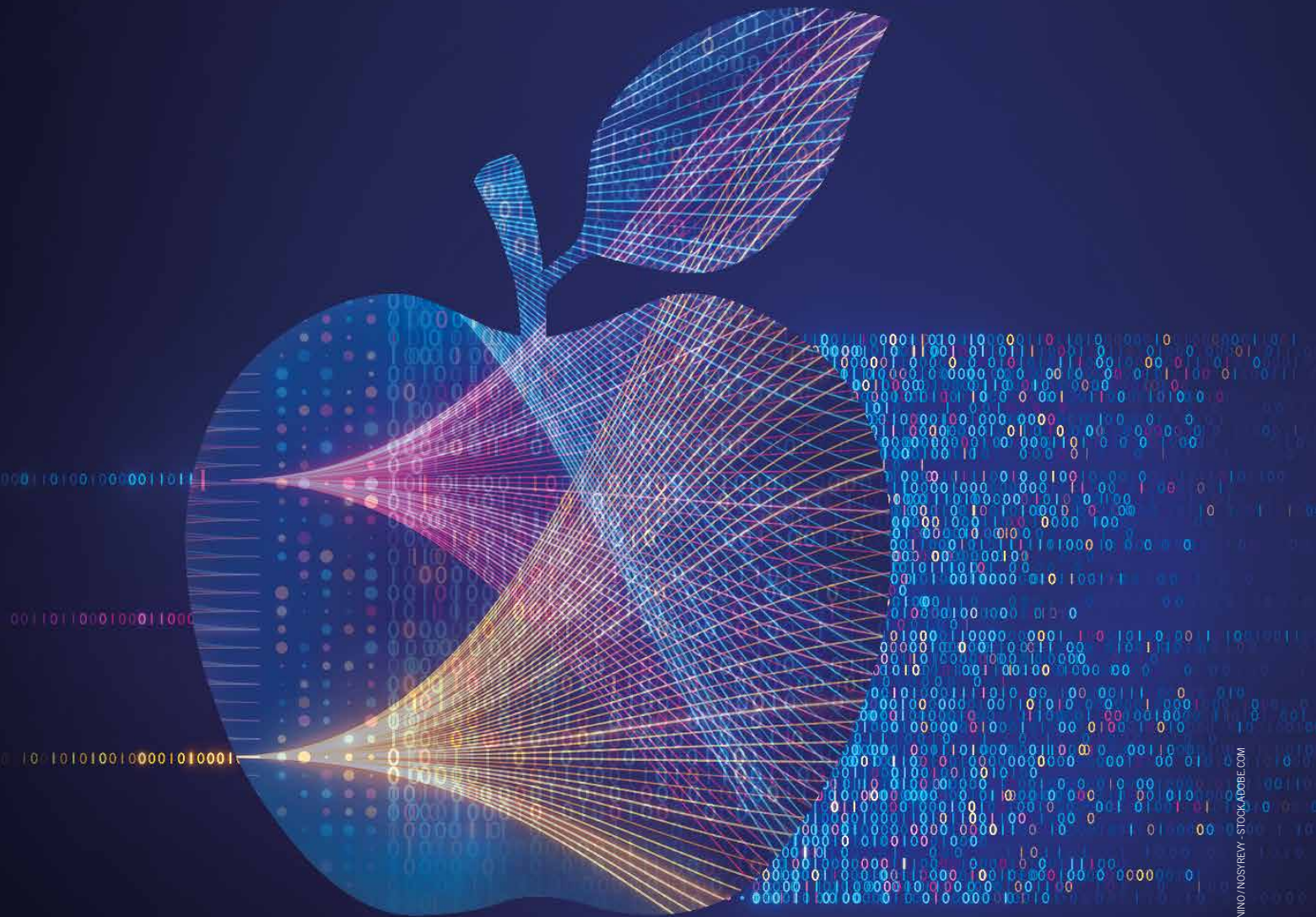
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# Big Data, Big Impact

How data analysis is revolutionizing food safety

BY **MARY BETH NIERENGARTEN**



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**W**ith the proliferation of tools to collect and analyze data that can inform problem solving and decision making, the use of big data and data analytics has become ubiquitous throughout many industries. While the food industry may be slower to adopt big data and data analytics than some other industries, such as healthcare, it's catching up as food scientists and other experts recognize its potential as a powerful tool to address large, complex problems in the food industry.

Food safety is one such problem. Affecting every step along the food supply chain, food safety relies on a company's ability to gather reliable data in a timely manner and then act on that information as needed. From food traceability to digital pest management to better detection of foodborne illness breakouts to reductions in food spoilage, big data and data analytics are being employed to advance food safety at the local and global levels.

"Big data can be used at all steps of the food value chain to improve food safety," says John Donaghy, PhD, head of food safety at Nestle in Switzerland. On the farm or at primary processing steps, he cites several data types that can be collected to improve food safety, such as water analytical test data, hygiene status of workers, and certification status of farms/processors. At the consumption/public health end of the food chain, he cites the use of big data and data analytics for communicating recalls to consumers and for source tracking foods that cause foodborne illness outbreaks. Between these end points, he indicates numerous areas during manufacturing where data can be collected, e.g., microbiological verification testing, process control data, and environmental monitoring data. "Data relevant to food safety and quality can be collected at so many steps throughout [the] food chain; even real-time monitoring of temperature during logistics and transport in the supply chain can be incorporated into dynamic risk management," he adds.

For food manufacturers and processors, from small to large businesses, the potential impact of big data and data analytics to improve food safety can be enormous. A 2022 report by the Global Food Safety Initiative (GFSI) Science and Technology Advisory Group (STAG) describes the potential impact on business, as well as what businesses should be thinking about when considering the

use of big data and data analytics in their own organization (see Tables 1 and 2, page 20).

A final key question for businesses, according to the GFSI report, is: "Do businesses understand the strategic impact of big data on their operations and do they have the appropriate talent strategy for these changes?"

Several food safety experts offer their views on the value of big data and data analytics for food manufacturers and processors that may help businesses better answer these questions.

### Collecting Big Data: Internal and External Sources

Suzy Sawyer, food safety, quality and regulatory digital and analytics leader at Cargill underscored the growing role that data plays for food companies to ensure safe, quality products. "What we've discovered at Cargill is that the vast amount of data collected from internal and external sources can be used to help identify potential food safety improvements, analyze, and manage quality control, and mitigate food supply chain risks," she says.

She cited a number of internal sources of data collection, including data gathered manually (plant floor quality and safety checks and observations), as well as sources from digitized technologies such as sensors (inline processing from machines/processes), data loggers (sensors capturing characteristics such as temperature and humidity), and instrumentation (near infrared detection instruments).

External data sources include technologies designed to exchange data collection to improve food safety, such as regulatory notifications or alerts, food-related media, weather, and commodity prices.

Digitizing data across the food supply chain enables companies to amass large quantities of internal data and to capture new data sources to improve food safety risk. New sources of data, such as those available on smartphones and social media, are creating massive data sets, while new technologies allow for the sharing of big data through what is called the internet of things (IoT). Data from sensors, devices, machines, and computing services can now be shared via the internet or a communication medium such as Bluetooth. One example of this is the large amount of data

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captured by RFID technology, providing information such as batch dates, product variables, weights, and sizes. Wireless devices can be used to automatically read data from RFID tags to improve stock management. Connecting sensors to this system could provide additional data on the environmental condition of goods as they move through the supply chain, such as temperature, humidity, dust, dirt, microbes, or food spoilage chemicals.

Other sources of data that are being generated from whole genome sequencing (WGS) and other “omics-based” methods offer a way to more precisely identify and characterize, for example, a specific bacterium within a food system. These data rely on advances in technology, such as machine learning and artificial intelligence, to generate algorithms that can offer predictive models of risk. FDA’s GenomeTrakr network, for example, uses WGS to help reduce foodborne illnesses and deaths. Another potential use of GenomeTrakr is to sequence pathogens that are not foodborne but that may still be linked to disruptions in the food supply chain; to date, the GenomeTrakr network has performed WGS on bacteria such as *Salmonella*, *Listeria*, *E. coli*, *Campylobacter*, *Vibrio*, and *Cronobacter*, as well as parasites and viruses, all of which are publicly available via the National Center for Biotechnology Information website at [ncbi.nlm.nih.gov](http://ncbi.nlm.nih.gov).

Abani K. Pradhan, PhD, professor in the department of nutrition and food science and Center for Food Safety and Security Systems at the University of Maryland in College Park, sees the increasing use of “omics-based” methods as a paradigm shift in bacterial surveillance. He says that machine learning has the potential to “extract useful patterns that could help improve current methods and models to predict risk or help improve manufacturing- and processing-related decision making.”

Dr. Pradhan emphasizes, however, that current risk assessment frameworks and predictive models don’t typically incorporate useful information such as pathogen genomics data. He and his colleagues at the University of Maryland are currently testing ways to improve food safety by integrating experimental and field data with mathematical modeling and developing predictive and risk models to help guide policymakers, government agencies, and the food industry in making informed risk management decisions. They are also developing models to use bacterial genomic data, along with the accompanying metadata, to help predict whether a

### Table 1. How Data Analytics Can Benefit Food Businesses

- Provide precise understanding of the reason for food spoilage.
- Improve a food’s shelf life by examining microflora in the plant environment.
- Track how a pathogen was introduced into a plant and how it is transferred from one location to another.
- Track the origin of an ingredient/lot of food.
- Better assess risks related to food/commodities from origin to harvest, to transport, etc.
- Ensure a product is not involved in a foodborne outbreak.
- Rapidly identify a contaminated lot if a product is involved in a foodborne outbreak to reduce the size and scope of a recall.
- Authenticate products.
- Use social media for early warning and mitigation of foodborne recalls or outbreaks.

Source: GFSI Science Technology Advisory Group Report 2022, available at [mygfsi.com](http://mygfsi.com).

### Table 2. What Food Businesses Should Do When Using Big Data

- Recognize how big data can help drive continuous quality improvement, as well as its limitations and gaps.
- Hire personnel who recognize when and where it makes sense to collect, store, analyze, and visualize big data.
- Put mechanisms in place to use outputs from data analytics to make decisions, such as collating data with dashboards needs to, for example, use for early warning, root cause analyses of incidents, supplier risk profiling, or manufacturing reaction.
- Share data globally and between agencies to help monitor the flow of pathogens through global supply chains.

Source: GFSI Science Technology Advisory Group Report 2022, available at [mygfsi.com](http://mygfsi.com).

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bacterium is more or less virulent in host systems. Further research involves developing a new method to incorporate bacterial genomic data into a dose-response modeling framework is underway (*Risk Analysis*. 2022;43:440-445).

“The primary advantage of these models is that they introduce a way to predict microbial behavior from a genomic perspective, particularly in microbial species that are known to have several subtypes (with potentially different characteristics) that can cause human infection and illness,” he adds.

Whether collecting data internally or externally, big data is just the source. And as indicated by the research just described, the real impact of big data is analyzing it and interpreting what the information means for an actionable goal.

### **Data Analytics: Translating Data into Actionable Information**

To harness the ability of big data to improve food safety, analytics to translate data into actionable information is needed. The term “precision food safety” is now being applied to refer to the use of big data, particularly the new data sources obtained from genomic sequencing and other “omics-based” methods, to improve food safety.

Strategic use of big data relies on the ability to analyze the information, whether by a food scientist within a company or a researcher working on developing predictive and risk models to help the food industry mitigate food safety risks.

Experts cite several challenges to this goal, one of which is precisely the “bigness” in big data. Dr. Donaghy refers to this as the volume and veracity of data. “The user has to understand where they can get the most value from all of this data and whether it is reliable enough,” he says.

Dr. Pradhan describes this challenge to processing large quantities of data as needing to “extract meaningful information from it, while ignoring ‘noise’ or irrelevant data.”

Another challenge is the need to digitize data so that it is in a form that can be analyzed, either by machine algorithms or trained personnel. Sawyer notes that in companies that have not modernized and are still working with legacy technology or manual processes, collecting data digitally or in a structured format may not be possible. She says a common theme Cargill hears when

benchmarking with companies is that there are large amounts of unstructured data exchange between organizations. “Companies need to have the ability to extract meaningful information from these inconsistent formats and languages,” she says.

Another challenge is the lack of data standardization. “In the absence of industry-wide and cross-industry data standards, sources of data have established their own definitions that don’t always translate between systems internal to an organization or externally,” says Sawyer.

Not only does this make it difficult to connect or exchange data across multiple sources to make information consumable and informative, Sawyer says that the lack of data standards can affect the ability to filter big data sets that can be relevant to an organization or to a problem to be solved. “One way Cargill addresses some of these challenges is through the use of metadata and data science concepts such as natural language processing,” she adds. “Our team of digital, data, and analytics experts within our food safety, quality, and regulatory organization is also focused on new ways of working and improving food safety through data-generating technologies.”

Dr. Donaghy underscores that not all companies will be able to easily meet these challenges. “Companies need to see the value/benefit of moving from their current ways of working,” he says. He cites examples of how different-sized companies can begin to use big data in their operations. For smaller companies, he cites the many off-the-shelf digital solutions that can be purchased, such as recall-ready software that companies can plug into, and programs for ready-made environmental monitoring that companies can use to plug in their test data results.

Larger companies, he says, may employ data scientists who can understand and help improve their internal data—such as supplier management data, certification/audit data, incident management data, cleaning program data, and environmental monitoring data—through data analytics, such as predictive analytics.

Dr. Donaghy notes, however, that companies will still need food safety and quality experts to direct data scientists. He cited the example of next-generation sequencing as a diagnostic/investigation tool for food safety. “Companies can employ a third-party laboratory to do this for them, or they can do this internally,” he

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says. “If they do the latter, it will require food safety specialists as well as bio-informaticians.”

For Dr. Pradhan, hiring a data analyst to process and analyze big data may seem logical, but he thinks that food manufacturers or other stakeholders may benefit by getting training from subject matter experts, such as scientists and researchers who have a good understanding of the food processing, manufacturing, and safety paradigms in these techniques.

Whether a company hires someone new or educates current employees, a certain skillset will be needed to navigate this new terrain of big data and data analytics as applied to food safety. Sawyer lists four primary skillsets: data literacy (the ability to read, understand, and interpret data), data translation (the ability to understand the business needs, to speak technology, and to translate between the entities), data analytics (the ability to analyze data for insights and decision making), and data science (the ability to uncover patterns in data and build predictive models with artificial algorithms such as machine learning).

### Data Sharing

To realize the full potential of big data and data analytics to improve food safety, data sharing among companies, regulatory bodies, and researchers is vital. Amassing large amounts of data inputs from large numbers of sources, and the more data that is available to work with strengthens a company’s ability to use the data to see patterns, predict risks, and make decisions.

Barbara Kowalcyk, PhD, director of the Center for Foodborne Illness (CFI) Research and Prevention and associate professor of food safety and public health at The Ohio State University in Columbus, and her colleagues have been working on how to facilitate data sharing, given the need to aggregate data across industry to best inform algorithms based on artificial intelligence and machine learning. “Data sharing between organizations in the [food] industry is difficult from a proprietary perspective, so we need to figure out a way to share data and aggregate it,” she says. “If you have enough data, you can mine the data to help inform specific situations on what works best and then share it.” For example, if an intervention has worked well for one company, sharing that with others may allow those companies to direct resources toward that intervention.

## Whether a company hires someone new or educates current employees, a certain skillset will be needed to navigate this new terrain of big data and data analytics as applied to food safety.

Dr. Kowalcyk and her colleagues are working to develop a data governance framework for sharing public and private sector data that will support the development of risk assessment models and burden-of-disease estimates. The project will help answer questions that many people in the private and public sectors have regarding data sharing, such as who will have access to the data, how it will be used, and how confidentiality will be protected.

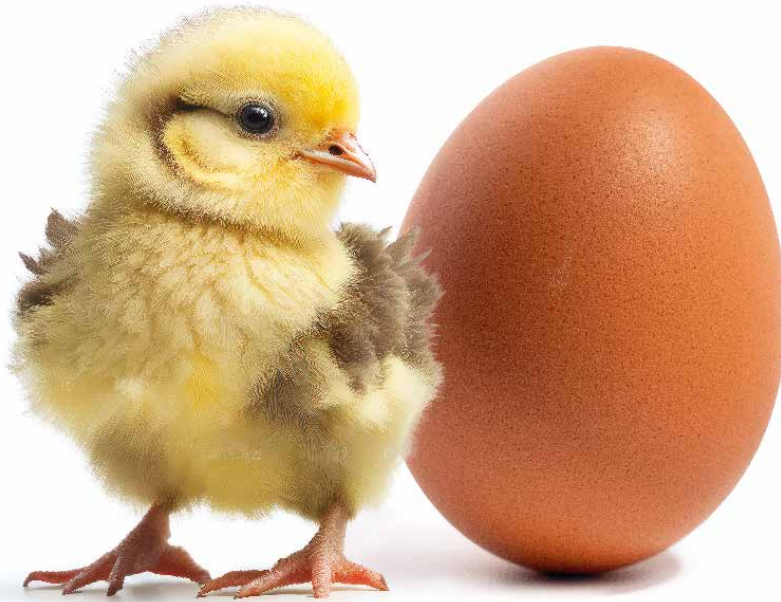
Initiatives underway are already highlighting both the reasons for and the benefit of sharing data to improve food safety. Along with the GenomeTrakr Network, FDA is piloting several other initiatives under FDA’s New Era of Smarter Food Safety. Launched in 2020, this initiative employs a number of “smarter” tools and approaches to improve food safety, such as root cause and predictive analyses, as well as other tools such as partnering with states to leverage data and analytics. Other FDA initiatives include the Artificial Intelligence Imported Seafood Pilot, the Domestic Mutual Reliance, and Remote Regulatory Assessments.

With access to new tools to capture large amounts of data and the means to interpret that data to improve food safety, food companies have a powerful new way to ensure the safety of their food product along the food supply chain—right at their fingertips. “All food sectors will benefit from the further use of big data interlinked from food source to consumption,” says Dr. Donaghy, “from the smarter way we do agriculture through to the more precise way authorities and manufacturers perform source attribution and investigation.” ■

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# Safety & Sanitation



According to data from the CDC, more than 58 million birds have died or been depopulated so far in the 2021-2023 ongoing outbreak. Of the total number of birds affected, nearly 43%, or almost 29 million of those lost, have been laying hens.

national figures noted for 2021, so this is a good starting point. As 2021 transitioned into 2022 in Florida, a flat of eggs more than doubled in price, hitting a \$7.00 to \$8.00 per flat price range, or about \$3.20 per dozen. Still affordable, but noteworthy to shoppers on a budget.

Moving into late 2022, eggs reached a jaw-dropping \$16.00 per flat in Florida, which is more than \$6.40 per dozen, in excess of 53 cents per egg in comparison with prior prices. Eventually, prices did come down some and, as of February 2023, the current price for a dozen eggs is \$4.50, which is definitely better but still much higher than the national average of \$3.46 per dozen. Admittedly, most of the data on Florida egg prices is anecdotal and could even be considered an isolated case, but these are real prices paid at a variety of national chain stores in the state over the period indicated.

Assuming the reality for most shoppers is likely somewhere in the range of the two data sets, that is still a massive price increase not fully explained by the pandemic or inflation. With inflation, groceries are up an average of 12%, which doesn't come close to explaining the increase in egg prices. On a related issue, the price of chicken has not experienced these dramatic price increases, so that leaves us with a single burning question.

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## Which Came First—the Chicken or the Egg?

What's really behind the increased cost of eggs

BY PATRICIA A. WESTER

**I**t's somehow fitting that we've been reduced to using riddles to explain why the price of eggs is out of control.

Egg prices, like many grocery items, skyrocketed during the pandemic primarily due to supply chain issues, but remained a cost-effective protein source. While coronavirus cases have stabilized, egg prices have continued increasing to the point that many families have had to cut them out completely, losing access to a breakfast staple and a valuable non-meat source of protein.

According to U.S. Department of Labor statistics, the national average price for a dozen eggs hit \$3.59 in November 2022,

which is slightly more than double the \$1.72 cost per dozen from a year earlier; however, year-over-year data doesn't give the entire picture on the price of eggs.

Rather than using generic national averages for egg pricing, let's look at a more complete history of egg prices in Florida, where it just so happens that I shop. Apparently, Floridians have some exclusive chickens, living in some pricey neighborhoods, providing our eggs. As the pandemic surged in the summer of 2021, a flat of eggs cost between \$3.50 and \$5.00. A flat contains 30 eggs, or 2.5 dozen, so that's roughly \$2.00 per dozen or 10 to 16 cents per egg. These prices align with the

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### What on Earth Happened to All the Egg-Laying Chickens?

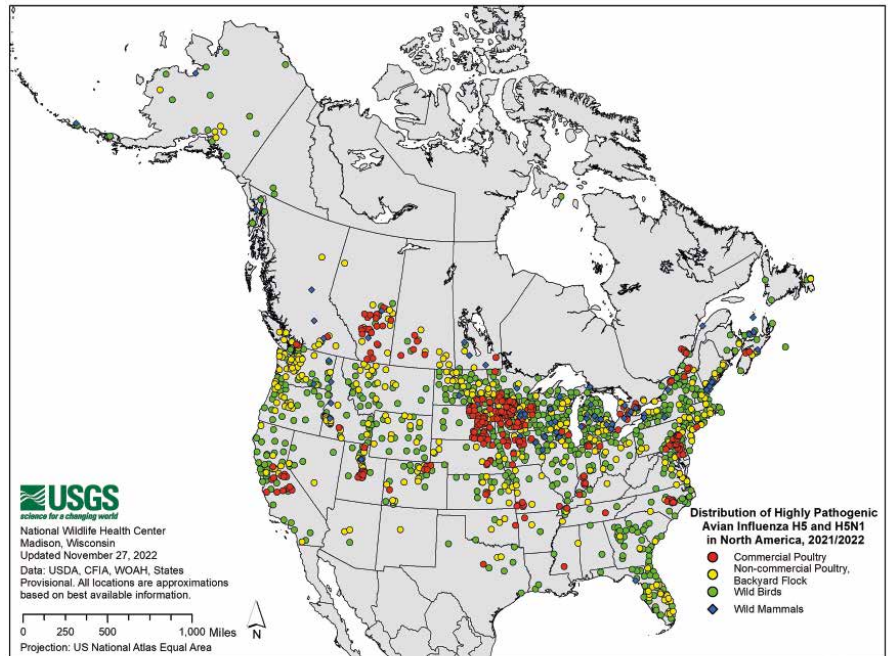
I recently came across an article that brought some levity to the egg situation while also shining a light on how the internet has chosen to explain the huge jump in egg prices. Social media users claim to have found a culprit for sky-high egg prices: The chicken feed did it.

Josh Keley, a writer for the Associated Press, in a February 5, 2023, article (“Fact Focus: Egg Shortage Breeds Chicken-Feed Conspiracies”) wrote that social media users on Facebook, TikTok, and Twitter were reporting that their backyard hens had slowed down or stopped laying eggs. While this can be a common occurrence during the shorter days of winter, no one seemed to consider this train of thought as an explanation. Instead, they began speculating that common chicken feed products were the cause of the reduced production. Curious, I wondered whether they might be onto something that should be investigated by product testing to look for contamination; however, I soon remembered that this was social media, not a scientific journal, which meant that somebody was going to come up with a conspiracy theory instead of a scientific solution.

### What Is Bird Flu?

**Low Pathogenic Avian Influenza (LPAI):** Low pathogenic avian influenza viruses cause either no signs of disease or mild disease in chickens/poultry (such as ruffled feathers and a drop in egg production). Most avian influenza A viruses are low pathogenic and cause few signs of disease in infected wild birds. In poultry, some low pathogenic viruses can mutate into highly pathogenic avian influenza viruses.

**Highly Pathogenic Avian Influenza (HPAI):** Highly pathogenic avian influenza viruses cause severe disease and high mortality in infected poultry. Only some avian influenza A(H5) and A(H7) viruses are classified as HPAI A viruses, while most A(H5) and A(H7) viruses circulating among birds are low pathogenic type LPAI A viruses. HPAI A(H5) or A(H7) virus infections can cause disease that affects multiple internal organs, with mortality as high as 90% to 100% in chickens, often within just 48 hours.



A map of confirmed HPAI detections in North America.

Keley went on to say that some users went further, suggesting that feed producers had intentionally made their products deficient to stop backyard egg production, forcing people to buy eggs at inflated prices. The fact that commercial feed producers and egg producers are often

vertically integrated entities doesn't seem to affect their theory, as one Facebook user wrote in a post shared more than 2,000 times: “One of the largest egg producers in the country cut a deal with one of the largest feed producers in the country to change their feed formula so it no longer contains enough protein and minerals for your chickens to produce eggs. They are now price-gouging eggs to make bank.”

Certainly, feed quality can affect hen egg-laying abilities; however, no widespread issues with feed or feed affecting egg production were reported in the article, and several major feed suppliers contacted by Keley said they had not changed their formulas.

I did find a notice for a February 8, 2023, Purina prescription pet food recall due to elevated vitamin K levels in a dry dog food product. The symptoms of vitamin K toxicity in dogs are similar to some of the reports about chickens on social media; certainly, it's at least possible backyard hens would eat dry dog food if it was accessible.

There are other factors that can have a negative impact on egg production. For example, the amount of light chickens are exposed to can affect egg production—chickens are sensitive to lengthening daylight that triggers laying to increase. The

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# Demystifying the Dust Hazard Analysis

This evaluation is required for facilities that handle combustible dust, which includes most food processing facilities

BY ALYSHA YINGER

**Editor's note:** This is part one of a two-part series focused on dust hazard analysis. In this article, we focus on the dust hazard analysis process. In our next issue, we will take a look at how to put the analysis into practice at your food plant.

**C**onfused about the dust hazard analysis (DHA) process? You're not alone. Many bakers and food processors have questions about DHA requirements. Here's what you need to know and how to get it done.

## Why Do You Need a DHA?

A DHA is required for facilities that handle combustible dust, which includes most food processing facilities. Dry food dust—including dust from sugar, flour, starches, cocoa powder, dry spices and flavorings, dehydrated milk products, and dust from processing grains and nuts—is combusti-

ble under the right conditions. These conditions include:

- Suspension of dust in the air in a cloud;
- Confinement of the dust cloud in an enclosed space, such as a storage silo, enclosed conveyor system or mixer, or dust collection system);
- Oxygen to fuel a combustion reaction (e.g., oxygen found in atmospheric air); and
- An ignition source, such as an open flame or high heat from ovens, sparks from friction in mechanical systems or conveyors, or static electricity.

Under the National Fire Protection Association (NFPA) standard 61, "Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities," Chapter 7.1.2.2, a DHA is required for bakeries and food processing facilities every five years. A new analysis may also be required if the facility

introduces new dust types, processes, or equipment that will substantially change the risk profile.

## The DHA Process

NFPA 61 requires that "the DHA shall be led by a qualified person." For most food processors and bakeries, that will mean getting outside help from an expert to complete the process. The organization does not mandate a specific format for the DHA but, in general, the process will include the following:

- Material characterization;
- Process characterization and hazard identification;
- Evaluation of existing safeguards;
- Mitigation recommendations; and
- Verification.

## Material Characterization

The first step in the DHA process is to determine the material characteristics of the dust. In some cases, it may be possible to use published industry values for your dust type; however, your dust must be substantially similar to the dust used for comparison in the published values. The explosibility of dust is dependent not only on its chemical composition but on factors such as particle size distribution, particle morphology, moisture content, and other variables. For this reason, it is usually advised that facilities collect a sample of their specific dust for analysis. The sample must be sent to an independent accredited laboratory (ISO17025 Accredited Lab or Calibration Round Robin Lab) and tested using NFPA-approved analytical processes covered by the accreditation. You can find an accredited laboratory at [dustsafetyprofessionals.com](http://dustsafetyprofessionals.com).

Testing may include all or some of the following:

- **Go/no-go testing:** A simple screening test to determine whether dust will ignite in a pile and/or explode in a cloud.
- **Explosion severity testing:** These tests are conducted in a pressure vessel to determine the explosion indices, measures of how severe an explosion would be if one were to occur. These indices include KST (the speed of pressure rise) and Pmax (the maximum pressure rise in a closed vessel).

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- **Additional explosion testing:** Other testing may include indices such as minimum explosive concentration (MEC), minimum ignition energy (MIE), and minimum ignition temperature (MIT). These values provide insight into the specific conditions under which an explosion is likely to occur.

### Process Characterization and Hazard Identification

The DHA will also include measurement of pre-mitigation conditions, analysis of the processes in the facility, and identification of specific hazards. For example, it can pinpoint:

- Where dust clouds tend to form (e.g., places where dust is disturbed);
- Where dust accumulates on surfaces;
- Where dust clouds are under confinement (e.g., enclosed conveyor systems, silos, dust collectors); and
- What potential sources of dust ignition exist.

### Evaluation of Existing Safeguards

The DHA should note the safeguards that are already in place and their effectiveness in reducing a combustible dust explosion risk. These may include:

- Housekeeping practices (e.g., wet or dry sanitation type and frequency);
- Administrative controls (e.g., training programs, access limits, hazard communication);
- Engineering controls (e.g., dust collection); and
- Safety systems (e.g., deflagration systems, fire breaks, fire suppression/sprinkler systems).

### Mitigation Recommendations

The DHA will include a set of recommendations specific to the facility. These recommendations will address the hazards identified in the DHA; they may include updates to existing safeguards as well as new recommendations. Examples could include:

- New housekeeping procedures;
- Upgrades to dust collection systems;
- Changes to process controls (e.g., changing the operating parameters of conveyance systems or mixers to reduce dust cloud formation);



CREDIT: COURTESY OF ROBOVENT.

## DUST FIRE AND EXPLOSION PENTAGON

All five elements of the pentagon must be present for a combustible dust explosion to occur.

- Removal of enclosures that create dangerous confinement of dust; and
- Removal of ignition sources.

### Verification

The final step of the DHA should include measurements to determine whether the mitigations have been effective. Specifically, have levels of dust been reduced on surfaces and in the air and have hazards identified in the DHA been removed?

### Collecting Your Dust Sample for a DHA

When preparing for laboratory testing of combustible dust, the dust must be collected in accordance with NFPA 652 Chapter 5.5. This document outlines procedures for safe collection of a representative dust sample. Some things to keep in mind:

- Contact your laboratory for specific requirements for collecting, storing, and shipping your dust sample. Sample size requirements may vary by laboratory and test type.
- Dust samples must be representative of the dust present in your facility. If you have different types and levels of dust in different places, you may want to collect multiple samples from different locations. Elevated surface samples will identify hazards of dust accumulation in the facility. Raw material and final product samples provide a baseline for understanding hazards related to material unloading and conveyance or packaging.
- Be careful not to introduce new hazards while collecting the sample. Samples should be collected without introducing an ignition source or dispersing dust into the air. Use non-sparking equipment such as plastic antistatic shovels and natural bristle brushes when collecting dust. When collecting samples from elevated locations, be sure to follow all safety guidelines for working at heights.
- Take care to preserve sample integrity when collecting and storing the dust sample to avoid the introduction of contaminants that could confound the investigation. Samples should be collected with clean equipment and placed in a clean plastic bag or non-conductive container.

Table 1. Understanding Dust Explosion Classifications

NFPA and OSHA categorize dust into four classes based on their  $K_{ST}$  value, or the speed at which pressure will rise in a closed vessel if combustion occurs. Many food dusts fall into ST Class 2. The ST Class will influence the type of mitigations required and dust collection system design.

**Note:** “Weak explosion” refers only to the speed of the pressure rise, and not to the ultimate damage the explosion can cause to a facility. Many of the most destructive combustible dust incidents in history have occurred in the food and agricultural sector.

Dust Explosion Class	$K_{ST}$ Value (Bar.m/s)	Characteristics	Typical Examples
ST 0	0	No explosion	Rock dust, silica
ST 1	>0 and ≤200	Weak explosion	Powdered milk, sulfur, sugar
ST 2	>200 and ≤300	Strong explosion	Wood flour, cellulose
ST 3	>300	Very strong explosion	Aluminum, magnesium



Collect dust samples in a clean, static-free container and follow all laboratory guidelines for storing and shipping your dust.

- Consult the U.S. Department of Transportation's hazardous materials regulations prior to shipping your sample and take all required shipping precautions.

These dust sample collection guidelines provide additional information for NFPA 652 compliance for sample collection, types of laboratory testing, and tips on finding an accredited laboratory for combustible dust testing.

### DHA Outcomes

The DHA should be considered a living document. While completion of a DHA is required for compliance with Occupational Safety and Health Administration regulations and NFPA guidelines, it should be the first step in an ongoing combustible dust safety plan.

The DHA will help you determine risks associated with your specific dust, identify areas of your facility in which specific combustible dust hazards exist, and make effective recommendations for the mitigation of combustible dust risks.

Once you understand your current state, risk profile, and mitigation options, it is time to put the recommendations into place and conduct validation testing to determine whether goals have been met. Risk assessment and validation should be an ongoing process. While the DHA is only required to be reevaluated every five years, facilities should take steps to ensure continued compliance and improvement. This includes:

- Monitoring airborne and surface dust levels;
- Ensuring compliance with administrative controls and housekeeping procedures;
- Maintaining safe operating limits for equipment as outlined by the DHA;
- Evaluating any changes in equipment, procedures, or processes to ensure that new hazards are not introduced;
- Training all employees in the hazards of combustible food dust and ensuring that they have job-specific training for their areas of responsibility; and
- Updating the DHA when significant changes to materials or processes have been made.

Few bakers and food processors have the necessary skillsets on staff to conduct a formal DHA and make mitigation recommendations. It is usually advisable to work with a qualified engineering partner when conducting the DHA and implementing recommendations. ■

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## Which Came First—the Chicken or the Egg? *(Continued from p. 24)*

amount of light laying hens receive is manipulated using artificial light, so those lights you see in chicken houses late at night are not there because the birds are insomniacs.

The group discussing egg prices on social media may have inadvertently identified a product that was eventually recalled, but instead chose to create a baseless theory to blame the feed guys. So, before another conspiracy theory is born, let's look at the most likely cause for the painfully high egg prices.

### Truth Versus Conspiracy

For several months, U.S. officials have been battling a bird flu outbreak that could break existing records. In December 2014, the National Wildlife Health Center detected HPAI viruses of Asian origin in wild waterfowl in the state of Washington. By the end of 2015, losses associated with this outbreak exceeded 50 million poultry,

resulting in more than \$3 billion dollars in economic impacts.

The wild migrating bird population is monitored year-round for the presence of strains of bird flu that could decimate domestic poultry flocks if not caught early. The virus spreads easily in bird populations through droppings or the nasal

### Recommendations for Poultry Workers and Bird Outbreak Responders

People working with poultry with known or possible infections of HPAI A viruses should follow worker protection and personal protective equipment recommendations from the CDC, available at [cdc.gov/flu](http://cdc.gov/flu). Additional guidelines are available on this page under "Information for Specific Groups."

discharge of an infected bird, which can contaminate dust and soil and be carried onto farms on boots and clothing or on truck tires. If a single case is detected, any domestic flocks that could have come into contact with an infected bird must be destroyed.

According to data from the CDC, more than 58 million birds have died or been depopulated so far in the 2021-2023 ongoing outbreak. Of the total number of birds affected, nearly 43%, or almost 29 million of those lost, have been laying hens.

That's a lot of chickens no longer laying eggs.

This is the most probable reason for the ongoing high cost of eggs, and prices should continue to fall as producers work to replace the birds lost in the outbreak. ■

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## How to Prevent Rodent Issues

An integrated pest management plan can help stop rats in your food facility

BY GLEN RAMSEY, MS, BCE

In October 2023, Orkin released its annual “Top 50 Rattiest Cities List” and, while many might assume that New York City would be No. 1 on this list, it was in fact the Windy City that stole the least-coveted spot for the eighth consecutive year.

With the drastic increase in rodent sightings during the COVID-19 pandemic, consumers and businesses alike have been concerned about their health and safety. For food manufacturers and distributors, the increase in rodent activity isn’t something that should be ignored.

While gradually resuming pre-pandemic activities has helped to reduce the number of public rodent sightings, the pests’ threat to public health hasn’t decreased. In fact, these filthy pests can spread dozens of harmful diseases—directly and indirectly—such as hepatitis E, leptospirosis, and hantavirus, in addition to contaminating food products and causing structural damage in buildings.

Left unaddressed, rodent sightings within a commercial facility can lead to ongoing infestations and, eventually, failed inspections and stalled operations—costly blows to your bottom line. Knowing how to spot rodent activity is essential in stopping them early. If you notice any of the follow-

ing signs around your food facility, you might have a rodent problem:

- Capsule-like droppings;
- Grease marks along skirting boards, walls, and tight spaces;
- Gnaw marks on walls, wires, and other materials; and
- Nests in dark areas such as crawl spaces, roofing, and garbage dumps.

So, how does a food manufacturing and handling facility protect itself against rats? By implementing an integrated pest management (IPM) program.

### Preventive Measures

Most food-handling businesses likely have heard about IPM programs, especially if they are regularly audited by third-party food quality and safety auditors or subject to frequent regulatory inspectors. These programs are implemented by qualified pest control technicians in collaboration with a business’s food safety and quality assurance team to help deter pest activity and prevent infestations. IPM programs focus on preventive techniques such as exclusion, sanitation, and maintenance to keep pests where they belong—outside of your food facility. When it comes to rodent control, exclusion is particularly important for facility managers.

Because food processing facilities receive and send shipments daily, it’s easy for rats and other rodents to slip into transportation vehicles, packaged goods and, eventually, your building. Not only does this jeopardize your business’s products and your reputation, but employee health is also at risk. Exclusion helps keep rodents outdoors by making sure potential entry points are quickly sealed and any maintenance work is completed in a timely manner. While each business’s exclusion plan will vary based on local pest pressures, climate, and location, the majority of pest control technicians will begin with a comprehensive facility inspection prior to implementing specific tactics. These tactics can include sealing cracks and crevices that rats can slip through, installing weatherstripping, and performing door sweeps.

Another preventive measure you can add to a plan is remote pest monitoring. When you’re running a round-the-clock operation like most food-handling facilities do, your employees might not have time to monitor for pests while also performing their production responsibilities. Remote pest monitoring can help flag pest issues for you to address with your pest control provider before a bigger problem arises. There are a variety of devices that can be used during remote monitoring, depending on your facility’s specific needs and structure, but the results are primarily the same: You’ll be able to track pest activity from any location and involve your pest control provider when needed to identify pest activity trends.

Remote pest monitoring is especially beneficial in automated food manufacturing and processing facilities that see little human activity, reducing the amount of time employees spend spotting pest issues in real time.

While monitoring pest activity remotely is beneficial in places in which staff aren’t always present, it’s helpful to have other observation methods in place. Staff training in pest control might not be high on your list of priorities, but take it from the experts in commercial pest control: It can save you a lot of money and time. Your employees,

*(Continued on p. 39)*

# Quality



## High-Pressure Processing

How the non-thermal technology can help ensure food safety without affecting quality

BY B. NGOC PHAN

**H**igh-pressure processing (HPP) is an innovative technology that has been pursued for more than a century to ensure food safety, extend refrigerated shelf life, maintain natural nutrients, and improve food quality (*WV Ag For Exp Stn Bull.* 1899;58:15-35). HPP inactivates foodborne pathogens and spoilage microorganisms while maintaining the freshness and natural nutritional value of the food products, unlike thermal treatments, which can damage nutrients and other bioactive compounds.

HPP is a non-thermal processing method that can improve food safety without changing a food's integrity. It has become widely accepted as a viable and important process in the food industry. The process allows food and beverage producers to ensure food safety, increase refrigerated shelf life, and maintain

product quality, with little to no destruction of a food's natural nutrition.

Traditional processing methods such as heat pasteurization cannot be used with many products due to the organoleptic effects that occur. Results of studies by various laboratories, academia centers, and other published reports clearly show that HPP will provide food safety benefits for many at-risk products, without affecting quality (*J Food Prot.* 2004;67:1709-1718; *Int J Food Microbiol.* 2007;115: 220-226; *J Food Prot.* 2006;69:2539-2543). The decline in food quality over the time a product is in refrigerated storage can result in economic loss due to distressed/spoiled products. HPP of various refrigerated products showed remarkable conservation of organoleptic properties, allowing for greater than three times the shelf life in storage when compared with the same product processed without HPP.

Despite the growing number of commercial food categories in which HPP is used, the meat industry remains the largest product category that uses the technology. The process is recognized by USDA's Food Safety and Inspection Services (FSIS) and other regulatory agencies such as Health Canada as a viable post-lethality treatment to ensure the safety of ready-to-eat (RTE) meats. It is used to inactivate *Listeria monocytogenes*, *Salmonella*, and pathogenic *E. coli*, as well as to reduce spoilage microflora, thus extending microbial shelf life and enhancing organoleptic quality without the use of chemical preservatives.

In 2003, FSIS issued a letter of no objection for the use of HPP as a PLT to control *Listeria* in RTE meat. The use of HPP in RTE meats continues to grow globally as manufacturers push to ensure consumer safety and meet demands for preservative-free, lower sodium products.

### Beyond Food Safety

There are numerous non-microbiological HPP benefits for raw proteins. HPP can enhance marination performance without the use of injection methods and vacuum tumblers and tenderize raw proteins with reduced liquid purge and yield improvement.

HPP products are also expanding to meet consumer demand for minimally processed and clean label foods and beverages. Newer product categories are taking advantage of the food safety, product quality, and nutritional benefits that result from the process. These include functional beverages, plant-based proteins, dips/wet salads, yogurt-based dressings, and the ever-expanding pet food industry. For example, pet food manufacturers use HPP to eliminate harmful pathogens in their raw materials to protect pets and their handlers from foodborne infections while maintaining the "rawness" of the product.

Due to the growing demand for immunity boosting products, in part due the ongoing pandemic, food and beverage manufacturers around the globe have increased their HPP offerings to meet new customer demands. ■

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## “Functional” Foods Continue to Gain Momentum

Foods enriched by ingredients with health claims continue to be popular among consumers, but how are they defined and regulated? | BY **JESSE STANIFORTH**

In early 2023, breakfast cereal manufacturer Post Consumer Brands announced the launch of a cereal called “Sweet Dreams.” The cereal will come in two flavors, blueberry and honey, and will be accentuated by lavender and chamomile and fortified with “a curated herbal blend and vitamins and minerals like zinc, folic acid, and B vitamins to support natural melatonin production.” A company press release stated: “More than ever, consumers are looking to embrace acts of self-care.”

The entrance of a major corporate cereal maker into the realm of these types of “self-care” foods is a reminder that, after a flare of popularity in the early years of the pandemic, “functional foods” are now

becoming an established supermarket offering.

A few years ago, it might have seemed unlikely for consumers to expect food products to support claims that they can help prevent conditions such as cardiovascular disease; boost gut health and immunity, and promote mental health, well-being, and sleep. Today, food producers know that consumers are willing to pay a premium for those promised benefits.

Brian Chau, a food scientist and consultant based in San Jose, Calif., says the global “dietary supplements” market—which includes functional foods—is on track to hit \$331.6 billion by the end of the decade. “The trend has accelerated since the pandemic,” Chau tells *Food Quality &*

*Safety*, “but certainly has grown since the rise of the bar and powder supplement category. Functional foods are integrated into daily routines as pill [and] tablet fatigue is setting in for younger generations. No longer do consumers expect just to eat when they’re hungry; they also see a meal or snack as an opportunity to improve health, without having to consume supplements separately in pill form.”

Chau notes that the increase of functional ingredients are primarily found in confections and beverages. He says that fortified gummy products are increasing in number, along with cookies, bars, chocolates, and drinks that are making functional claims.

### Why Functional Foods?

Kantha Shelke, PhD, a senior lecturer at Johns Hopkins University in Baltimore and founder of nutrition research firm Corvus Blue, identifies a particular need that functional food serves for consumers. Generally, consumers choose functional foods because they feel these products reward their health, she says, but also because they see a social and moral incentive in taking care of themselves. For some, adding functional foods to their diet can be a way of advertising their lifestyle choices to others.

If consumers were already shifting away from taking vitamins and supplements in pill form, the pandemic was a mighty inducement. Sarah Johnson, PhD, director of the Functional Foods and Human Health Laboratory at Colorado State University’s College of Health and Human Sciences in Fort Collins, says the rise of functional foods was closely linked to the pandemic simply by how much more aware consumers became of health and disease. “Functional foods—or ‘superfoods,’ which is a more commonly used term—are definitely selling more than they were previously,” Dr. Johnson says. “Especially with the pandemic, consumers are looking for foods and beverages that can support their health, mitigate infection and adverse effects of COVID, and also promote mental health and well-being.”

### What Are Functional Foods?

Dr. Johnson notes that “functional” foods are a difficult category to describe. Some

foods—such as fruits, vegetables, nuts, legumes, and grains—are inherently functional and confer significant health value to consumers. Many other functional foods, however, are either designed to be functional or simply boast that they contain functional ingredients.

The functionality of this second class of foods is harder to measure. “Some of those ingredients are at levels that can provide physiological effects and health benefits,” Dr. Johnson says, “while others may just be in there because they are known to have health benefits but are not provided at levels to be functional.”

Dr. Johnson notes that many products boast that they contain an ingredient that has been subject to human or animal studies and has shown some proven effects, but the ingredient has not been studied as part of a product. She gives the example of the soluble dietary fiber inulin, whose health effects as an individual product have been studied, but whose efficacy as an ingredient to another product has never been assessed. This hasn’t prevented producers from adding health claims to products containing inulin.

### A Rising Trend

Dr. Johnson says that, overall, functional foods do seem to be delivering more to consumers than they were a few years ago. “Consumers have driven functional food development to some degree because, as

consumers learn about health and sustainability, the demand for certain products and types of products increase,” she says. But, she adds, researchers and food producers publicizing research on health effects has primed the public to demand

**Especially with the pandemic, consumers are looking for foods and beverages that can support their health, mitigate infection and adverse effects of COVID, and also promote mental health and well-being.**

—SARAH JOHNSON, PhD

foods that reflect such research. “I think both consumers and marketing or dissemination of health-related research drive demands and desires.”

Consider fermented foods, probiotics, oatmeal, and oat fiber, says Dr. Shelke. Consumers were already eating these products when researchers discovered the perceived gains associated with them. Both media and marketers immediately began reporting the potential health advantages of consuming these existing

foods, and producers of such foods quickly got on board to market their products based on function. “Once food companies realized that people had interest in these types of products,” Dr. Shelke says, “they created more such products and then went on to expand the category with new types of nutraceuticals and functional foods. [Consumer] interest and market demand drove companies to innovate and create new functional products—and rinse and repeat.”

The problem with “functional foods,” she says, is that “all foods have functional properties, but it is the dose and frequency of consumption that matters most. The physiological [or] functional effects of functional foods depend on several factors besides just composition and the amount consumed.”

There’s no reason to presume that the functional foods boom is a passing fancy, Dr. Shelke says. Consumers may very well continue seeking out foods with perceived health rewards, but there remains the possibility that the field can expand. “Every food can be a functional food,” Dr. Shelke says. “It is how they are combined against the backdrop of lifestyle, other choices, inherent genetics, and the environment that makes even the seemingly lowly grains and tubers be dubbed as superfoods or functional foods.” ■

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# Testing



## High Alpha-Amylase GM Corn Analysis

Processors may want to adopt high-sensitivity testing methods to detect cross contamination with food-grade corn

BY AKSHAY VIDWANS

**M**ost corn processors and consumer packaged goods (CPG) companies associate genetically modified (GM) high alpha-amylase corn with ethanol production. That association was true five years ago, but times have changed, and corn processors and CPG companies must be aware of a product new risk profile this corn poses to their operations. High alpha-amylase corn production is growing by double digits each year in part due to its adoption as cattle feed.

The risk of cross pollination and cross contact has been growing in areas where both food-grade corn and GM corn intended for ethanol or livestock feed are planted. This growth has correlated

with rise in the frequency of processing and product quality issues at major corn processors across the U.S. related to high alpha-amylase corn.

Corn processors and CPG manufacturers who want to keep their clients happy by supplying quality products are dealing with this new challenge by adopting new preventive controls that include implementing inbound corn testing.

### High Alpha-Amylase Corn Adoption

The high level of alpha-amylase content in GM corn acts as a catalyst in breaking down complex starch into smaller chains called dextrans. The effect is demonstrated to be highly beneficial in saving time and energy when converting corn starch to

sugar for ethanol manufacture, but there are also claims that it drives digestibility and efficiency in cattle feed. As a result, high alpha-amylase corn is an innovative, specialized value proposition benefiting both ethanol and cattle feed production. These applications account for 90% of domestic corn use, according to USDA.

This value proposition for cattle feed is proving to be very successful. The cattle feed application for this corn first introduced in 2018 has witnessed dramatic adoption, with double-digit growth in sales of all high alpha-amylase corn seed in 2021. As a result, high alpha-amylase corn farms are no longer concentrated geographically only near ethanol plants. They are now all over the U.S. in every corn-growing region. With this growth in corn farms, the cross-contact risk is growing every year. Wind and weather, as well as shared equipment, storage, and transport, can all lead to high alpha-amylase corn contamination and product issues.

### What Millers Should Know about High Alpha-Amylase Corn

For corn processors, there is a consequential side effect of the alpha-amylase produced in this GM corn when it mixes with their food-grade corn. All of the extra starch-digesting enzyme inherent in the GM variety does not simply dissipate during the milling process but remains intact in the individual fractions of the milled corn, whether wet milled or dry. The enzyme laced into the milled product can reach optimal activity rate when it is being processed at elevated temperatures during the cooking process. The result is accelerated, unintended starch breakdown, which causes product quality issues.

The enzyme sometimes remains active even after the food product is packed. The nature of the enzyme, which acts as a powerful catalyst that is not consumed in the starch hydrolysis process, results in carbohydrates continuously disintegrating into sugar to a point of dysfunction. This has been responsible for disastrous results in the real world, with processors citing issues that include:

- Sticky or fragile tortillas;
- Crumbly chips and cornbread;
- Soupy and runny corn grits; and
- Non-binding tamales.



The high overlap of high alpha-amylase corn growth areas and U.S. milling capacity poses significant risk to the food-grade corn that millers buy and, in turn, ship to their customers. Up until recently, however, the milling industry has been hesitant and skeptical about the need for testing for high alpha-amylase corn. Elevators, distributors, and operations managers fear that additional testing steps will disrupt procurement operations in the middle of a labor shortage. Onsite quality managers also have limited awareness of high alpha-amylase corn testing in root cause analyses for quality concerns.

However, firsthand experience with quality issues in production and customer complaints are changing that mindset with senior quality managers. CPG manufacturers cannot afford to work with food-grade corn commingled with high alpha-amylase corn. Processing and manufacturing with a contaminated supply can lead to production losses, consumer complaints, and—potentially—to the loss of customers.

CPG quality control managers are now starting to ask millers to evaluate food-grade corn for alpha-amylase levels at a high sensitivity before they agree to make the purchase, and testing for high alpha-amylase corn is becoming the standard at most major players in the corn milling industry for sensitive processes such as nixtamalization and baking. No CPG manufacturer wants their consumers unhappy due to sticky tortilla or runny grits, and the onus is on millers to heighten their vigilance and prevent the unintentional introduction of enzymes into the product they supply.

### High-Sensitivity Case Report

In the fall of 2021, one of the largest U.S. corn millers was struggling with multiple batch failures of masa flour. The head of quality worked to uncover the root cause of the failures, and was surprised to discover that high alpha-amylase corn was the primary factor in the failures, even though they were testing every inbound

truck using a test that was able to detect one in 400 kernels (0.25%) GM contamination. The root cause analysis demonstrated that the miller needed to revise their acceptance criteria for inbound corn to a much lower cross-contact level under 0.1%. The miller then employed a high-sensitivity test capable of detecting high alpha-amylase corn in the customer's batches at one in 2,500 kernels (0.04%).

### Preventing Risk

At even the lowest levels, high alpha-amylase corn levels must be monitored to prevent the corn from moving through the food supply chain. This will ensure customer satisfaction and prevent business risk caused by poor-quality product. Quality managers across the industry are best positioned to mitigate this issue by identifying the sources of risk for their procured corn, thus protecting their brand and customers. ■

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# Manufacturing & Distribution



## Five Advantages to Using Video Monitoring in Food Facilities

The technology can help food processing facilities improve compliance, increase profitability, and assist with inspections | BY HEIDI SCHMIDT

**I**n March 2020, the Department of Homeland Security designated food and agriculture production one of 16 critical infrastructure sectors. This was a significant recognition, as it allowed food processing plants to continue their activity during the pandemic. Even with the pandemic mostly in our rearview mirror, this designation shelters the sector from future disruptions.

The classification also comes with additional compliance and regulatory issues. While health and safety are the top concerns in these industries, production efficiency and business operations are not to be neglected. With a more and more unstable geopolitical climate, a lot rests on the shoulders of food processing facilities.

Video monitoring can help take some of that burden off your shoulders. It can improve processes and compliance, and help streamline processes. When you hear “video monitoring,” security is often the first thing that springs to mind. Granted, enhanced security is not a small feat, but video monitoring in food processing plants can help with a lot more. Here are five advantages to using this technology in your food facility.

### 1. Ease FDA Inspections

Thanks to the Food Safety Modernization Act (FSMA), FDA’s regulatory requirements with regard to food processing has increased significantly.

FDA inspections aren’t always easy to pass. Everything is under scrutiny, from your processes to the equipment you use. While using the right food processing equipment to avoid contamination is a fairly straightforward guideline, when it comes to procedures and the way they are implemented, things can get murkier. This is where the right surveillance equipment can assist.

Video surveillance can help you prove your point, especially through the technology’s physical security component: You can prove that your processing plant was not contaminated by unauthorized personnel or intruders by showing footage of who had access inside. Moreover, video monitoring can help prove that you’ve thoroughly secured the storage and use of toxic chemicals. When combined with access control systems, video surveillance can be your best ally during an FDA inspection.

### 2. Identify and Resolve Equipment Failure

When essential equipment is down, your entire plant may have to stop working. Depending on how long it takes to get to the root of the problem, you can lose hundreds of thousands of dollars due to activity disruptions. According to a 2015 study from research firm Aberdeen Strategy and Research, a food processing plant can lose up to 20% of its capacity because of downtime.

Through intelligent video surveillance systems, you can see all the activities that led to an equipment’s failure in real time, and you can identify the sequence of events at fault and solve the issue quickly. More importantly, you can prevent downtime from happening altogether. While some equipment malfunctions are easily missed by workers in a noisy plant area, they often can be easily spotted by an operator in a remote location who may be viewing from a different perspective.

### 3. Streamline Operations and Prevent Losses

Real-time monitoring can help identify staff effectiveness, as well as faulty processes that may lead to losses. The traditional way of identifying process faults—through human inspectors monitoring the lines—can’t be as comprehensive as video surveillance. Moreover, the latter comes with a hard-to-beat advantage: the bird’s-eye-view perspective, which is impossible to achieve using human eyes alone.

This is why 93% of companies that use video systems for cross-functional benefits report a positive impact on operations, according to 2013 research from the Loss Prevention Research Council.

### 4. Expand New Employee Training

Video monitoring can help pinpoint common knowledge gaps for your new

*(Continued on p. 39)*



# Traceability Standards Can Help Improve Food Safety

Moving to two-dimensional barcodes on food labels can enable access to unprecedented levels of product information and transparency

BY ANGELA FERNANDEZ

The supply chains that industries rely on to carry products around the world are undergoing a seismic transformation. Upheavals triggered by the COVID-19 pandemic and its seemingly never-ending repercussions continue to impede the flow of goods in every sector, including the global food supply. Shoppers are no longer surprised to discover that their favorite grocery products are out of stock; even restaurants are reporting availability issues that affect their menu offerings on a daily basis.

Unpredictable supply timelines can cripple the provision of goods across all industries, impacting production, sales, and customer satisfaction. The food industry faces the additional challenges related to maintaining food safety through the distribution of perishable items. Grocery stores and restaurants manage their supply chains and inventory with meticulous attention to temperature control requirements and expiration dates to ensure that

food is safe to eat when it is sold. Delayed shipments can compromise freshness and elevate the risk of spoilage or contamination, posing a threat to public health.

Meanwhile a massive, technology-based evolution of traceability systems connecting suppliers and retailers across the entire supply chain is underway. This system hinges on effective teamwork among trading partners to facilitate real-time data exchanges so that all stakeholders can quickly pinpoint the location and disposition of a particular product at any time throughout its journey to point of sale.

In order for this system to work, all parties in the supply chain must be engaged in a collaborative approach based on standardized data that will allow clear and timely information exchanges. System compatibility and data standards are essential to enable full visibility and traceability so that buyers will know which products are available or out of stock,

where they are in the distribution chain, and when delivery can be expected, for starters.

Sharing pertinent supply chain information helps all trading partners anticipate, plan, and optimize their ordering, delivery, and inventory management, as long as the data is exchanged in a standardized format that all parties can understand. This is the premise behind the adoption of data standards to enable clear and accurate exchange of information.

The momentum to incorporate technology for supply chain improvement also coincides with and supports two major initiatives driving the food industry's adoption and implementation of data standards: FDA's proposal to heighten traceability requirements for certain foods and a movement toward labeling products with two-dimensional (2D) barcodes that enable access to unprecedented levels of product information and transparency.

## FDA Heightens Traceability Requirements for High-Risk Foods

Data show that most foodborne illness outbreaks in the U.S. are caused by certain food categories that are particularly susceptible to pathogenic contamination. The Food Safety Modernization Act (FSMA) directed FDA to develop a standardized mechanism to identify these foods that pose a higher risk to consumers and to monitor these specific products with extra vigilance: to know where they are at all times, enabling fast, accurate removal from the supply chain if needed, as in the event of a recall or market withdrawal.

That's why FDA is now imposing extra, mandatory traceability requirements for producers of foods they have designated as "high risk" under Section 204 of FSMA. The agency's new Food Traceability Rule, with a proposed compliance date in January 2026 for all producers, will require that all supply chain partners that harvest, produce, handle, and acquire foods on FDA's Food Traceability List (FTL) must keep more detailed records to drive greater transparency, helping to prevent or better mitigate outbreaks of foodborne illnesses.

The rule specifically requires those who "manufacture, process, pack, or hold"

*(Continued on p. 36)*

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foods on the FTL to record certain key data elements (KDEs) associated with different critical tracking events (CTEs) in the supply chain. CTEs include growing, receiving, creating, transforming, and shipping; different KDEs will be required for each event, depending on the commodity being tracked.

The new mandatory recordkeeping procedures go beyond the typical “one up, one back” traceability to incorporate more robust data; under 204(d), each product needs its own unique identifier, batch/lot code, and serial number to be captured at every step of the supply chain process. Supply chain partners will have to maintain the data in their systems for two years and provide it to FDA within 24 hours of official request in the event of a recall so that affected products can be removed from the supply chain as quickly and with as much precision as possible.

Section 204 is an important part of FDA’s commitment to dramatically improve food safety. The blueprint calls for a new, technology-driven approach to food safety that enables supply chain partners to effectively communicate details about products on order, in inventory, and in distribution.

To ensure the traceability data recorded at every stop along the way can be understood and shared by all stakeholders in the chain of custody, the blueprint specifies that “existing consensus standards” be used to ensure that systems are designed with interoperability as a foundation. It calls for the use of global data standards to help industry speak the same language in transmitting product, location, and event information across the supply chain.

GS1 US is working with the food industry to help stakeholders understand how standards can be leveraged to enable better traceability and meet FSMA requirements. By using standards, foods harvested, processed, or manufactured can be identified with specific global trade item numbers. These numbers can be embedded along with expiration dates, batch/lot/serial numbers, quantities, weights, and other product information in a barcode on each product case. The barcode enables automated data capture at every point along the supply chain. Each stop is identified with a unique location number.

Transaction events such as shipping or receiving can be recorded and shared using an information service to maintain a complete product history and pass updated information along to the next entity in the supply chain.

### The Barcode as Information Powerhouse

Retailers have been scanning barcodes to facilitate product identification at checkout, primarily for pricing information, for 50 years. Modern, digital technology has enabled development of new, 2D barcodes that are capable of carrying a large amount of data, including the traceability details required under FDA rules and regulations. Product information such as ingredients, nutritional information, batch/lot numbers, country or place of origin, and expiration dates can all be encoded into a 2D barcode—such as QR codes and data matrix barcodes—and ensure regulatory compliance with the newly proposed traceability rule.

Consumers, who are increasingly interested in learning more about the foods they buy and eat, can quickly find detailed information with a simple scan of this barcode on their smartphones. This enables consumers to make more informed decisions based on their personal values and concerns. In addition to ingredients and allergens, today’s consumers are focused on a product’s place of origin, its producer’s fair trade and sustainability practices, and other sourcing and processing details. Brands can increase consumer engagement by providing easy access to all this information, as well as promotional offers, recipes, and more.

Complete and accurate product information that is consistent between the in-store and online shopping experience is vital for consumer engagement today. The UPC cannot accommodate the growing demands for greater product information transparency, traceability, and authentication. By transitioning to 2D barcodes on product packaging, brands can provide more robust data. This migration will support a multitude of uses, including better recall management.

Retailers can leverage the information contained in a 2D barcode to highlight specific, verified product attributes that shoppers are looking for, details that

cannot be encoded in a traditional UPC code, but that could be made accessible via a web-enabled data matrix barcode or QR code. These advanced data carriers also support retailer business processes and supply chain needs, enabling faster and more accurate product traceability, efficient inventory management, recall readiness, sustainability, and product authentication through access to expanded product details.

Increased product transparency will help retailers nurture relationships with shoppers and encourage brand loyalty. People shop where they know they can find what they need. This becomes even more important when they are frustrated by uneven product availability and must resort to finding replacement products. The availability of detailed product information can help retailers convert shoppers into buyers.

Grocery and other retail industries have made a collective commitment to enable broadly accessible 2D scanning capability at the point of sale by 2027. While linear barcodes will remain, the 2D barcodes will add significant functionality and benefits to better enable consumer engagement.

### The Supply Chain of the Future

Information is power, as the saying goes, and when it comes to supply chain operations, it certainly is. The more stakeholders know about food products traveling through the supply chain and at retail, the better equipped they are to handle fluctuations in supply and demand, to meet evolving consumer needs, and to take swift, appropriate action when necessary.

Interoperable supply chain data that can be captured and shared by trading partners throughout a product’s journey from “farm to fork” is fundamental to the advancements needed. Transitioning to the supply chain of the future—including more granular track-and-trace capabilities and data-rich 2D barcodes to increase transparency and consumer engagement—is happening. As these changes take hold, the food industry will realize greater resilience and better operational performance. Better food safety is possible with the help of new technology and industry collaboration. ■

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# Monitoring Temperature Data

Upgrade regulatory compliance and food safety with data logging devices

BY STEPHEN B. KNUTH

**K**eeping foods and beverages at recommended temperatures is a critical factor while they are in storage. But how do we make sure they are continuously stored correctly and are safe for the consumer? Any company that handles food must meet mandated requirements to safely store, move, and ship their goods. This requires checking temperature data at frequent intervals to make sure they meet FDA regulations for continuous storage conditions and provides proof that those thresholds weren't exceeded.

When monitoring technology isn't available, temperatures must be checked by someone who with a clipboard or computer who walks to each freezer, refrigerator, or container, to make sure those storage places are kept at the correct temperatures. But human data collection also introduces the potential for human error. If a refrigeration unit goes down outside of the regularly scheduled temperature monitoring cadence, or if someone forgets to make the rounds, the product can quickly fall outside of temperature range that is designated to be safe. If the food is outside of the safe temperature range for an extended period, it must be disposed of, which could cost a food processor a tremendous amount of time and money.

## Data Logging Devices

With an internet-connected data logging device, human error is far less of an issue. Technology-controlled data loggers help eliminate the miscalculations or errors that come with real-time monitoring. These data loggers allow warehouse and restaurant managers to easily collect tem-

perature data without having to physically check in on storage. In addition, this data is stored on a server, which allows the user to show immediate proof of compliance with certain temperature-related regulations during audits.

Data loggers include a temperature monitoring sensor and data recorder that can send information to a cloud that is accessible to warehouse and restaurant managers. Monitoring schedules can also be set to any given interval specified by the individual setting up the logger—hourly or daily, for example. The logger can be set to send an immediate alert via text or email on anything that goes wrong, including specifics on what happened and identifying which storage facility or appliance needs attention.

There are many different types of data loggers and different functions that they serve. Portable data loggers allow you to monitor without a computer; some loggers come with a probing sensor that can be inserted into items such as meat to check internal temperatures and humidity monitors for food items such as certain types of produce that can be negatively affected by arid conditions, as well as those foods that require humidity to remain in peak condition.

Many data loggers can be ethernet connected, but they are also available via cellular, wi-fi, or Bluetooth connectivity. The communication type used will be based on the type of storage: transportation, warehousing, or in store. A Bluetooth or 4G data logger might be best for transporting goods and ethernet or wi-fi would be best for stationary storage, like that found at warehouses, restaurants, or grocery stores.

## Case Report

A recent case from a U.S. meat distributor shows how data loggers can help improve the efficiency and safety of a food handling operation.

To ensure the premium quality and safety of its inventory, which averages approximately \$60 million worth of meat at one time, this distributor was required to manually measure its entire inventory frequently throughout the day. This process included having employees walk around the company's storage facilities roughly 15 to 20 times per day to manually check and record multiple temperature gauges both inside and outside the facility's freezers and refrigerators.

The many flaws of this approach included wasted time due to inefficiency and the introduction of human error, which included potentially missing a measurement cycle or misreading the gauges, leaving a refrigerator door open after reading a measurement, and other mishaps. All of these factors threatened the security and quality of the company's inventory. It also made the required reporting of all temperature measurements to regulators, quality inspection organizations, and the grocers who purchase the meat more difficult.

The company engaged a data logging provider to leverage its technology to automate the storage/temperature management process. They purchased multiple wireless data loggers, which continuously measure temperature data and automatically uploaded it to a cloud service to be stored and viewed from computers and mobile devices,

*(Continued on p. 39)*

# NEW PRODUCTS



## Benchtop Meter Series

Hanna Instruments, Inc. has announced its Advanced Benchtop Meter Series. There are three new models available with one benchtop meter for testing pH, another dedicated to conductivity, and one for measuring dissolved oxygen. Providing fast, accurate, and repeatable measurements, the meters are perfect for various applications and testing in laboratories and food manufacturing. A customizable touchscreen allows users to only show the data that they need. Other features such as the ethernet and wi-fi connection capabilities allow data transfer via FTP or email. **Hanna Instruments, Inc., [hannainst.com](http://hannainst.com).**

## Robotic Electric Force Compliance System

Suhner has expanded its suite of robotic grinding accessories and tools with the electric EFC-02, which delivers constant force throughout robotic grinding, sanding, and deburring processes. As with any end-of-arm tooling, the EFC-02 connects a grinding machine to the robot. The system



can be used for material removal or surface finishing even in tight or narrow spaces often found when processing stainless tanks and vessels for the food industry. The all-electric technology allows high-frequency measurements to monitor force and acceleration throughout the process. An advanced control algorithm then dynamically adjusts force and automates grinding processes based on pre-programmed parameters. **Suhner, [robotic-grinding.suhner.com](http://robotic-grinding.suhner.com).**



## Double Seal Enclosures

Custom Stainless Enclosures, Inc., introduces 4Xxtreme Double Seal Enclosures for extreme indoor and outdoor environments. The enclosures feature double seal and double stud mounting technology, an ultra-clean free-draining design, a single hygienic quarter-turn door design, and a field-replaceable blue gasket system, resulting in a product that is ideal for the food and beverage industries. The double seal technology offers multiple layers of protection. The outer seal rejects 99.9% of water, so the inner seal never sees any water pressure. Any water that does get through the outer seal is minimal and easily passes through the weep holes in the bottom of the enclosure door, ensuring that there's never water build-up between the seals. **Custom Stainless Enclosures, Inc., [4xxtreme.com](http://4xxtreme.com).**



## High Temperature Grease

Renewable Lubricants has introduced Bio-High Temp 180 EP Grease, a multipurpose lithium complex grease that withstands high temperatures and is biodegradable. This formulation is characterized by super high viscosity index base oil and lithium complex thickener, which provides a very high load carrying capacity, resistance to water and corrosion, and performance in a wide range of temperatures. The product is ideal for use in conveyor rollers, bearings, electric motors, pumps, and agricultural and industrial wheel bearings where disc brakes generate high temperatures. Formulated to provide a longer seal life with reduced oil leakage, this environmentally friendly, zinc-free product meets high-pressure pump requirements. **Renewable Lubricants, Inc., [info@renewablelube.com](mailto:info@renewablelube.com), [renewablelube.com](http://renewablelube.com).**

## Five Advantages to Using Video Monitoring in Food Facilities *(Continued from p. 34)*

employees. You can catch these knowledge gaps through video surveillance and address them better in your initial training—before they become serious issues.

### 5. Improve Health and Safety

Employee health and product safety are the biggest concerns at food processing plants, and they can be aided by video monitoring. In complex food supply chains, there are far more chances for food to become contaminated are increased by each additional step. Each new stage has its own risks. Video surveillance can help identify the riskiest stages and address each problem before they escalate.

### Choosing a System

Every plant manager knows that choosing the right food processing equipment for

their facility is crucial. Video surveillance systems should be treated the same way. While off-the-shelf cameras are definitely more affordable, they are also more likely to contribute to food contamination because they are not made of bacteria-resistant materials. Furthermore, store-bought solutions don't have the longevity and endurance you need in harsh environments such as food processing plants. Extreme temperatures and extreme temperature variations, humidity, noise, and steam are just a few of the things that impact a camera's lifespan.

Dedicated cameras meet the Stainless AISI 316 standard, which means they are compliant with FDA regulations. It's not just the equipment used in food processing directly that can contaminate the food; it's also the additional devices and tools.

This is why it's important to use video monitoring systems that don't increase your contamination risks.

Dedicated food processing facility cameras also have a long life advantage. They are built to withstand humidity, noise, extreme temperature, temperature changes, and high vibration levels. This means that the investment in specialized cameras is protected for a longer period of time. Additionally, food processing managers can rest assured knowing that their monitoring feed won't be interrupted by yet another camera failure due to the harsh environment to which it has been exposed. ■

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## How to Prevent Rodent Issues *(Continued from p. 28)*

primarily those on the production floor, see and hear more than you might know, which makes them invaluable in helping to identify pest issues. Once your staff knows the types of pests that frequent your facility, can identify the persistent hot spots, and understands the process for reporting activity, they'll be able to help you kick these pests to the curb. Don't forget to do your part as a leader by making sure pest activity logs are accessible to your employees and including your sanitation team in trainings,

as they're most likely to spot pest issues during cleanings.

Now that you know how to spot signs of rodent activity and can implement processes and procedures to reduce their impact on your business, don't forget to review your IPM plan frequently with your pest control provider. Rodent activity can fluctuate with the seasons, so it is important to regularly evaluate the effectiveness of your plan to make sure food safety remains a top priority.

If you don't currently have an IPM program in place or employ a reliable pest control provider, now's the time for action. Whether your food facility is located in one of the top 50 rattiest cities or not, prioritizing preventive pest control measures will help you avoid extensive problems down the line, and your customers and employees will appreciate that you are prioritizing their health and safety. ■

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## Monitoring Temperature Data *(Continued from p. 37)*

at anytime and from anywhere. This data was simultaneously collected from multiple data loggers deployed in various locations, providing real-time reports to the company's employees.

Using the data loggers, the distributor virtually mapped out each freezer/refrigerator to determine the temperature settings that are ideal for each room's layout. The wireless functionality of the loggers allows employees to check the status of each loggers using an accompanying app. They can even tell immediately if a freezer or refrigerator door has been left open, causing temperatures to rise.

This allows the company to ensure that proper conditions are being continuously maintained in real time.

One of the key activities in handling meat is taking inventory from a frozen to a thawed state safely. The temperature of the meat must be closely monitored throughout this process. With a data logger outfitted with a food probe made for measuring internal temperature, the company is also able to dial in on the exact parameters of this process. Overall, the company found a solution in which data loggers drastically improve the efficiency and accuracy of its inventory management.

### Improve Productivity and Reduce Error

Making the relatively small investment in a data logger, which pales in comparison to the potential costs of product loss, can help eliminate errors and drastically improve productivity. The inaccurate data that can lead to spoiled food is no longer a threat. Protecting the consumer is the most important aspect of the food industry and data loggers can be a simple, cost-effective upgrade that fortifies safety procedures. ■

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Knuth is president of TandD U.S.

# SCIENTIFIC FINDINGS

For access to the complete journal articles mentioned below, go to “Food Science Research” in the April/May 2023 issue at [foodqualityandsafety.com](http://foodqualityandsafety.com), or type the headline of the requested article in the website’s search box.



## Non-Destructive Characterization of Pulse Flours

The consumption of plant-based proteins sourced from pulses is sustainable from the perspective of agriculture, environment, food security, and nutrition. Increased incorporation of high-quality pulse ingredients into foods such as pasta and baked goods is poised to produce refined food products to satisfy consumer demand. However, a better understanding of pulse milling processes is required to optimize the blending of pulse flours with wheat flour and other traditional ingredients. A thorough review of the state-of-the-art on pulse flour quality characterization reveals that research is required to elucidate the relationships between the micro- and nanoscale structures of these flours and their milling-dependent properties, such as hydration, starch and protein quality, components separation, and particle size distribution. With advances in synchrotron-enabled material characterization techniques, there exist a few options that have the potential to fill knowledge gaps. These authors conducted a comprehensive review of four high-resolution nondestructive techniques (i.e., scanning electron microscopy, synchrotron X-ray microtomography, synchrotron small-angle X-ray scattering, and Fourier-transformed infrared spectromicroscopy) and compared their suitability for characterizing pulse flours. ***Comprehensive Reviews in Food Science and Food Safety*. Published online on March 7, 2023. doi: 10.1111/1541-4337.13123.**

## Pesticide Application and Salmonella Survival on Tomato Leaves

Outbreaks of Salmonellosis have been traced to contaminated tomatoes. The produce production environment poses a risk for *Salmonella* contamination; however, little is known about the effects of pest management practices on the pathogen during production. The study objective was to evaluate pesticide application on the inactivation of *Salmonella* on tomato leaves. Thirty greenhouse-grown tomato plants were inoculated with *S. enterica* serovars Newport or Typhimurium. Plants were treated with one of four pesticides, each with a different mode of action. *Salmonella* was enumerated at 0.125 (3 h), 2, 6, and 9 days post-inoculation (dpi), and counts log-transformed. Growth of the pathogen was not observed. At 2 dpi, PAA and streptomycin significantly reduced surface *Salmonella* concentrations of inoculated tomato leaves while significant *Salmonella* log reduction occurred in the ground tomato leaves after copper hydroxide treatment when compared with the control. No significant differences in *Salmonella* populations on tomato leaf surface and in ground leaves were observed from 2 to 9 dpi, regardless of pesticide application. These findings suggest that single in-field pesticide applications may not be an effective mitigation strategy in limiting potential *Salmonella* contamination. ***Journal of Food Safety*. Published online on February 1, 2023. doi: 10.1111/jfs.13043.**



## Crustacean Food Safety

Crustaceans are popular seafood items worldwide, owing to their rich nutritional value, unique tastes, and their incorporation into a variety of cuisines. There has been a great concern about the safety of crustaceans for human consumption, as they are more prone to hazardous contaminants due to their exposure to diverse habitats and unhealthy farming and handling practices. These hazards can arise from chemical contaminants such as heavy metals, environ-



mental pollutants, and bio-toxins or biological sources, that is, pathogenic microbes and parasites. The different types of chemical contamination of crustaceans as well as biological hazards are examined in this review. Although there are many reviews on contaminants in fisheries, nothing is traces to crustaceans. The current review compiles the food safety hazards of crustaceans arising from both chemical and biological origins and their impact on human health in farmed versus wild origins. Future perspectives have been raised toward HACCP protocol implementation during handling, processing, and storage of crustaceans and posing real-time freshness monitoring tools, such as intelligent packaging. ***Journal of Food Safety*. 2023;43:e13026. doi: 10.1111/jfs.13026.**



### Sensory Analysis of Hard Ciders

Although alcoholic or “hard” cider is a beverage of growing popularity throughout the Northeastern and Mid-Atlantic United States, the industry lacks a consistent language for describing the sensory quality of its products. The main objective of this research was to explore sensory attributes that can be used to describe a large representative sample of ciders from Virginia, Vermont, and New York, using classical descriptive analysis (DA). The secondary objective of the research was to determine whether the cider samples’ sensory attributes differ based on extrinsic factors, such as style, packaging, and apple varieties. The study was conducted using a standard DA: Eight panelists were trained for 13 hours to develop a lexicon of aroma, taste, and mouthfeel descriptors for 42 cider samples. Then, participants evaluated each cider in duplicate for all descriptive attributes in standard sensory-evaluation conditions. The results were analyzed to determine overall differences among the individual cider samples, geographic origins, cider styles, and packaging formats, as well as significant differences across individual attributes. Here, the authors report on 29 attributes that can be used to discriminate cider samples, as well as a subset of attributes that differentiate ciders based on extrinsic product variables. These results highlight the potential for more descriptive, sensory-based style guidelines and may inspire future research related to cider production practices. *Journal of Food Science*. Published online on February 28, 2023. doi: 10.1111/1750-3841.16507.



### Using Imaging Techniques to Assess the Quality of Bakery Products

One of the most widely researched topics in the food industry is bread quality analysis. Different techniques have been developed to assess the quality characteristics of bakery products. However, in the last few decades, the advancement in sensor and computational technologies has increased the use of computer vision to analyze food



quality (e.g., bakery products). Despite many publications on the application of imaging methods in the bakery industry, comprehensive reviews detailing the use of conventional analytical techniques and imaging methods for the quality analysis of baked goods are limited. Therefore, this review aims to critically analyze the conventional methods and explore the potential of imaging techniques for the quality assessment of baked products and provides an in-depth assessment of the different conventional techniques used for the quality analysis of baked goods, which include methods to record the physical characteristics of bread and analyze its quality, sensory-based methods, nutritional-based methods, and the use of dough rheological data for end-product quality prediction. The authors discuss the applications of imaging techniques for assessing the quality of bread and other baked goods. These applications include studying and predicting baked goods quality characteristics (color, texture, size, and shape) and classifying them based on these features. *Comprehensive Reviews in Food Science and Food Safety*. Published online on March 13, 2023. doi: 10.1111/1541-4337.13131.



### Consumer Perception of RTE Cheese Dips

Cheese dips are an expanding category sold as ready to eat (RTE) in grocery stores or served hot in restaurants (RST). The purpose of this study was to determine key consumer attributes for cheese dips and evaluate whether key drivers of purchase for cheese dips were distinct between grocery store or restaurant purchase. A total of 931 participants were asked two different sets of questions based on the location they most frequently purchased and consumed cheese dip in the prior six months, at a restaurant (n = 480) or from a grocery store (n = 451). Consumers first evaluated psychographic and agree/disagree questions regarding cheese dip and then completed maximum difference exercises focused on color and other extrinsic cheese dip attributes. Finally, an adaptive choice-based conjoint was used to determine the relative importance of cheese dip attributes. Clustering of conjoint utility scores revealed differences in preference for spiciness, but similar preferences for other attributes within both consumer groups. RTE and RST consumers indicated that their ideal cheese dip was white in color, moderately thick, and of medium spiciness, with small visible pepper pieces and jalapeno pepper flavor. For both consumer groups, spiciness was the most important characteristic of cheese dips, followed by package for RTE consumers and pepper flavor and consistency for RST consumers. *Journal of Food Science*. Published online on February 27, 2023. doi: 10.1111/1750-3841.16498.

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