

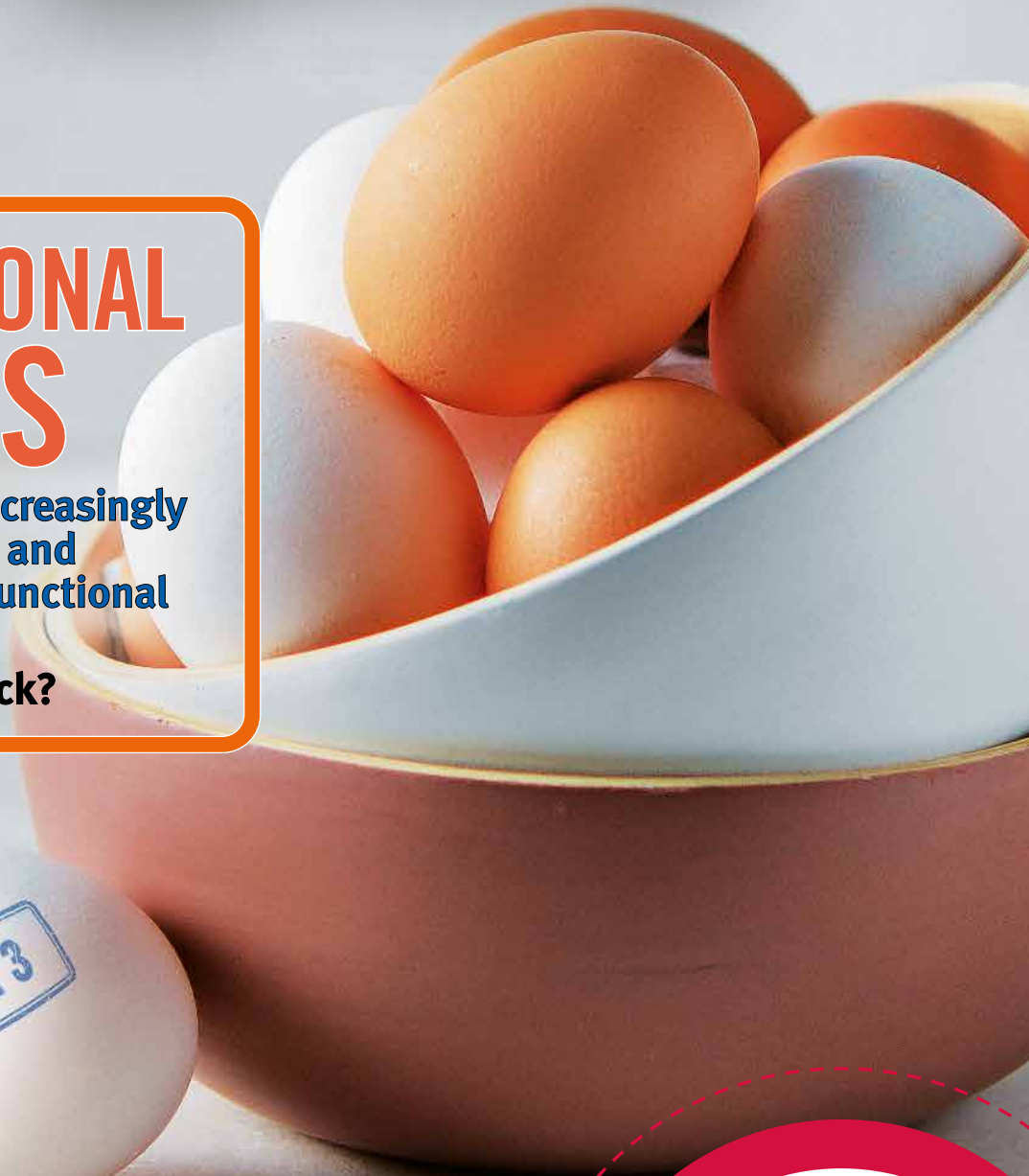
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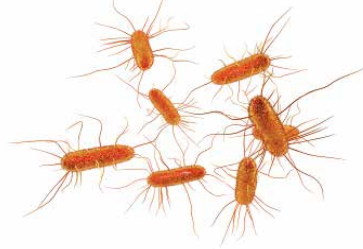
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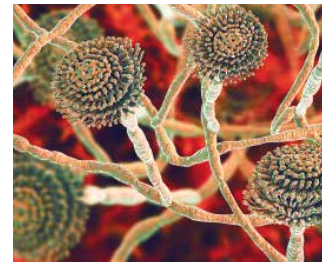


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Letters should be no longer than 350 words.

Submit letters to:  
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(Letters may be edited for space and style.)

**Correction:** In the article "A Psocid-Free Facility," which published in the February/March 2021 issue, we used an incorrect image of a psocid. The image has been updated in the online version of the article.

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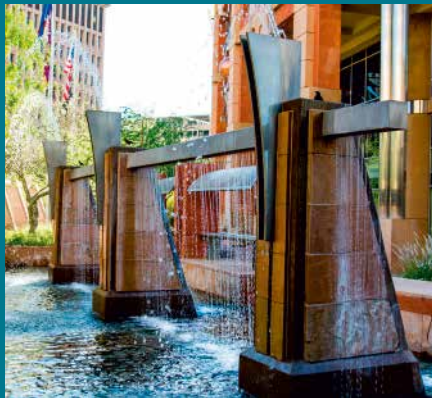


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# From The Editors

## The State of the Chicken

**P**ast editorials I have written for *FQ&S* have focused on how the publication can help processors build and/or upgrade their food quality, safety, and sanitation programs. The mantra for doing this is simple: develop, document, implement, and maintain.

When developing protocols, the people doing the work need to understand the goals. What are we doing? Why are we doing it? Who will do the work? How will it be documented? Once development is done, it is time to commit these thoughts to paper. What gets drafted should clearly describe what's to be done and must be detailed enough so that those reading the protocol can clearly understand what is expected. Consider sharing draft procedures with non-technical staff, the rationale being that if the non-technical people can understand it, it should pass muster in actual practice.

Occasionally, things get lost in translation. For example, one concern when designing aircraft is to protect the canopy or windows from bird strikes. An outfit developed a procedure during which they would launch a chicken carcass at the windows and evaluate results. They were asked to share the procedure with another group, who reported no success. The chickens were shattering the canopies and often ended up embedded in the pilot's seat. The group who developed the method responded as follows: "Thaw the chickens first." Once they did this, testing moved forward. While it may be a silly example, it emphasizes the need for proper documentation and asking questions if something is unclear.

An essential element for implementation is education and training, i.e., making sure that those performing the work understand what they are doing and why. Implementation is also the time when procedures may be tweaked. The people who are being briefed on the protocols may have additional insights. If management has created an environment where communication flows in all directions, the opinions of line workers and others are valued and appreciated.

Maintenance is the final part of the equation. Once procedures are in place, it is imperative that they be adhered to. There are many different elements that make up maintenance, including record review, internal audits, and GMP checks. While this would seem to be easy, it is often found to be a root cause for problems—people simply get sloppy or try to take short cuts, or take a task for granted and something gets ignored.

**Richard F. Stier**  
Co-Industry Editor



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# NEWS & NOTES

## FDA Releases New Actions Designed to Reduce Toxins in Baby Food

BY KEITH LORIA

In response to a February 2021 report released by the U.S. House of Representatives Committee on Oversight and Reform Subcommittee on Economic and Consumer Policy, FDA has issued a letter to baby and toddler food manufacturers reminding them of their obligations under the FSMA Preventive Controls for Human Food Rule to consider chemical hazards in foods when engaged in their required hazard analysis of food products.

FDA says it will also seek “impactful solutions for reducing toxic elements in foods commonly consumed by babies and young children.” The agency also committed to engaging in a process to set standards and limits for the presence of heavy metals in baby foods.

The new actions include issuing guidance to manufacturers for “key foods”; planning to finalize its action level for inorganic arsenic in infant rice cereal, which it started working on in 2016; and working to finalize its draft guidance for an inorganic arsenic action level in apple juice and release a draft guidance for lead action levels in juices.

Laurie Beyranevand, director of the Center for Agriculture and Food Systems at Ver-

mont Law School, notes that while this is an important first step and signals a stronger commitment to address the issue of heavy metals in baby foods than we’ve seen from FDA over the past few years, these actions are not enough. “A few years ago, FDA convened a Toxic Elements Working Group to reduce exposure to toxic elements across FDA’s regulated product categories,” she tells *Food Quality & Safety*. “The working group prioritized lead, arsenic, cadmium, and mercury, as these metals present the highest public health risk when individuals are exposed at high levels. However, to date, FDA has only issued voluntary guidance to address inorganic arsenic in rice cereal, meaning it contains nonbinding recommendations that can’t be enforced by the agency in the same way a binding regulation can.”

Janilyn Hutchings with StateFoodSafety, a food safety education organization, says that, in addition to taking the new actions it just announced, FDA could also work on drafting action levels for inorganic arsenic and lead in other baby foods. “It could also consider appropriate action levels for cadmium and mercury,” she says. “As more testing and studies are available and more widely used, the FDA will likely implement more changes to ensure the safety of babies and children.”



## Study: Ultrasonic Cleaning of Leafy Greens Could Reduce Instances of Foodborne Illness

According to a new study, streams of water carrying sound and microscopic air bubbles can clean microbial contaminants from spinach leaves more effectively than current washing methods.

Researchers used acoustic water streams to clean spinach leaves directly sourced from the field crop and compared the results with leaves rinsed in plain water at the same velocity. The results showed that the microbial load on samples cleaned with the acoustic streams for two minutes was significantly lower six days after cleaning than on those treated without the added sound and bubbles. The acoustic cleaning also caused no further damage to the leaves.

Timothy Leighton, a professor of ultrasonics and underwater acoustics at the University of Southampton in the U.K., invented the technology and led the research. “Our streams of water carry microscopic bubbles and acoustic waves down to the leaf,” he says. “There, the sound field sets up echoes at the surface of the leaves, and within the leaf crevices, that attract the bubbles towards the leaf and into the crevices. The sound field also causes the walls of the bubbles to ripple very quickly, turning each bubble into a microscopic ‘scrubbing’ machine. The rippling bubble wall causes strong currents to move in the water around the bubble and sweep the microbes off the leaf. The bacteria, biofilms, and the bubbles themselves are then rinsed off the leaf, leaving it clean and free of residues.”

The report was published in *Ultrasound in Medicine and Biology*.





# Washington Report



## Congress to Investigate COVID-19 Cases at Meatpacking Plants

Probe to include three processing giants, OSHA

BY KAREN APPOLD

**A** U.S. Congressional subcommittee launched an investigation into widespread coronavirus infections at meatpacking plants on February 1, 2021. The investigation follows reports that nearly 54,000 workers at 569 plants tested positive for the coronavirus, and at least 270 died.

Some organizations such as United Food and Commercial Workers (UFCW),

a labor union representing approximately 1.3 million workers, say that plants should have done more to protect workers. Meanwhile, the Occupational Safety and Health Administration (OSHA) is making efforts to improve worker safety, while the North American Meat Institute (NAMI) and the three food manufacturers named in the letter say that they have gone above and beyond to ensure employee safety during the pandemic.

Rep. James E. Clyburn (D-SC), chairman of the House Select Subcommittee on the Coronavirus Crisis, sent a letter to OSHA and to Tyson Foods, Smithfield Foods, and JBS USA, which are three of the nation's largest meatpacking companies. Each company has had multiple COVID-19 outbreaks.

"Public reports indicate that under the Trump Administration, OSHA failed to adequately carry out its responsibility for enforcing worker safety laws at meatpacking plants across the country, resulting in preventable infections and deaths," Clyburn wrote. "It is imperative that the previous administration's shortcomings are swiftly identified and rectified to save lives in the months before coronavirus vaccinations are available for all Americans."

In response, Marc Perrone, president of UFCW International, said in a statement,

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“Chairman Clyburn’s investigation will bring the transparency needed to hold the meatpacking industry accountable for the safety failures that resulted in hundreds of workers dying and thousands continuing to get sick from this virus every month.”

Policy expert Patricia A. Wester, CEO and founder of the Association for Food Safety Auditing Professionals in Gainesville, Fla., also believes Congress’ letter was justified and says that it highlights a serious regulatory and jurisdictional gap between OSHA and USDA’s Food Safety and Inspection Service (FSIS). She says food facilities should have followed CDC Guidance for Businesses and Employers Responding to Coronavirus Disease 2019 (COVID-19) to combat outbreaks, and expanded them to cover activities not addressed by that document, which would allow others to benefit from their experiences. Furthermore, FSIS has well-defined boundaries for enforcement action options during food safety events that OSHA appears to lack; the meat industry might have been able to exploit that knowledge gap to further minimize OSHA’s enforcement actions.

### OSHA’s Response

In addition to Congress’ letter, in January 2021, President Biden issued an executive order calling on OSHA to increase protections for workers. In response, OSHA published new guidance to help employers and workers identify risks of exposure to contracting COVID-19 in the workplace. The agency is currently reviewing its enforcement efforts related to COVID-19 to identify any changes that could better protect workers and ensure equity in enforcement, an OSHA spokesperson tells *Food Quality & Safety*.

The agency is also working to establish a new national emphasis program to focus OSHA’s efforts on violations, such as those at meat processing plants, that put the largest number of workers at risk for contracting COVID-19.

In commenting on OSHA’s new guidelines, Wester says that the new document aligns with CDC’s COVID-19 guidance document, although gaps remain in both documents. As guidance documents, they are only recommendations, not enforceable requirements, handicapping OSHA’s enforcement authority. There are also op-

erational gaps regarding how to prevent further spread when a worker tests positive for the virus, such as eliminating the common practice of temporarily storing PPE on a crowded, shared coat rack when workers leave production areas for breaks.

“In the days ahead, these gaps will need to be closed and enforcement language strengthened to prevent continued outbreak events in these facilities,” Wester says.

The letter from Congress criticized OSHA for fining meatpacking companies based on a company’s annual revenue and how much they pay their executives. In response, an OSHA spokesperson tells *FQ&S* that OSHA cites based on the hazard and the maximum penalty amount set by Congress. When setting a penalty amount, OSHA begins with the maximum penalty, then makes adjustments based on various factors outlined in Chapter 6 of the Field Operations Manual. “While monetary fines are effective enforcement tools, the most important outcome of an OSHA citation is that it requires the employer to abate the underlying workplace hazard, removing workers from dangerous situations,” the spokesperson says.

Wester says COVID-19 exposed OSHA’s weaknesses, just as it did in healthcare and so many other infrastructure areas. “Underfunded and under resourced, OSHA was most likely unprepared for the scope, scale, and consumer impact of the outbreaks, making it even more susceptible to prioritizing operational needs over worker safety. Added political pressure from the White House to reopen as essential businesses would certainly have tipped the scales even further to placing production needs over employee safety,” she says.

### Meatpacking Plants Tout Their Efforts

Despite the Congressional subcommittee’s criticism, spokespeople for meatpacking plants say their companies made extensive efforts to keep workers safe. In a February 1, 2021 statement, Keira Lombardo, chief administrative officer of Smithfield Foods in Smithfield, Va., said, “From early in the pandemic, we have taken extraordinary measures to protect our team members from the virus and we have met or exceeded the prevailing federal, state, and local health and safety guidance.”

## Why Meatpacking Plants and Their Communities Can Be COVID-19 Hotspots

While the total number of COVID-19 cases and deaths associated with the proximity to livestock plants is estimated to be between 236,000 and 310,000 (6% to 8% of all U.S. cases) and 4,300 to 5,200 (3% to 4% of all U.S. deaths), respectively, as of July 21, 2020, the vast majority of these cases are likely related to community spread outside these plants, says Chris Boulos, MBA, who co-authored an article published in the *Proceedings of the National Academy of Sciences* about livestock plants and COVID-19 transmission. The research cites multiple characteristics that make meat plants susceptible to local outbreaks of respiratory viruses, including:

- Long work shifts in close proximity to coworkers, difficulty in maintaining proper face covering due to physical demands, and shared transportation among workers.
- Cold temperatures and powerful HVAC systems inside slaughtering plants, which may increase transmission risk.

- Worker socioeconomic status and meatpacker labor practices. Among U.S. front-line meat-processing workers, 45% are categorized as low income, 80% are people of color, and 52% are immigrants, many of whom are undocumented and lack ready access to healthcare and other worker protections that could facilitate COVID-19 prevention and treatment. In addition, employees at these facilities may face incentives to continue working, even while sick, through company policies.

The study also found evidence of community transmission outside the plants. The data suggest that meatpacking plants feature a particularly high intensity of COVID-19 transmission among industrial facilities or along transportation routes, which increases the likelihood that people infected within the plants in turn spread the disease throughout local communities, Boulos says.—KA



Lombardo said the company invested more than \$700 million in critical measures to protect employees, including on-site COVID-19 pre-screening and testing facilities; air purification systems; extensive physical barriers at work stations; employee protective equipment; significant facility modifications and expansion to ensure distancing in key areas, such as break and lunch rooms; thousands of sanitation stations and prominent banners and signage that outline and encourage safe practices in multiple languages; and additional new employees dedicated to ensuring that distancing and sanitation practices are implemented correctly.

Smithfield Foods has also implemented liberal leave and pay policies that guaranteed pay for nearly 13,000 employees who were quarantined but did not test positive for COVID-19.

During a February 9, 2021, earnings call, Tyson Foods' President and CEO Dean Banks announced the hiring of a chief medical officer to ensure that the organization continues to remain vigilant and aggressive toward overall team member wellness. The company also hired 200 new nurses and administrative staff, bringing the total occupational health staff to almost 600 team members. "With these resources, we're advancing our health and safety priorities to support our vaccine rollout and build our wellness programs," Banks said.

In addition, Banks said Tyson, headquartered in Springdale, Ark., has extended an ongoing partnership with a clinical services provider to prepare for broad vaccine distribution and to ensure that U.S. team members are educated across multiple languages about the COVID-19 vaccine. Meanwhile, thousands of team members continue to be tested every week; approximately half of its workforce was tested as of February 9.

Tyson Foods has also invested hundreds of millions of dollars during the pandemic to transform its U.S. facilities with protective measures, from walk-through temperature scanners and workstation dividers to social distance monitors and always-on testing, and also provided additional team member pay and benefits, says Gary Mickelson, a company spokesperson for Tyson Foods.

Since the onset of the pandemic, JBS USA, in Greeley, Colo., has invested more

than \$200 million in health and safety interventions, provided more than \$160 million in bonuses and permanent increased pay, and donated more than \$50 million to support local communities, said Nikki Richardson, a spokesperson for the company, in February.

JBS USA has also implemented hundreds of safety measures, including offering unlimited PPE, constructing permanent physical barriers, establishing physical distancing protocols, and installing hospital-grade ventilation systems in all facilities. JBS USA provides immediate testing to all symptomatic team members and close contacts and has conducted more than 45,000 surveillance tests of asymptomatic team members to date. It has voluntarily removed vulnerable population groups with full pay and benefits, covered 100% of all COVID-19 related health expenses for team members and family members enrolled in its health plan, and offered a \$100 incentive bonus for any U.S. team member willing to get vaccinated.

In response to the congressional letter, NAMI, a voice for the meat and poultry industry, issued a statement on February 1, maintaining that more than \$1.5 billion in comprehensive protections have been instituted since the spring, successfully cutting average case rates for meat and poultry workers five times lower in December 2020 than they were in May 2020, while infections rocketed up by nine times for the general population in the same period.

"The meat and poultry industry is focused on continuing these effective protections, reaffirmed by the Biden Administration, and ensuring frontline meat and poultry workers are vaccinated as soon as possible, as employers, unions, civil rights leaders, and governments around the world agree these workers should be among the first vaccinated after health-care workers," the organization's statement said.

### Others Cite Room for Improvement

In contrast to the meatpacking plants and NAMI, some organizations and policy experts had different opinions on how plants have handled the pandemic.

Wester says the meat industry needs to assess the real impact of ever-increasing line speeds and finally prioritize worker safety over production demands. "In-

centives that emphasize attendance over worker health need to be eliminated," she says. "Testing platforms that provide real-time results need to be deployed industry-wide to prevent asymptomatic transmission among workers. Better track and trace systems are needed to detect community spread as early as possible."

Wester says it's also worth noting that meat packaging plants made little mention of reduced line speed as a mitigation step. "Instead, barriers were placed between workers that appear to be a sanitation nightmare, raising the question of increased food safety hazards in the future," she says.

Carl S. Custer, MS, a retired food microbiologist in Bethesda, Md., also believes that meatpacking facilities should have done more to protect employees from COVID-19 when it became evident that plants were hot spots. "I've seen floor managers impede plant management safety policy to improve production because their bonus is based on productivity," he says. "I've also seen workers disregard plant safety policy out of ignorance and the urge to speed up."

UFCW's Perrone said in statement, "Under President Trump, OSHA was asleep at the switch and consistently failed to enforce the safety standards needed to protect America's meatpacking workers. This new investigation will help to shine a light on these failures and ensure the industry and regulators take the steps necessary to better protect these essential workers as the pandemic continues. As the union for our country's meatpacking workers, UFCW is calling on every CEO in the industry to fully cooperate with this investigation so the American people learn the truth about these safety failures and can trust that immediate action will be taken to ensure these outbreaks never happen again."

As the congressional investigation continues, Custer expects that establishments will insist that workers and supervisors follow and impose CDC guidelines regarding COVID-19. If not, they risk litigation and regulatory interventions. ■

Appold is a freelance writer based in Pennsylvania. Reach her at [kappold@msn.com](mailto:kappold@msn.com).

### What Do You Think?

Have something to say? Send your thoughts to [skuehne@wiley.com](mailto:skuehne@wiley.com).

# Legal Update



## Cannabis Update

Will 2021 be the year of cannabis reform?

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

**C**annabis legalization in the United States is continuing to sweep across the country at a breakneck pace. Even amidst a pandemic, a shaky economy, and historically unprecedented division and partisan rancor, ballot measures and legislation to legalize marijuana continue to enjoy widespread bipartisan support. Arizona, Montana, New Jersey, and South Dakota all approved ballot initiatives in November 2020 to legalize adult-use marijuana, joining 11 other states that had already legalized it.

Less than a decade after Colorado and Washington became the first states to legalize it, Virginia will become the 16th state to legalize adult-use cannabis. In total, thirty-six states (nearly three quarters) have legalized marijuana for medical and/or adult use, and that number is certain to increase, with another dozen States considering adult-use legalization measures in 2021. While not all of these states will enact legalization measures this year, at least five states (New Mexico, New York, Connecticut, Pennsylvania, and Florida) appear likely to do so.

Yet, regardless of how many states enact permissive cannabis laws, antiquated and scientifically unsupported federal policy continues to stymie industry growth. Perhaps the biggest hurdle for the industry is that marijuana remains classified as a schedule I substance under federal law. Schedule I substances are defined as having a high potential for abuse and no accepted medical use. The impact of that designation, from a legal and business perspective, is difficult to overstate. It outlaws the interstate transport of marijuana, bans banks from doing business with legitimate marijuana businesses, and generally prohibits federally funded institutions from conducting marijuana research, among many other restrictions. Predictably, descheduling marijuana is at the top of the agenda for those who support legalization.

Achieving that goal has proved exceedingly difficult, despite the unportable designation of marijuana as a schedule I substance and the widespread national support for legalization. According to a recent Gallup Poll, nearly 70% of Americans support legalization. This is more than at any point in the past five decades. Last year, every state that held a legalization referendum approved it. Despite the widespread support, however, Congressional Republicans remain largely opposed to legalization. As a result, efforts to enact reform have languished in Congress, and key hurdles remain in place.

### Recent Legislation

The lack of reform is not due to a lack of legislation. Last September, the Secure and Fair Enforcement Banking Act (“SAFE Act”), the first version of which was drafted in 2013, passed the House with 76% support. It was the first time a stand-alone cannabis law was voted on by the full House. The SAFE Act would not legalize cannabis, but it would allow financial institutions and insurance companies to provide financial services to cannabis businesses, opening up an ability to secure commercial loans and access credit transactions. The bill stalled however, because Senate Majority Leader Mitch McConnell (R-Ky.) refused to bring it up for a vote in the Senate.

In December 2020, the House of Representatives made history again when it passed comprehensive legislation that



would federally legalize cannabis. The Marijuana Opportunity Reinvestment and Expungement Act (“MORE Act”) would transform U.S. cannabis law and fundamentally expand the opportunities available to cannabis businesses.

Specifically, the law would remove marijuana from the list of scheduled substances under the Controlled Substances Act and eliminate federal criminal penalties for individuals who manufacture, distribute, or possess marijuana (states would still have criminal jurisdiction over marijuana offenses and would be able to enact the laws they deem appropriate). The MORE Act would also create a 5% federal tax on cannabis products, which would be applied toward small business loans and support for law enforcement. It would make Small Business Administration loans and services available to cannabis-related legitimate businesses or service providers and establish a process to expunge convictions and conduct sentencing review hearings related to federal cannabis offenses.

The MORE Act was passed by the House of Representatives, again with bipartisan support. The historic vote represented the first time that either chamber of Congress voted to legalize cannabis. Following passage in the House, Senator Chuck Schumer (D-N.Y.) commented: “I have long believed that any effort to reform our nation’s marijuana laws should also include significant measures to undo the harms that too many families and communities have suffered as a result of the war on drugs.” With Sen. McConnell as Majority Leader in the Senate, however, the bill would not receive a vote in the Senate. At the time, it appeared the Senate would remain under Republican control, in which case, meaningful reform was unlikely.

Following the surprise sweep by Democrats in the January 2021 runoff elections in Georgia, hope for comprehensive cannabis reform was revived. In a February statement issued by Sen. Schumer, along with fellow Sens. Cory Booker (D-N.J.) and Ron Wyden (D-Ore.), the senators asserted: “Ending the federal marijuana prohibition is necessary to right the wrongs of this failed war [on drugs] and end decades of harm inflicted on communities of color across the country.” Nevertheless, given the immediate health and economic crises facing the nation, cannabis reform will

likely remain on the back burner for the time being. Even so, reform remains likely. Consider, for instance, that Vice President Kamala Harris was one of the original co-sponsors of a previous iteration of the MORE Act.

Certainly, cannabis issues are extraordinarily complex, transcending legal, social, geographical and economic barriers. Despite (or perhaps because of) the rapid legal and cultural shift, confusion

**While there are currently no federal standards for cannabinoid hemp processors or retailers, and cannabinoid products are not federally approved as dietary supplements or food additives, that will likely change in the future.**

and misinformation regarding cannabis abound. But, as laws across the country become more permissive, people see firsthand how beneficial cannabis legalization can be. Even those who are not interested in consuming cannabis are benefitting from the massive tax windfall generated by cannabis sales. Excise and sales taxes on cannabis raised more than \$1.9 billion in 2019. Those dollars can be applied to much needed education and infrastructure improvements. By contrast, enforcing cannabis prohibition laws costs taxpayers approximately \$3.6 billion a year. Additionally, legal cannabis sales totaled \$9.5 billion in 2017 and are projected to reach \$23 billion by 2022.

### **HEMP and CBD Products**

On the hemp front, the FDA is still in the early stages of creating its own rulemaking process governing non-psychoactive cannabinoids in hemp, like cannabidiol (CBD), a compound widely credited for treating a variety of ailments, including stress, pain, and seizure disorders, among others. As a reminder to readers, the term “cannabis” includes both hemp and marijuana. The two share many properties, but whereas marijuana typically pro-

duces high levels of tetrahydrocannabinol (THC)—the psychoactive compound that produces a “high” when consumed—hemp does not. Hemp produces only trivial amounts of THC, generally insufficient to cause impairment. Hemp is also utilized for a range of nutritional and industrial purposes.

While there are currently no federal standards for cannabinoid hemp processors or retailers, and cannabinoid products are not federally approved as dietary supplements or food additives, that will likely change in the future. Given the federal government’s lack of action, states have been active in developing regulatory frameworks governing CBD products.

New York, for instance, recently enacted comprehensive regulations governing the manufacture and sale of cannabinoid hemp products. Among the most notable shifts in the New York framework are an allowance for more permissive THC levels and the requirement that cannabinoid hemp processors maintain qualified third-party GMP certifications. These are both common sense, reasonable measures. The more permissive THC allowances will improve outcomes for business by allowing them to address marginally higher THC levels rather than destroying the products. Likewise, the new certification requirements will promote enhanced consumer safety and confidence, giving consumers better assurance that the products they purchase contain what they say. The New York regulations provide what is broadly expected to be a successful framework that will likely be adopted by other states, and perhaps even federally.

Only time will tell whether 2021 is the year that comprehensive cannabis reform finally occurs at the federal level. But at a minimum, we are closer than we have ever been. We have never before seen, as we have with cannabis, such a rapid emergence of an entire industry. Consequently, it is impossible to predict what might come next. But given the rapid adoption and popularity of cannabis legalization initiatives across the U.S., it appears that cannabis is here to stay. ■

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# Global Interests



## Food Waste During COVID-19

How the pandemic has impacted food waste at the consumer level | BY AURORA A. SAULO, PHD

**F**ood waste is a complicated concept. There are various definitions from different respected units using data from varying sources and studies using different methods. USDA defines food loss as the loss of edible food that occurs in the food supply chain starting from post-harvest and including losses at the retail and consumer levels. The Food and Agriculture Organization (FAO) of the United Nations defines food loss as the decrease in the quantity or quality of food that occurs in the food supply chain from harvest/slaughter/catch, but doesn't include loss from retailers, foodservice providers, and consumers. FAO defines food waste as the decrease in the quantity or quality of food that occurs in the retail and consumption levels of the food supply chain. The United Nations and the In-

stitute of Food Science & Technology, the lead professional society of food science and technology in the U.K., follow FAO definitions.

In this article, I focus on food waste, or the loss of food that occurs at the consumer level.

### Food Waste Estimates and Causes

The USDA Economic Research Service estimates that, in 2010, food loss in the United States comprised 31% of the food supply at the retail and consumer levels, or approximately 133 billion pounds of food, with an estimated retail value of \$162 billion. The European Union's (EU-28) total edible and inedible food waste is estimated at 88 million tons in 2012, with about 62 million tons (or about 70% of the total food waste) coming from the wholesale and

retail, foodservice, and household levels, and costing more than €140 billion (\$168 billion) yearly when accounting for associated financial costs. Households contributed the most to the total EU-28 food waste at about 53%, while processing added about 19%.

Global food waste is estimated at 1.3 billion tons per year, per the FAO, or more than one-third of worldwide food production. Fresh fruits and vegetables lead global food waste at 45% of the global food production, with food waste from residential homes one of the largest rates. Most of this waste goes to landfills, where conditions support generating greenhouse gases such as methane, which contribute to global warming. Those food wastes may occur due to improper handling, lack of proper storage, unsold stock, and processing (e.g., peeling, washing, drying). Other factors contributing to food losses and waste in the food supply chain include no raw materials in the farm, no labor in the farm, limitations on transportation, or problems due to infestations, microbial spoilage, over ordering, equipment malfunction, food culls, failure to meet product specifications, seasonal foods, bulk size packaging, overstocking, overproduction, and human error, which often results from lack of worker training.

At the consumer level, a consumer's different understanding of product expiration dates, product storage at inappropriate temperatures, shopping and cooking in excess of actual need, inappropriate food management, lack of cooking skills, and lack of knowledge of preservation practices further contribute to food waste.

### Influence of COVID-19 on Food Waste

Did COVID-19 lead to an increase or a decrease in food waste?

Researchers of a study published in *Environment, Development and Sustainability* (2020) reported that during a crisis there is a preference to save rather than to throw, as consumers did during severe



recessions in Greece and Italy, leading to reduced waste. But the same researchers also contend that pandemic-driven disruptions such as lockdowns, storage limitations, and stockpiling, coupled with the lack of consumer cooking skills and practices, could have increased household food waste during COVID-19.

Research results published in the journal *Food Policy* in 2015, before the pandemic, indicated that countries that are most developed and have higher income per capita produced larger amounts of food waste. For example, those living in the Czech Republic, Estonia, Lithuania, and Poland produce less food waste than those from Denmark, Ireland, and Sweden. People aged 65 and older tend to produce less food waste than their younger counterparts. Since females are most likely to be the primary food preparers at home, they are more familiar with and produce less food waste than males, according to the same researchers. Unemployment is associated with producing less food waste than employment. Those with a higher level of education tend to have higher earnings and produce more food waste than those with a lower level of education. People living in rural areas produce less food waste than those in urban areas, and living in areas with less litter tends to encourage residents to produce less food waste.

In 2017, before the pandemic, India had one of the lowest food waste rates per capita (51kg, 112 lb.) in the world. On the other end of the scale, Australia reached 361 kg (796 lb.) while the United States had 278 kg (613 lb.), the highest rates per capita worldwide—more than the combined reported food waste rates of the United Kingdom, Germany, France, Italy, and Sweden. During the pandemic, when researchers interviewed respondents of similar demographics and gender distribution from the U.S. and Italy about their perceived rates of food waste during COVID-19, the respondents thought their rates of food waste had decreased, with a higher rate of reduction among U.S. respondents than those from Italy. The researchers explained that these decreases in food waste may have resulted from targeted shopping or purchasing foods that address specific issues, such as those that strengthen the immune system, increased cooking time at home due to lockdowns and stay-at-

**COVID-19 resulted in limited food supplies, higher food prices, limited employment opportunities, and reduced take-home pays; however, increased time in the home improved consumer cooking practices and food management skills, leading to improved efficiency in food production at the consumer level that may have led to reduced food waste.**

home mandates, food shopping with increased and deliberate planning, intentionally decreasing shopping time at the supermarket, and food shopping without family members who were prone to impulse purchasing.

Concerns about the stability of the food supply were heightened during the pandemic, and no clear answers could be obtained from those who supplied food to the consumers. People with high levels of NFC (need for cognitive closure) during these stressful times depended on clear answers, devoid of ambiguity or confusion, to manage stress. They perceived that they needed more food than usual and characteristically stockpiled food without necessarily using it, resulting in a potential increase of food waste and associated food packaging materials.

In its advertisement during Super Bowl LV, Unilever hired a celebrity to offer tips on how to avoid food waste at home. Food waste became trending news. But The Hartman Group clarified that food waste has already been in the forefront of consumer concerns, even prior to the pandemic. The group explained that, during the pandemic, consumer awareness increased such that more than half (56%) of those they interviewed were willing to increase composting food waste. Those were in addition to the 16% who were already composting food waste. Thus, a decrease in food waste during COVID-19 was expected.

A formal association between food waste and the environment was established by the Upcycled Food Association in 2020, resulting in another trending initiative. The new trend is called upcycled food products and is defined by UFA as “new, high-quality products from otherwise wasted—but perfectly nutritious—ingredients” for the world community while

benefiting the world. UFA claims that more than 100 company members have committed to upcycling food products into new safe products. The organization has also developed a certification scheme that labels food using upcycled food ingredients or products, which will support their vision to “build the sustainable food system of the future.” This trending association of food waste with the growing global concern for the environment is very attractive to Millennials and the younger generations.

COVID-19 resulted in limited food supplies, higher food prices, limited employment opportunities, and reduced take-home pays; however, the increased time in the home improved the consumer’s cooking practices and food management skills, leading to an improved efficiency in food production at the consumer level that may have led to reduced food waste. In addition, because employment, rather than unemployment, is correlated with increased food waste, decreased employment and income may likewise have led to a decrease in food waste. And, perhaps, due to the scarcity of food supplies during the pandemic, consumers consciously increased their awareness of what they should use without waste.

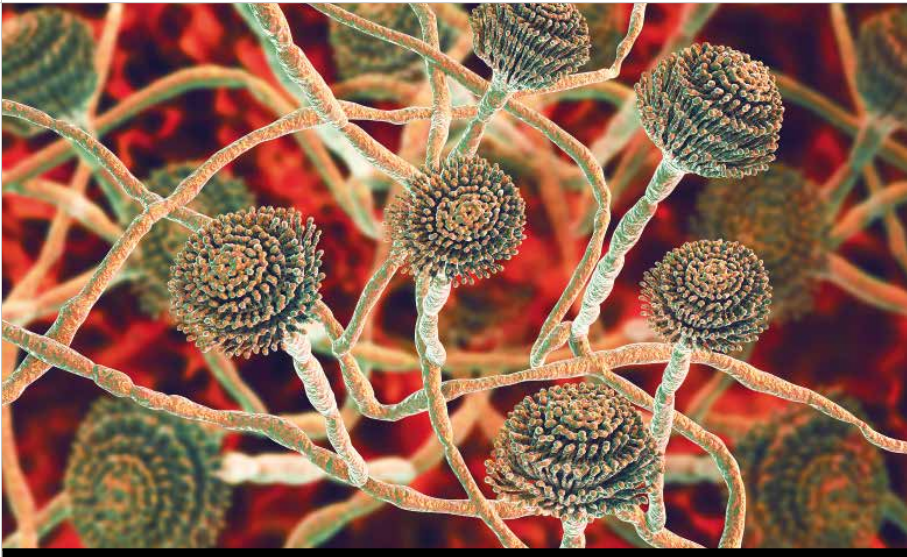
Thus, available research data seem to demonstrate that food waste has been reduced during the COVID-19 pandemic.

### **Mitigation Strategies**

To develop meaningful and relevant strategies, it’s necessary to have a harmonized global definition of food waste. To date, strategies recommended to reduce food waste at the consumer level (as presently defined) include ways that many consumers are already practicing because of the conditions imposed on them by COVID-19.

*(Continued on p. 38)*

# Cannabis Corner



## Microbial Contamination of Cannabis-Infused Foods

Testing infused food and beverages for microbial contamination should be done, whether or not FDA insists upon it

BY JESSE STANIFORTH

Cannabis-infused food products usually look just like any other foodstuff. In many cases, an infused product may taste quite similar to its non-infused counterpart. Yet on a food safety level, the two stand distinctly apart. Though cannabis flower contains a number of potentially active compounds, such as flavonoids and aromatic terpenes, the term “cannabis” in cannabis-infused product refers primarily to the addition of active cannabinoids—chiefly, tetrahydrocannabinol and/or cannabidiol, but also cannabigerol and cannabinol. Such cannabinoids are usually received from cannabis extractors in the form of cannabinoid distillate. Due to the heat and chemical extremes required to extract cannabinoids to distillate, this is good news for those worried about the potential for microbial pathogens endemic to

the cannabis plant to contaminate products downstream.

Zamir Punja, PhD, a professor of plant biotechnology at Simon Fraser University in Burnaby, B.C., Canada, was lead author of a 2019 study that cataloged pathogens and molds affecting the cannabis plant. He notes that most of the seven or so pathogens affecting cannabis flower buds would not survive any solvent extraction, liquid carbon dioxide, or temperatures higher than 60°C.

“I would consider these methods to have eliminated living microbes,” Dr. Punja says. “What we don’t yet know is what would happen if a contaminated bud has [fungal] growth on it and the microbe produces a toxin. Some of these toxins can survive solvent extraction and are heat stable. So, they may survive through the extraction process, and possibly be con-

centrated. The majority of the mold should be killed by extraction, but it remains to be seen whether toxins that may be produced by the microbes growing on moldy product can still be detected in extracts.”

Kevin McKernan, the chief science officer of Beverly, Mass.-based cannabis biotechnology firm Medicinal Genomics, concurs, noting that CO<sub>2</sub> or ethanol extraction processes sterilize the cannabis flower, but may also enrich mycotoxins and pesticides in the process. “Not all microbial contaminants are flower derived, and regulators are still looking to ensure the infused products have not been contaminated downstream of the extraction process,” he says.

### Oversight

What kind of a threat do such processed mycotoxins pose for consumers? Charles T. Deibel, president of food safety testing firm Deibel Laboratories, acknowledges

### Microbial Pathogens Particular to Cannabis

Though two dozen or more pathogens may infect the cannabis plant, Zamir Punja, PhD, says there are roughly seven that affect cannabis flower buds. Fortunately for most cannabis producers and consumers, buds can undergo an electrobeam irradiation treatment, which essentially eliminates all pathogens, he says.

The problem is that some pathogens may have the capacity to do lasting damage before they’re irradiated. Dr. Punja says that researchers are not yet certain of how microbes that produce toxins may affect a contaminated bud.

Among the fungi that produce toxins are *Botrytis*, *Fusarium*, *Penicillium*, and *Aspergillus*, all of which may afflict a cannabis plant. Importantly, the toxins these fungi produce are heat stable and may survive solvent extraction. However, Dr. Punja stresses, the science surrounding the understanding of these fungi in cannabis is emerging and has not yet been settled.—/S

Dr. Punja's and McKernan's concerns, but he's not certain how much we should worry about them. "Aspergillus produces an extremely heat-stable toxin aflatoxin," Deibel says. "[Aflatoxin] is an extremely stable toxin structure, and it can absolutely survive some of the processing to make distillate, but it's rare. You're just looking at a numbers game. Bacteria are a hell of a lot more prevalent in recalls and [incidences of] foodborne [illness] than some of these oddball toxins like aflatoxin."

Not just bacteria, says Lori Glauser, co-founder and interim CEO of Nevada cannabis testing firm EVIO Labs. Before infused foods and beverages go to market, producers are also testing for a variety of pathogens. "We test the final product, not just the cannabis ingredient," Glauser says. "When testing for yeast, mold, *E. coli*, *Salmonella*, and mycotoxins in infused products, it is

more likely that the pathogen is introduced from the food product itself rather than the cannabis component."

It's the food product, not the cannabis, that makes infused products so complicated, because, while infused foods come in an increasingly wide variety of shapes, flavors, and permutations, infused products are not subject to FDA oversight. "As soon as you put THC in a food product, the FDA says, 'Not my jurisdiction,'" says Deibel.

When it comes to infused food products, FDA treats them more like medicine than like food, says Glauser. "The FDA requires that manufacturers have 'reasonable assurance that food is not adulterated,' and will perform sampling of certain commodities." But the safety of THC-infused foods is overseen at the state level alone, and the differences in requirements from state to state vary widely.

"In California, each batch of cannabis is tested for *E. coli*, *Salmonella*, *Aspergillus*, and mycotoxins, says Glauser. "In Oregon, there is no requirement for microbial testing yet, but that is expected to change in 2021. In other states, product is tested for yeast and mold. In Massachusetts, product is tested for all of the above, plus coliforms and certain bacteria."

But even between states that test for the same pathogens, differences may arise, says McKernan, who stresses that the sample size requirements, targets, and thresholds for failure differ from state to state.

All that testing is less demanding than that required of food products under FDA, adds Deibel, who says that food producers subject to FDA oversight must test many more batches of higher weights than are ever demanded of edible cannabis products.

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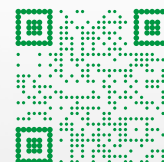


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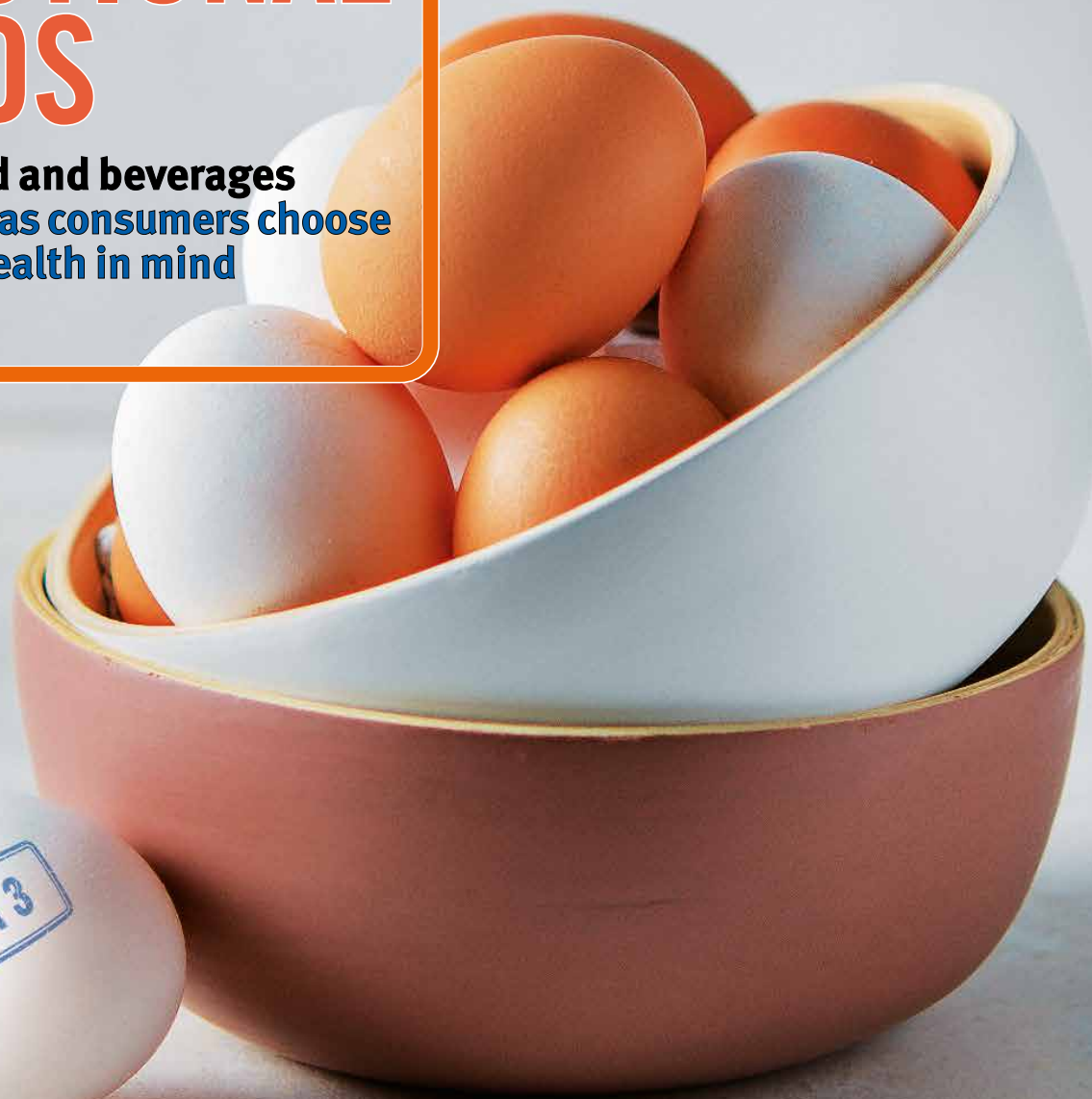




# THE RISE OF FUNCTIONAL FOODS

**Fortified food and beverages  
gain traction as consumers choose  
to eat with health in mind**

BY LORI VALIGRA



**C**onsumers have been purchasing foods, ingredients, and beverages that provide added health benefits since the 1980s, but these “functional foods” have gained prominence during the COVID-19 pandemic, when homebound people began cooking more often and seeking healthier ingredients.

Functional foods claim to offer a broad array of benefits, including stress reduction, anti-aging, pain relief, heart health, brain function, and increased energy. Almost any food in the grocery store that offers more than the recommended dietary allowance of a nutrient could be considered a functional food.

More than half of consumers say they are eating more healthily than before the pandemic, and 63% of grocery shoppers regularly buy foods for specific health benefits, says A. Elizabeth Sloan, PhD, CEO and owner of California-based nutraceutical consultancy firm Sloan Trends. Consumers are particularly interested in vitamins and minerals, immunity-boosting products, pediatric health, and support for individuals at higher risk for getting more severe COVID-19, such as those with hypertension, obesity, or diabetes.

In 2019, immunity ranked 18th among the health issues of greatest concern, but now it ranks third, Dr. Sloan says. Sales of products with an immune claim, whether they be fresh, frozen, or refrigerated, rose 21% in 2020. In the second half of 2020, foods and beverages that help control diabetes rose 14%, obesity 13%, and hypertension 9%, she says, quoting statistics from IRI, a data research firm based in Chicago.

“COVID-19 reminded consumers about the importance of taking specific nutrients, especially those related to immunity, driving consumers to look for more fortified foods,” Dr. Sloan says. Fortified foods, which contain added nutrients, are considered functional foods, whereas enriched foods, which only add back original ingredients removed during processing, are not.

The demand for fortified foods runs counter to a marketing trend over the last few years. Food marketers had pursued a naturally healthy formulation strategy and did not label specific nutrients or fortify products such as breakfast cereals, Dr. Sloan says. That strategy is backfiring now, she says, with some market research showing

that up to one-third of consumers think they are not getting enough nutrients. “The lesson here for marketers is, if you have something that is nutritionally important, you need to flaunt it, or it is a missed opportunity,” she adds.

### What Is a Functional Food?

Japanese academics were among the first to promote the concept of functional foods in the early 1980s, defining them as having nutrition, sensory satisfaction, and physiological functions. Japan established regulations

**COVID-19 reminded consumers about the importance of taking specific nutrients, especially those related to immunity, driving consumers to look for more fortified foods.**

—A. ELIZABETH SLOAN, PHD

for functional foods in the early 1990s, followed by the European Union a decade later (see “Regulating Functional Foods Internationally, p. 21).

In the U.S., there is no clear definition for what a functional food is, apart from those created by industry organizations (see “Defining Functional Foods,” p. 20). Because FDA doesn’t have a statutory or legal definition for functional foods, it does not specifically regulate them, says Sarah Johnson, PhD, assistant professor in the department of food science and human nutrition at Colorado State University in Fort Collins. Food quality and safety for functional food products are regulated the same way as for any other food; however, FDA does oversee health claims made for these foods.

The definitions provided by industry organizations have a common theme, that a functional food provides benefits beyond meeting the basic nutritional needs of

*(Continued on p. 20)*



(Continued from p. 19)

calories, carbohydrates, fats, proteins, vitamins, and minerals. Functional foods add bioactive components such as nutrients or plant-based chemicals that affect one or more physiological functions in the body to improve health, reduce disease risk, or improve disease outcomes, Dr. Johnson says. Some of the better-known functional foods include teas that can reduce stress, orange juice fortified with calcium, high-protein yogurt, detoxifying water, and fermented foods rich in probiotics.

Functional foods are eaten by people of all ages for different reasons. People tend to look for foods that will help them maintain the ability to do things as they age, including enhancing mobility, mental function, immunity, and energy, says Catherine Adams

## Defining Functional Foods

FDA doesn't have a statutory definition for functional foods, so it does not regulate them, but industry groups have given some guidance with their own definitions. The Academy of Nutrition and Dietetics defines functional foods as whole foods and fortified, enriched, or enhanced foods that have a potentially beneficial effect on health when consumed as part of a varied diet on a regular basis at effective levels.

The Institute of Food Technologists says they are foods and food components that provide a health benefit beyond basic nutrition (for the intended population). Examples may include conventional foods; fortified, enriched, or enhanced foods; and dietary supplements. Functional foods provide essential nutrients beyond quantities necessary for normal maintenance, growth, and development, and/or provide other biologically active components that impart health benefits or desirable physiological effects. The International Life Sciences Institute defines them as foods and food components that have the ability to beneficially influence body functions to help improve the state of well-being and health and reduce the risk of diseases.—LV

Hutt, PhD, chief science and regulatory officer at Sloan Trends. Both older and younger people want to protect themselves from aging poorly. “Young people really are concerned about having the energy to do what they need to do,” Dr. Hutt says. They also are concerned about stress, sleep, and digestion. She says that protein is used in a lot of functional foods because it can increase lean body muscle.

Sustainably produced functional foods also are in big demand, Dr. Johnson says. That includes foods produced with less of an environmental footprint, which includes growing and packaging the food. Clamshell packages that are fully recyclable have become popular, she says. One food she studies is microgreens, small edible greens that take less space to grow and are growing in popularity.

## CBD

One area getting a lot of attention is cannabis-derived cannabidiol (CBD), which claims to offer relaxation and pain reduction, among other benefits.

While FDA acknowledges there are products on the market that contain CBD, it is still illegal at the federal level to infuse it into food and beverages. FDA says CBD products may put the health and safety of consumers at risk because its effects and safe dosage still are not known. However, FDA currently is “taking steps to improve the efficiency of regulatory pathways for the lawful marketing of appropriate cannabis and cannabis-derived products,” according to its website. That’s good news to those making and wanting to consume the products. “Many food companies, large and small, are sitting with products at the ready, hoping FDA will take such an action,” Dr. Hutt says.



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## FDA Regulation

FDA oversees misbranding of food that might claim medical benefits. There are specific rules for health claims on food packages or in advertising, Dr. Hutt says. Claims have to be truthful and not misleading, and they cannot be disease claims.

In a well-publicized effort to clamp down on what it saw as misbranding, FDA, in May 2009, issued a warning to General Mills about claims for its Cheerios cereal at the time. The agency said that language on the cereal's label, including a claim that the cereal is clinically proven to lower cholesterol, made the cereal sound like a drug that could prevent, mitigate, and treat high cholesterol and heart disease, according to WebMD. "Food is supposed to support optimal health or maintain health," Dr. Hutt says. "It is not intended to treat diseases. She says consumers should be able to trust what they see on products as health claims.

## Measuring Results

One of the first steps in creating a functional food is making sure people will consume it, Dr. Johnson says. It has to taste good, because even if it has healthful ingredients, consumers won't buy it if it tastes bad. Another important aspect is making sure the product is not just trendy, with an ingredient that consumers link with improved health, but that it contains enough of the ingredient to provide a benefit.

It can be difficult for consumers to measure results from a functional food, but there are some functional ingredients that

are easier to gauge. For a functional food aimed at boosting iron, a blood test three to six weeks into eating it will show whether or not it is effective, says Kantha Shelke, PhD, principal at Corvus Blue, a Chicago-based food science and nutrition research firm.

"A good example is Cream of Wheat. Expecting moms and nursing moms who cannot hold their iron can eat Cream of Wheat because it's fortified [with iron], and that particular form is really gentle on your stomach," Dr. Shelke says. "When they go for their next blood test, they can see it. And word has gotten around over the years, so people trust it."

Another way to gauge the effect of a fortified food is in a product such as a fortified energy drink, where an effect is immediately palpable, she says. "People trust it, they have no doubt, and they buy it," she says.



## Regulating Functional Foods Internationally

While functional foods are not regulated separately by FDA in the United States, other countries have taken a more specific approach to the scientific merit of benefits listed on functional food labels.

In 1991, the Japanese Ministry of Health, Labour and Welfare set up a regulatory system for functional foods called "Foods for Specified Health Use," or FOSHU, to evaluate foods for their effectiveness and safety. FOSHU also approved statements on food labels about how the food affects the human body, and qualifying foods could include the FOSHU seal on their labels.

In Europe, the International Life Sciences Institute initiated the Functional Food Science in Europe, or FUFUSE, project in 1995 to establish a science-based approach for assuring that specific nutrients and food components positively affected their targeted functions in the body. Over a period of three years, the effort involved about 100 European experts in nutrition and medicine who critically assessed the state of the art in functional foods.

The work by FUFUSE led to a project called PASSCLAIM, or Process for the Assessment of Scientific Support for Claims on Foods, in the early 2000s to produce a pan-European generic tool that could scientifically assess health-related claims on foods or drinks. In 2006, the European Union adopted a regulation on nutrition and health claims made on food.

The European Food Safety Authority is charged with verifying the scientific substantiation of submitted claims regarding general health, disease risk reduction, child development or health, and criteria for setting nutrient profiles.—LV

## Functional Foods By the Numbers

- 65% of consumers seek functional benefits from their food and beverages.
- \$64.9 million: Value of the global functional foods market in 2018.
- \$99.9 million: Estimated value of the global functional foods market in 2025.

Sources: Zion Market Research, Kerry.

People have come to expect function from practically every food or drink, she says. She thinks the trend could continue. "Human beings are creatures of habit," she says, noting that office workers who moved to working remotely during the pandemic may not have continued their habit of picking up coffee and a donut in the morning and may instead have formed new habits with food. "Some of the newer habits may stick." ■

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

# Safety & Sanitation

PEST MANAGEMENT



## Pest Management in Food Processing Warehouses

Protecting food by protecting its surroundings

BY ANNA BERRY, MS

Commercial pest management can be synonymous with brand protection, ensuring that a customer never associates pests with a particular food processor or restaurant. As commercial pest management professionals (PMPs), our jobs often are to protect the food supply. This is a serious undertaking that involves protecting food through all stages of its processing, including in the retail environment, in restaurants, and often in a consumer's

home. That consumable item is the last step of a complicated, multi-faceted processing system that takes all different types of ingredients and turns them into something crave-worthy through the magic of food science. It's that final product that is worthy of protecting.

The production lines on which these products are created are at the forefront of sanitation and pest management protection efforts; however, many of the real risks to that product do not stem from those pro-

duction lines, but from unlikely, low-profile areas of the facility that have the potential for pest infestations. The building design, process flow, structural and sanitation resources, storage practices, and even neighboring facilities can all directly impact whether the production line feels pest pressure. Additionally, warehousing and receiving areas where ingredients and final products are stored tend to be near production lines, which harbor their own set of pest risks.

### Stored Product Pests

Dry ingredients, such as baking mixes, cocoa, nuts, and flour, may enter a food processing facility infested with stored product pests such as Indianmeal moths (*Plodia interpunctella*), cigarette beetles (*Lasioderma serricorne*), warehouse

(Continued on p. 24)

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(Continued from p. 22)

beetles (*Trogoderma variabile*), and flour beetles (*Tribolium spp.*). Stored product pests live in the food they eat; the food is their home. If the facilities processing and packaging these ingredients have a stored product pest infestation, the product that they are shipping out may have that same infestation, which can in turn infest the destination facility.

Stored product pest population development is a function of time and temperature. The longer a population sits in a container in warm temperatures, the more generations will develop. For this reason, first-in first-out stock rotation is essential. Forgotten totes or pallets of ingredients may hold generations of stored product pests that are quietly devouring the product and growing their population, eventually to a point where they need to find new harborage to infest and spread throughout the warehouse. Using storage containers that prevent these pests from entering or exiting the food can be an excellent tool to minimize risk. Well-sealed plastic or metal storage containers can prevent pests from escaping an infested container and protect product that is not infested. Racking can also be a common source of stored product pest infestations within a warehouse. Product and ingredient spills collect in the beams of the racking and in the racking legs and guards, providing an excellent harborage.

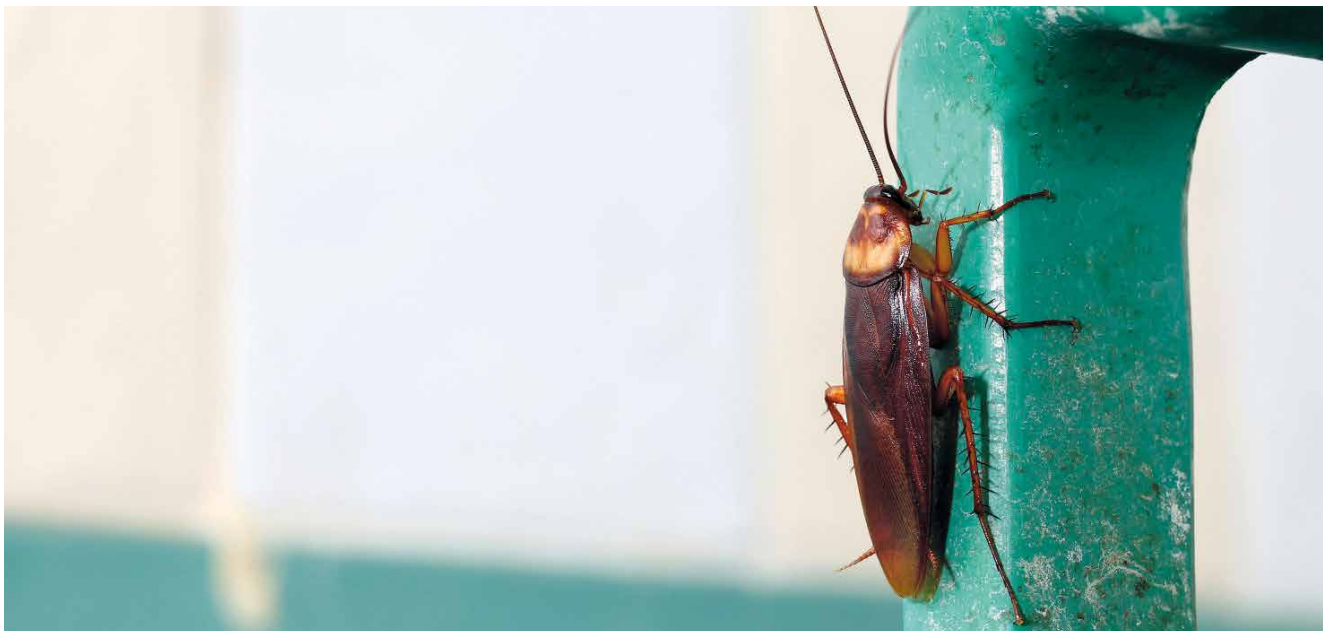
Though we tend to think of stored product pests as internal infestations, several stored product pests, such as the warehouse beetle, have populations on the exterior of a building. These populations are often monitored on the interior through pheromone traps and/or insect light traps (ILTs), but the source may be outside of the building. In such cases, a facility may need to focus on exclusion, using fans, light management, and sealing to keep those outdoor pests on the exterior.

Monitoring and control: Finding infested product in a warehouse can be daunting. With rows of pallets packed high with susceptible ingredients, it may seem as though stored product pests can loom anywhere. To assist with finding stored product pests, PMPs can implement a pheromone program. Pheromones and/or kairomones are placed in tent or pitfall traps, depending on which species are being targeted. Not all stored product pests have had pheromones synthesized for them, so it is important to remember that we cannot monitor for all stored product pests. Fortunately, the most damaging stored product pests do have synthesized pheromones. The monitoring traps will guide our inspection, telling us what areas of the warehouse have the most activity and warrant our attention. There is no replacement for a detailed and systematic inspection, but with monitoring data, we can find that infestation faster.

Once the infestation is found, it's essential to remove it. In a warehouse, this is typically a forgotten ingredient. Removing and disposing of the container and its contents will remove not only the food that the insects are consuming, but also the bulk of the infestation itself. Inspection and monitoring must continue to determine where the infestation has spread. Sometimes it has spread to a point where we cannot remove all sources. Fumigation, heat, or freezing may be solutions in these situations, but even these strategies are typically temporary. Sanitation must be present to prevent reinfestation.

### Commensal Rodents

Commensal rodents are the rodents that actively attempt to get into and live in our facilities. They include the house mouse, Norway rat, and roof rat. These rodents typically enter a warehouse through unsealed parts of the building or in a pallet. Warehouses with docks are particularly susceptible to rodent entry, because completely sealing dock doors, plates, and levels can be difficult and costly. Even the most perfectly sealed facility can be vulnerable to rodents as a result of poor employee practices, such as leaving man doors propped open and not fully closing dock doors. Rodents are drawn to the shelter or food these facilities may provide and, once inside, immediately look for ar-



eas to hide. Balers, unused equipment, and other dark spaces make great homes for rodents. If not discovered quickly through inspection and monitoring traps, they can move, spreading throughout the facility.

Rodents, particularly mice, are also often brought into a facility in infested pallets. They are called “pallet mice,” and they make their homes deep within a pallet of ingredients. They usually enter from the underside and may not be visible from the outside of the pallet. When these pallets come into the facility and are placed for use, the mice begin to leave the pallet and spread throughout the facility. This can be particularly frustrating for a facility with excellent sealing and employee practices, who are unknowingly letting in a Trojan horse containing mice.

**Monitoring and control:** Multi-catch traps are the standard monitoring tool for rodents inside a facility. Sometimes, it may make sense to place them on the exterior of a facility if the PMP needs to know how big a population is or if they cannot risk a poisoned mouse dying inside the facility. Otherwise, it’s common to trust exterior rodent stations to inform whether or not the exterior population is present and active. This is judged by the amount of bait or monitoring blocks that are digested, droppings left behind, or gnaw marks on the station.

The key to control, particularly for pallet mice, is inspection at receiving. Employees trained to look for evidence of rodent activity may be able to identify infestations and reject infested pallets before they enter the facility.

When there is evidence inside the facility, whether that is droppings, live or dead rodents, nesting evidence, or other damage, PMPs can start to develop a control strategy. Snap traps with attractive lures are an excellent choice for quick control. The success of a snap trap program in a warehouse will be dependent on placement, lures used, and competing foods. A good snap program requires equal parts patience and creativity; placing the same traps in the same place with the same lure will rarely get your population under control. An aggressive snap trap program may need to be supplemented with rodenticides, where safe and legal.



**Warehouses with docks are particularly susceptible to rodent entry, because completely sealing dock doors, plates, and levels can be difficult and costly.**

### Flies

Flies that impact a warehouse are typically divided into two broad categories: small flies and large (or filth) flies. Though similar in so many ways, there is an important difference between the two. Small flies typically come from the interior, while large flies usually come in from the exterior. We may find both inside a facility, but when we are looking for the source, it will vary based on which fly is present. Small flies are a group that includes many species, and each has its preferred habitat and needs. Identifying the fly in the warehouse is an essential first step, because it will dictate whether the PMP should look primarily inside or outside for the source. This may also lead us to a particular food source. Identification, therefore, really gears the PMP’s inspection in the right direction.

Large flies in a warehouse are typically there due to open doors and docks, much like commensal rodents. Light management can play an important part in this too, as these pests are drawn to the light on both the interior and exterior of the facility. Dumpsters and spills are typically the source of these flies, though any moist organic material can provide an acceptable exterior harborage.

Small flies typically come from the interior of the facility. In a warehouse, that may

be related to structural or sanitation issues associated with sewers, drains, or cleaning rooms. However, they may also be associated with liquid ingredients that are stored in the warehouse. A thorough inspection based on the food preferences of the species identified will identify the source and dictate the proper control method.

Facilities that process liquid ingredients with spill potential may have more frequent and long-term infestations, particularly if that material seeps onto the floor or into grates.

**Monitoring and control:** ILTs are often considered a universal flying pest monitoring tool. While they are very effective for some species, others do not respond as strongly to the light. Nonetheless, an ILT is a good first line of defense and monitoring tool to determine what species are in the facility.

Flies are generally not cryptobiotic, meaning they do not try to hide the way rodents and cockroaches do. This can make inspection easier, as adult flies are often very visible. The challenge is finding them in the juvenile stages, which may be hundreds of feet away from where we are seeing the adults. Once the PMP is able to find the source, insecticide may need to be applied (if appropriate) where the juvenile flies are harboring. Insecticides geared towards the adults will provide relief but will not eliminate the problem.

Renowned urban rodentologist Bobby Corrigan, PhD, a consultant with RMC Pest Management, has said that there must be lines of defense in rodent work. That same philosophy holds true when protecting food processing products. If PMPs can keep the areas surrounding food production pest free, then they are more likely to keep dedicated food production areas pest free. Likewise, if the exterior of a facility can be kept pest free, it is more likely that the interior of the building will remain pest free.

It is important to look at the facility as a whole when developing pest programs, paying attention to all the areas that may not be as highly sensitive, but may be high risk. Doing so will keep high sensitivity areas safe, ensuring that the overall food supply is protected. ■

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# Pest Management Documentation

Be prepared for your next food safety audit | BY FRANK MEEK

**F**ood processing facility managers know the importance of product quality and run a tight ship to meet regulatory requirements, while delivering goods on time and without issues. Third-party food safety audits help ensure that operators are practicing food safety measures, and proper preparation for these visits, whether they occur in person or are held remotely, is essential to your success.

While the COVID-19 pandemic has required changes to the way audits are conducted in food processing facilities, third-party audits remain a priority to ensure that food safety standards are upheld. Unfortunately, understaffing and limitations to interior pest control service may have provided the perfect conditions for pests to enter and multiply in facilities, unnoticed. Whether your facility has continued to participate in audits as usual, has adjusted to a hybrid version, or has paused in-person audits during the pandemic, remaining prepared is crucial. Operating a food processing facility is a demanding job already, and the last thing you want to do is fail an audit due to preventable pest issues.

A poor audit score—or worse, a failed audit—could have damaging effects on your business, ranging from tarnished reputations to canceled orders and lost profits. With the pest control portion of your audit accounting for up to 20% of your final score, it's important to have a reliable pest control provider who understands your business and your industry's requirements for food safety and pest control. Additionally, your provider needs to be aware of the various audit schemes that in are use and what their specific, individual requirements are.

## Your Pest Management Program

Because food processing facilities provide ample resources needed for survival—shelter, water, ideal temperatures and food—they will always be prone to pests. Although operators in these facilities have strict sanitation and safety measures in place, pests such as cockroaches, rodents, and stored product pests can still disrupt operations.

An integrated pest management (IPM) program, which focuses on preventive techniques rather than reactive treatment for pests, is one of the best ways to make sure your facility is prepared. Partnering

with your pest control provider to assess your facility's pest pressures and maintaining a proper sanitation and cleaning schedule are key steps to a successful IPM program.

Maintaining proper documentation is also necessary to ensure IPM success, as well as an essential part of the pest control portion of your food safety audit. Keeping documentation updated is important because, even with a pest-free facility, you could still lose points on an audit due to insufficient or poor documentation.

Your auditor doesn't just want to see pest monitoring devices and a pest-free facility. They want to see an ongoing commitment to upholding food safety measures. The following documents can help demonstrate that commitment.

- **IPM plan:** This documentation includes your written IPM program, pest management food safety rules and your risk assessment. Make sure these documents are kept updated (at least annually) and address any recent changes to your IPM program or facility.
- **Pest sighting log:** Facility managers and staff should have this available and updated at all times. Entries should include the date of the sighting, type of pest, location, and the actions taken to prevent future occurrences.
- **Service documentation:** These are reports of your pest control provider's visits and will provide the auditor with



more details about any pest findings, pest pressures specific to the facility, and whether any corrective measures taken by your facility were successful.

- **Pesticide documentation:** While the use of pesticides in food processing facilities is often limited, your pest control provider should keep a record of any pesticides used, along with labels for the products and safety data sheets. These will show your auditor that you're maintaining a safe and environmentally friendly facility.

### Be Prepared

Now that you know what information is needed for your food safety audit, be sure you stay prepared. Audits can be unannounced, so staying ready will help prevent any unpleasant surprises. The goal is to be ready every day for an audit.

To make sure you're prepared for an audit:

- Communicate with your pest control provider on an ongoing basis throughout your partnership. While they are

the expert when it comes to pests, you know your facility better than anyone. Taking a proactive role in the partnership will help prevent pest issues in the long run.

- Involve your entire staff in the IPM plan; they know the most about your facility and may spot pests or other issues before you do.
- Conduct annual assessments, regular inspections, and risk assessments with your pest control provider to ensure your IPM plan remains effective and proper.
- Make sure you're aware of any changes to your pest control service, and be sure to document them. The pandemic altered the way many facilities were able to work with their pest control providers, so document any changes prior to your audit.
- Don't wait until the last minute to get your documentation in order, because it takes time to compile the information. Your pest control provider should have hard copies of all the essential

reports and paperwork, but keeping them digitally is also a good idea. Most pest control providers have digital systems for documentation that even provide trend reports and analysis your auditor will appreciate. It's also easier to share documentation digitally when there are so many required items.

- Your pest control provider should have proof of their training available for your records as well.

In this time of heightened public health concern, food safety audits shouldn't be ignored in an effort to keep the supply chain moving at all costs. Even if your audit is conducted virtually, your documentation still will be required. Working with the right pest control provider for your business and being a proactive partner will help ensure that your next food safety audit is a success. ■

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# Quality

LABELING



## Flavor Labeling in 2021

What's new in the regulatory landscape

BY GWEN BUFFINGA

**A**lthough typically less than 3% of a finished product's volume, flavors play a significant role in delivering complete and accurate on-package communication. Getting flavor labeling right is essential for food and beverage manufacturers to meet FDA guidelines for safety and fulfill consumer needs for transparency. Regulatory teams know they must address flavor labeling complexities to reduce the risk of FDA enforcement or consumer litigation if labeling is incorrect.

Some of the flavor labeling challenges that food and beverage manufacturers and

foodservice providers faced in 2020 have extended to 2021. And, as consumer demand for safe food expands, new food and flavor labeling regulations are on the horizon. Fortunately, insights about upcoming changes can make it easier to navigate the labeling landscape.

### Temporary Labeling Changes Due to COVID-19

Pandemic-driven supply chain disruptions led FDA to provide interim guidance for relief to manufacturers at the end of May 2020. This allowance of the temporary flexibility will cease with the

discontinuation of COVID-19's status as a national emergency. While the vaccine for COVID-19 has already started to roll out, supply chain obstacles may affect the immunization timetable needed for manufacturers to return to pre-pandemic operations.

Under the interim guidance, food manufacturers can use their existing labels when applying minor changes to their formulas, which would otherwise cause mandatory label changes. The FDA provided the following details about appropriate changes to formulas that fall under the guidance scope. Use of existing labels is possible when the ingredient is minor and is present at less than 2% of the formula, the ingredient is not a significant ingredient (characterizing) or a source for a label claim, or the ingredient does not affect the finished product in function or nutrition.

The temporary changes apply to flavors if manufacturers want to replace them with appropriate substitutes meeting the same common name. For example, manufacturers must replace a natural flavor with a natural substitute and manufacturers must replace an artificial flavor with an artificial alternative.

FDA gave additional clarification about flavor changes that fall outside the guidance and would require applicable label changes, including situations when the change affects a characterizing flavor, such as chocolate, and when it's a primary, recognizable flavor in the food or beverage, such as chocolate milk; the source of an identity claim for a finished product for flavors with widely known taste profiles such as strawberry, banana, or watermelon; and when it is associated with a standard of identity which, in the world of flavors, only includes vanilla flavorings.

FDA also reminded manufacturers about the Food Allergen Labeling and Consumer Protection Act (FALCPA), which states that any ingredient change affecting allergen or sensitive ingredient presence in a product requires a modification to a manufacturer's label.

### Organic Certified Flavors

A 2018 ruling from the National Organic Program (NOP) went into effect at the end of 2019, requiring manufacturers to use certified organic flavors whenever commercially available. The ruling is a response to



a 2014 petition from the Organic Trade Association (OTA) that pointed to the growing availability of certified organic flavors due to use of technologies by flavor providers that increase production efficiency of organic options, more monitoring by USDA that helps flavor manufacturers find and source ingredients from certified organic producers, and detailed guidance about the documentation flavor houses must obtain to verify flavor ingredient authenticity.

Flavors that make organic claims must meet the same standard as the end-product. The flavor must contain 95% or more organic ingredients and 5% or less of non-organic ingredients.

The material list in the organic standard provides manufacturers with guidelines for flavor ingredients and identifies substances that don't comply. An ingredient such as an amino acid, for example, would meet requirements for a natural flavor, but it doesn't fit within the rules for certified organic flavors.

Labeling for organic flavors is more rigorous than for natural flavors. An organic flavor manufacturer must create and affix a lot number to bulk or non-retail packaging, just as with any other flavor. It must also share any non-organic natural flavors that are part of the formula with the certifier and use the word "organic" properly as a modifier. For example, a CPG manufacturer using a blueberry-type flavor with no organic blueberry derivatives in the formula could label it "organic flavor," but not "organic blueberry flavor."

When searching for certified organic flavor manufacturers, USDA's NOP Organic Integrity Database, which lists certified organic operators, is a useful resource. A robust vetting process for flavor manufacturers includes asking whether an operator has accurate and accessible documentation with evidence about the identity, purity, strength, and composition of flavor ingredients. Certificates of analysis, environmental certificates, and any import documents are also essential. Gathering insights into the supply chain used for organic flavor ingredients is also important. Supply-chain stability and expertise with logistics will help manufacturers manage any substitutions needed to meet launch schedules. It's also important to conduct or review onsite inspection results. Whether CPG manufacturers rely on a third party or

use their own experienced inspector, verification of compliance with certified organic requirements adds assurance to the flavor company's NOP listing or website. Finally, you'll want to assess the availability of R&D teams and organic suppliers for custom flavors and ingredients that meet regulatory requirements.

Certified organic flavor suppliers must meet the same requirements as other organic products. The NOP understands the transition from natural flavors to certified organic flavors is continuous but expects flavor manufacturers to demonstrate their process for finding organic replacements for non-organic natural flavors used in organic products and to show that they're actively looking for organic alternatives to natural flavor ingredients.

### National Bioengineered Food Disclosure Standard

In early July 2020, USDA's Agricultural Marketing Service (AMS) issued four documents informing manufacturers about the National Bioengineered Food Disclosure Standard (NBFDS). The guidance offers manufacturers insights about the validation and test methods related to refinement procedures and detection of modified genetic materials in foods and beverages. Food and beverage manufacturers have until the end of 2021 to align labeling with the new ruling.

The documentation includes information about the proper determination of test methods, clarifications for limits of detection, terms definitions, and general steps to validate if a genetic modification is undetectable in an ingredient or finished product.

In addition to offering validation guidance, the AMS clarified that the NBFDS is solely for educational purposes and removed sections of the standard that explicitly referenced food safety. Importantly, "regulatory oversight by USDA and other federal government agencies ensures that food produced through bioengineering meets all relevant federal health, safety, and environmental standards."

USDA defines a bioengineered food as one that "contains genetic material that has been modified through in vitro rDNA techniques and for which the modification could not otherwise be obtained through conventional breeding or found in nature."

Notable points of the NBFDS include:

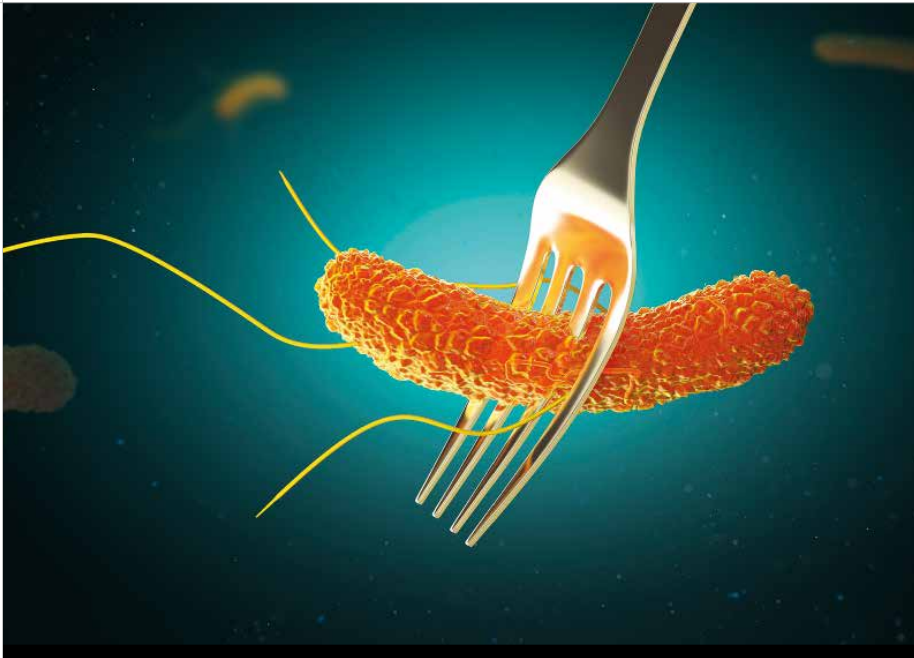
- Disclosure of highly refined foods and ingredients derived from bioengineered (BE) crops, such as soy sauce or corn syrup, isn't required;
- Incidental additives such as enzymes or yeast are exempt from BE disclosure and align with the ingredient declaration requirements under applicable FDA regulations;
- Manufacturers with sales lower than \$2.5 million annually and foodservice providers are exempt;
- Foods certified under the NOP are exempt because the organic certification process already requires manufacturers to prove they aren't using BE ingredients;
- Foods from animals that consumed bioengineered feed are not considered bioengineered food products;
- Food companies may use one of four options for disclosure on food labels: Text using the words "bioengineered food" or "bioengineered food ingredients"; a symbol with accompanying words; the use of electronic disclosures, such as a hyperlink or QR code, along with a telephone number to call for more food information; or a statement offering a phone number where consumers can send a text message to get the disclosure. Small packages and food sold in bulk receive special exemptions;
- The final BE rule establishes a threshold for the inadvertent or technically unavoidable presence of BE substances of up to 5% for each ingredient; there's no threshold allowance for any BE presence that is intentional; and
- The compliance date set by USDA for BE disclosure is January 1, 2022.

Consumers use on-package information to understand the health implications of the food and beverages they purchase and eat. Federal law requires the ingredient statement and nutrition facts panel to include essential details about nutritional content, ingredients, and known allergens. Continuing to monitor the regulatory landscape and adhere to flavor and food labeling guidelines will help manufacturers maintain consumer trust and build brand loyalty in 2021. ■

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# Testing



## Is Your Pathogen Data Giving You the Full Story?

How pathogen load measurements deliver a deeper dive for meat and poultry food safety

BY CHRISTINE ALVARADO, PHD

**E**ver hear what they say about ducks? “Calm and unruffled on the surface but paddling like heck underneath.”

The same could be said for pathogen measurements in meat and poultry plants. Essentially, all processing facilities already measure prevalence—or presence—of bacterial pathogens such as *Salmonella*. Measuring pathogen load can also help plant managers dive more deeply under the surface and, ultimately, uncover ways to improve food safety management.

### Understanding Pathogen Prevalence

The USDA Food Safety and Inspection Service (FSIS) uses pathogen prevalence, as

indicated by performance standards, as the primary process control measure to evaluate the safety of meat and poultry products.

Prevalence is a yes or no answer—it’s either yes, the pathogen is present or no, it’s not. Prevalence is expressed as a percentage of samples tested. For example, if you’re testing 100 poultry carcasses, and 20 test positive for *Salmonella*, the prevalence is 20%.

*Salmonella* prevalence indicates pathogen presence, but it does not indicate whether the positive result is due to one cell or many cells. To determine prevalence, the collected sample goes through an enrichment process that provides nutrients and temperature conditions favorable to the growth of *Salmonella*. This

enrichment step allows the number of *Salmonella* cells to replicate over time and reach a level that allows presence to be detected. This methodology produces a positive prevalence result, even if the *Salmonella* cell numbers are low in the initial sample.

To protect public health, FSIS looks for processing plants to reduce pathogen prevalence at every step, from animals or birds coming into the plant all the way to the outgoing final product.

Plant managers often use prevalence testing to assist with process control. A poultry processor might take samples from five or more areas, such as rehang, post-pick, pre-chill, post-chill, and final product. Prevalence testing will confirm the desired decrease in pathogen presence at every step. If prevalence increases, that may signal a problem requiring an additional intervention at that step or it may indicate a needed improvement in the management of a system or process.

### What Is Pathogen Load?

Recently, more companies have started measuring pathogen load in addition to pathogen prevalence. Also referred to as enumeration, load data supplements the prevalence yes-or-no answer by measuring the number of cells of a particular pathogen present in a sample. With new technology, load testing can detect very low numbers of pathogen cells.

Since bacterial cells grow logarithmically, load is expressed via a log<sub>10</sub> scale versus a numerical scale. For instance, 10<sup>1</sup> log CFU/g equals 10 cells, 10<sup>2</sup> log CFU/g equals 100 cells, 10<sup>3</sup> log CFU/g equals 1,000 cells, and so on.

### Why Pathogen Load Matters

Pathogen load measurements tell the plant manager the number of actual bacteria in the system, not just their presence. The higher the pathogen load, the higher the potential food safety risk, especially at the final product. By measuring both prevalence and load, plant managers can get a robust and real-time picture of what’s happening in the plant.

It’s possible to have high pathogen presence and low pathogen load, if many of the carcasses test positive but each one

(Continued on p. 32)



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<sup>1</sup> Elanco Animal Health. Data on file.

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Poultry

(Continued from p. 30)

carries only a few cells. If only a few carcasses carry high levels of contamination, a plant might have low pathogen presence and high pathogen load. Each of these scenarios may require further investigation to determine if the process is under control and to identify solutions to reducing prevalence and/or load to ensure final product food safety.

Load measurements can provide additional data to help managers determine both what's working well and where improvements may be needed. Understand-

Understanding and reducing the pathogen load throughout the system, including at preharvest, can identify hot spots and areas to improve control.

ing load can identify areas to apply antimicrobials, areas where process control may be failing, or areas where equipment or system management could be improved. This concept is especially true when validating an antimicrobial. Reducing load is the goal of an antimicrobial, and this can be easily measured with pre- and post-intervention sample testing. This method of validating an antimicrobial also takes into consideration variation that exists in processing.

### Using Pathogen Load Data

Finding sources of cross-contamination is one way for managers to use enumeration or load data. Cross-contamination can be an issue in meat and poultry production: One animal or group of animals can contaminate others, and improperly adjusted equipment can potentially create a cross-contamination issue.

This can happen, for example, if the first group of birds entering the plant for the day comes in from a flock that has a high load or prevalence of *Salmonella*. That one flock—or even one bird—could leave *Salmonella* cells on the picker, cross-contaminating all other birds being processed for the rest of the day.

Table 1. Example *Salmonella* Load at Various Production Stages

	Flock #1	Flock #2
Poultry house	10 <sup>6</sup> log CFU/g	10 <sup>4</sup> log CFU/g
Rehang	10 <sup>5</sup> log CFU/g	10 <sup>3</sup> log CFU/g
Pre chill	10 <sup>3</sup> log CFU/g	10 <sup>1</sup> log CFU/g
Post chill	10 <sup>2</sup> log CFU/g	Non-detectable

In this situation, it can be difficult to pinpoint what went wrong. Prevalence data does not distinguish between birds that were positive for *Salmonella* coming into the plant, and those that were cross-contaminated. The plant manager just knows *Salmonella* is present. By determining load and presence, the plant manager is able to detect the problem location and apply a potential solution.

### Lower Load = More Effective Interventions

It's difficult, if not impossible, for an antimicrobial to achieve zero pathogen prevalence in meat and poultry processing. This is because all live animals enter the plant carrying bacteria, and end products are not commercially sterilized. But, processing plants can focus on incoming pathogen loads, process controls, and the effectiveness of their food safety systems by measuring pathogen load and prevalence.

When it comes to *Salmonella*, the industry rule of thumb for a successful in-plant antimicrobial intervention is a 1 log reduction in load. The lower the incoming pathogen load, the better the chances are that an antimicrobial will successfully reduce the pathogen.

For example, animals or birds may come into the plant with a *Salmonella* load of 10<sup>5</sup> CFU/g. A multi-hurdle combination of antimicrobials and process controls may achieve a three-log reduction in the final product, lowering the load to 10<sup>2</sup>. But imagine if the incoming load is only 10<sup>3</sup>. That means the multi-hurdle combination of interventions will reduce load to less than 10<sup>1</sup> and lower the potential food safety risk.

Understanding and reducing the pathogen load throughout the system, including at preharvest, can identify hot spots and areas to improve control.

Good management systems throughout production can help decrease the load

of *Salmonella* on incoming birds. Research shows that live production controls, including proper probiotics to help optimize gut health, may help reduce *Salmonella* prevalence in the poultry house and in ceca of the birds.

The benefits of reducing loads on incoming birds can be seen throughout the entire processing system to the final product.

In a real-world example, flocks from two different houses in the same complex enter the processing system with different levels of *Salmonella*. (See Table 1, above.) As these birds are processed, those from the house with a lower incoming load register less *Salmonella* throughout the entire slaughter process. The house with the lower load was able to see the benefits from multi-hurdle antimicrobials more than the house that had a higher starting load.

### Continuous Improvement from Farm to Fork

In meat and poultry processing, USDA performance standards continue to tighten as regulatory bodies work to improve product safety and consumer trust. Allowable pathogen prevalence percentages continue to decrease.

Processors have successfully responded to and met every new performance standard; however, for continued improvement, the industry has reached a point where it's necessary to incorporate live production factors with processing data. Measuring and understanding overall pathogen loads is one way the full food chain can work together. Communication and coordination between processors and live-side managers will help the meat and poultry industry continue to deliver a safe, reliable food supply. ■

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# Detecting Pathogens in Dairy

Pathogens in these products can be difficult to detect due to their complex matrices | BY ANDREA TOLU



**F**ood contamination generally depends on two major variables: how easy it is for a particular product to become contaminated and how difficult it is to discover the contamination through the testing methods in use. With milk and dairy products, the combination of these two factors make the probability of food safety incidents much higher than with other foods.

The risk starts at the very source. “Milk-ing happens in a non-sterile environment that can harbor different pathogens,” says Dino Demirovic Holmquist, vice president of business development at Eurofins. “For bacteria to grow, you need humidity, the right temperature, and food. Milk has the perfect combination: It’s liquid, nutritious, and is drawn from the cow at a temperature between 32° and 34°C.”

The other variable is not favorable either: Pathogens in dairy products can be difficult to detect because of their complex matrices and the interaction among different microorganisms. One of the effects of this interaction is a phenomenon called metabiosis, which happens when a microorganism creates the right conditions for the growth of another one. A typical example, says Holmquist, is a pathogen that lowers the pH in milk, creating a perfect environment for another pathogen that was already there, but in very small quantities. As this second pathogen grows, it produces a substance or other favorable conditions in which a third one can flourish and make a product unsuitable for consumption, he adds.

In fermented products, these interactions may have the opposite effect of keeping bacteria undetected when using standard plating techniques. “Fermentation often uses lactic acid bacteria,” says Luke Thevenet, a pathogen technical sales specialist at 3M. “These can produce antimicrobial compounds that compete for resources with the pathogen that you’re trying to detect, preventing it from growing.”

The same phenomenon occurs in dairy powders: “Powdered dairy is probably one of the most difficult matrices to recover pathogens from and prevent interference if using an unvalidated detection method. Their low-water-activity environment is not conducive for low numbers of pathogens to survive and grow rapidly, which affects the detection and recovery rate of molecular platforms,” says Celina To, regional technical sales manager at Hygiena.

Whether it is metabiosis or competition between microorganisms, the result is that the pathogen is there, but invisible to standard plating methods. “You can have the best technology, but if the pathogen hasn’t grown to levels above the limit of detection, it is not going to provide valuable information,” says Thevenet.

To complicate this situation even further, dairy is one of the most dynamic segments in the food industry, with new products and formulations launched every week: “If you’re introducing new ingredients all the time, you might not have data on their pathogenic risk, their interaction with the rest of the formulation, or whether

the tests you’ve been running are still valid for that new matrix,” says Thevenet.

Using an aggressive heat treatment such as ultra-high temperature (UHT) to sterilize milk in all products would not be a viable solution, says Holmquist: “Ultra-high temperatures oxidize lipids and caramelize sugars [and] will change the taste, which is the main reason we buy milk and dairy products these days. What’s more, the dairy industry has always claimed to interfere very little with milk and keep it very close to its natural state. With the clean label trend, this has become even more important.”

## The Need for Speed

To be sure, plated methods are not any less valid because of these challenges. With the right strategy, the right enrichment process can always be found. For example, says Thevenet, “You might have to adjust the pH or select antibiotics to target the competing microorganisms, while promoting a positive growth environment for the pathogen.”

“Any ingredient could be problematic without any preliminary testing to validate the method for that dairy facility” says To. “Also, it’s not the type of dairy processing that creates challenges; rather, these depend on whether the dairy facility has a robust and easy-to-use environmental sampling plan, where technicians are trained to look for areas that are difficult to clean and swab. This is one of the major hurdles with environmental detection.”

The real problem is time: “Heat-resistant and spore-forming bacteria like *Clostridium* can survive in plant-based dairy formulations, while *Geobacillus stearothermophilus* has been detected in extended shelf life and aseptic dairies before. Even with the right enrichment conditions, these can take up to 10 to 14 days to be detectable on plates. But many facilities can’t wait that long to hold and release products,” says To.

“Speed is crucial,” says Thevenet. “Processing environments are dynamic, and if you’re waiting several days for a result, a lot can happen: Microorganisms can be spread around processing plants by forklifts, carts, or employees.”

For dairy processors, a successful food safety program is a matter of preparation,



says Thevenet: “A lot of money is invested in a product and people’s lives could potentially be at risk, so picking the right pathogen test is extremely important. You need to consider the matrix and size of the sample you’re testing, the manufacturing and lab environments, the available technical resources, and the expertise levels of your technicians. You also need the data to prove that a method is appropriate for your samples.”

### A Holistic Approach

Because speed is crucial, detection solution providers are striving to make tests faster, either with improved enrichment media or with alternative methods. 3M has developed methods based on loop-mediated isothermal amplification (LAMP), while Hygiena’s methods focus on ATP and DNA-based PCR technology.

Making test execution faster will also become more important, says To: “Lab automation and optimized, reliable, and validated methods will help reduce staff turnover and allow technicians to allocate their time to other tasks, making results more reliable and repeatable. Also, with cloud-based software, a lab can quickly identify process challenges onsite and make data-driven decisions, from environmental monitoring to pathogen identification.”

Improved speed and accuracy, however, are just part of the solution. One of the most recent advancements in pathogen detection is using next generation sequencing (NGS) to look more deeply into complex food matrices: “With standard plating techniques, you have to know what to look for, while NGS can be used both for identification and characterization,” says Holmquist. “The first approach is called shotgun metagenomic sequencing, where you sequence the DNA of all microorganisms in a sample and see in what proportion they are present. The other is called targeted metagenomics, or barcoding, where you identify family genus, species, serotype, type, and strain of a known microorganism.”

Targeted metagenomics is proving very useful for tracing outbreaks of foodborne illness and can be applied successfully inside the processing plant, too. “When you find a pathogen in your plant, the challenge is to determine whether it’s a transient microorganism that comes from the outside or a persistent one,” says Holmquist. “Some of the recent recalls were based on the same pathogen that had caused a recall from the same facility several years before.”

Shifting the mindset from pathogen detection to strain tracking, says Holmquist, makes it possible to know what is really going on in a facility, instead of just sampling random points throughout the processing chain.

An important piece to this holistic approach, says Thevenet, is to integrate existing data points and technologies other than pathogen testing, such as data from raw ingredients and seasonality, to build predictive models. “This way, you would know with what product, or pathogen, or at what time of the year you’re more susceptible to having a contamination,” he adds. “For scientific vendors, the next step will be to create software that is able to track and integrate data from different platforms and make these types of predictions.” ■

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# In The Lab

PATHOGEN CONTROL



## The Importance of *E. coli* Detection Methods

How laboratories can ensure safe and efficient testing

BY NEVIN PERERA

**W**ith the demand for beef products continuing to rise and research activities increasing in North America, the *E. coli* O157 testing market is growing rapidly. In North America, this market is expected to nearly double to more than a trillion dollars, by 2027. Such demand necessitates streamlined, cost-effective, and—most importantly—accurate *E. coli* O157 testing to prevent outbreaks as much as possible. Food producers and processors need to ensure they have the best

processes in place to keep up with this demand safely and efficiently. This may require putting a critical eye to the supply chain to create an effective and sustainable food safety plan.

Foodborne pathogen outbreaks such as those caused by *E. coli* O157 are not just problematic for consumers; food producers and processors feel the effects as well. Considering lost revenue, product recalls, clean-up costs, and potential lawsuits, the monetary ramifications of an *E. coli* O157 outbreak can be catastrophic for testing

laboratories. By examining processes currently in place, members of the food supply chain can make the changes needed to ensure that their testing processes are safe, efficient, robust, and economical.

### Examine the Food Safety Plan

To solidify a well-rounded food safety plan, food processors and producers need a clear roadmap tracing every item. Samples need to be tracked in detail, including their source of origin, how they're stored at source, mode and route of transportation, how long they're transported for, and points of primary and secondary interaction throughout the supply chain. It's also imperative to have a plan of action in case of a product recall. Producer plants need quicker recall procedures and rapid sample traceability, along with notification systems, to implement as soon as contaminated samples are identified by the food processor.

Effective sample monitoring systems ensure that if the food processor can identify exactly where the outbreak occurred, it can also identify what specific samples have been contaminated. Because this outbreak could trace back as far as the slaughterhouse, meticulous sample tracking is essential for every member of the food supply chain.

*E. coli* O157 testing carried out in processing facilities is only as strong as the chosen test technology of the certified method developer. This will ensure reliable sample tracking and fundamentally allows the method developer to work with each individual customer to create a novel internal monitoring plan of their materials using their specific methodology. For optimum success in this process, laboratories need a method developer with both reliable testing results and robust customer services.

### Implement a Sustainable Testing Solution

Many food testing labs currently use PCR or culture methods for their testing procedures. These systems are not without their drawbacks. While PCR is a proven technology and an accurate testing application, ELISA testing methods are just as reliable as PCR and culture-based testing methods. ELISA tests also offer additional benefits, making them a better option for

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many labs looking for increased automation, improved overall turnover of sample results, and cost savings.

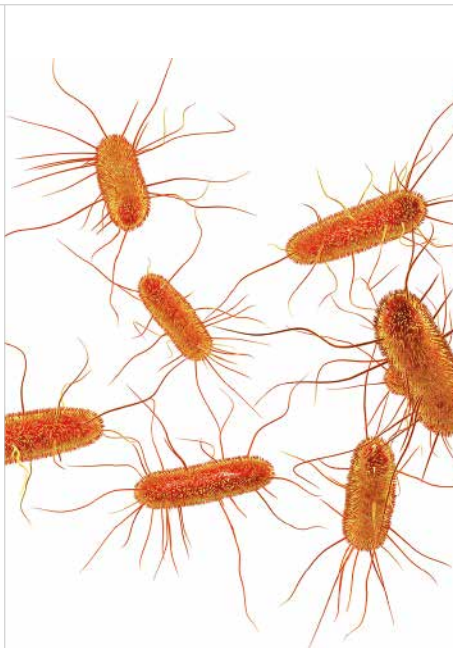
Labs may find that the multiple liquid-transfer steps associated with PCR testing leave many opportunities for errors, and because a high level of skill is necessary to complete the process, a great deal of time and money needs to be spent on training.

High throughput immunoassay ELISA testing challenges the shortcomings of PCR testing. ELISA tests are easier to automate and require less training time to operate, meaning testing labs can onboard employees more quickly and cost effectively. Pre-installed protocols with onscreen step-by-step directions to set up and run assays results in walk-away automation that frees up time for lab testers to multitask, allowing tests to be run in the background while employees complete other necessary tasks throughout their shift.

ELISA testing methods can also increase lab output dramatically; in some cases, certain immunoassay diagnostic kit devices can even double the throughput of some PCR or culture-based testing services. Therefore, while time to result can be comparable between PCR testing and ELISA testing, the volume of results in one run may be vastly different between the two technologies, depending on the number of handling steps utilized in the different methods, the number of reactions able to be processed per automated instrument run, and the number of instruments that can be overseen by a single operator. Ultimately, this difference can impact operational key performance indicators and affect productivity margins by lowering the base cost per reaction.

In addition, confirmation procedures can start up to one full day earlier when compared with PCR protocols, which require a subculture step prior to confirmation, saving time in identifying contaminated product. With ELISA testing, labs have the flexibility to run any number of samples with ultimate efficiency, so smaller labs can batch test for maximum automation and output.

When deciding on a testing provider, it's also essential to evaluate the company's customer service and technical support to ensure your lab tests will not be disrupted by a lack of technical response. Labs should look for service providers that



**ELISA testing methods can increase lab output dramatically; in some cases, certain immunoassay diagnostic kit devices can even double the throughput of some PCR or culture-based testing services.**

provide hands-on support and training, remote trainings if need be, and access to appropriate entities to provide both assay- and machine-related inquiries.

#### **Look for Cost-Saving Solutions**

When evaluating cost savings in the *E. coli* O157 testing supply chain, every minute aspect counts. If a product is proven to be contaminated and is subsequently destroyed, the producer ultimately loses out on the supply's full profit margin. However, even a false positive can create stalls in the supply chain, necessitating a product pull or quarantine.

In a best-case scenario following a positive test, the product is ultimately proven to be safe, but the time needed to confirm a potential positive contamination means the shelf life of that product is reduced. Stores may not have enough time to sell the product before its shelf life expires, resulting in a full profit loss for that supply. The

best way to circumvent that outcome is to ensure your labs are using testing methods less likely to create false positive results.

Since PCR testing can detect non-viable target cells, there's an increased chance for false positive results, which could lead to delays in shipping product and loss of capital for the supply chain. ELISA tests are less likely to result in false positive notifications, which can save time and money.

ELISA tests also have minimal cold storage requirements and need less fridge space than molecular or culture-based methods for the same number of samples, which reduces the overall cost of running a lab.

Ultimately, the best way to reduce laboratory costs is to look for testing solutions that increase automation throughout the entire testing process. Look for solutions that require fewer manual steps, fewer liquid-transfer steps, less capping and uncapping of tubes—all small time savers that can add up to more output and bigger cost savings.

#### **The Bottom Line**

It's up to each individual laboratory to find and implement the testing procedures that work best for its needs. Lab technicians should study current workflows with a critical eye for areas of potential improvement. Look at the testing process as a whole: Is your lab taking advantage of the automation advancements in the pathogen testing space? Is your throughput as high as it could be? Does your method provider offer you the technical and customer support you need?

Adoption of a particular method technology, including any of the immunoassay, molecular, or cultural technologies available to a facility processor, may be preferred based on operational and historical parameters. However, no one technology is universal for all the requirements of the *E. coli* O157 testing market. A willingness to be open-minded and allow methodological diversification could be advantageous to a processor, resulting in benefits ranging from cost savings to lower sample false positive incidence rates, leading to greater brand protection and service recognition. ■

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## Food Waste During COVID-19 (Continued from p. 15)

I described these practices in my most recent article in “Global Interests,” which published in the December 2020/January 2021 issue of *Food Quality & Safety*, on the eating and buying behavior of consumers during COVID-19. For example, most consumers now plan their meals ahead and prepare shopping lists of specific foods. They read food labels and choose foods such as canned and frozen products, which have a shelf life longer than those of fresh fruits and vegetables. They have increased their food storage capacities at home; many have purchased freezers and additional refrigerators.

Although consumers are aware of food expiration dates, there needs to be consumer education on the correct interpretation of “use by ...,” “best by ...,” or other food expiration terms. Some consumers interpret food expiration dates printed on the food package as absolute dates and throw foods away the day after the expi-

ration date without determining existing food condition, resulting in increased food waste.

Several researchers have prominently recommended communication as a mitigation strategy. Roe and colleagues (in the journal *Applied Economic Perspectives and Policy* in 2021) emphasized that consumer education should focus on food management and food preservation skills. Sharma and colleagues (in the journal *Resources, Conservation & Recycling* in 2020) reiterated these areas for consumer education and added that there is a need to teach the public the relationship between shelf life information and food waste.

Brizi and Biraglia (in *Personality and Individual Differences* in 2021) encouraged policy makers to meet the needs of NFC by using precise and reassuring information rather than emphasizing distressing situations (e.g., the pandemic). These strategies are then pulled together to communicate

the aim for a sustainable food system with “core principles” consisting of “reusing food and food waste and composting food to recycle nutrients.”

These strategies are not new, but rather all align under the same global issues—economic, social, and environmental. Consumers currently practice some of these strategies during the stressful times of the COVID-19 pandemic. But, will the consumer continue this behavior when the world has satisfactorily managed COVID-19 and returned to some semblance of pre-pandemic living? Or will consumers selectively choose practices that they find most convenient but produce the results that they are searching for, such as saving money, managing their health, and even improving their appearance and feel? And which practices will those be?

Only time will tell. ■

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## Microbial Contamination of ... (Continued from p. 17)

### Risk on the Rise

While the chances of getting *Salmonella* from a cannabis-infused gummy are fairly low, says Deibel, that relative safety is only for the time being. Producers may begin shifting norms and ingredients that have made previous gummies shelf stable. Meanwhile, with so many hoping to strike gold selling cannabis-infused foods and beverages, the variety of food types is expanding dramatically beyond gummies, cookies, and brownies.

The problem with savvy consumers looking for high-end quality and flavors is that they want nothing to do with the mass-produced ingredients that have proven themselves safe for consumers in large numbers. They want new and inventive flavors, and they often want them in chocolate products.

“Chocolate, and especially some of the toppings—fresh fruit, nuts—those can absolutely have *Salmonella* in them,” Deibel says. “If I were to name my five biggest concerns for *Salmonella*, they’d be: chocolate, nuts, raw meat, raw ag [agricultural

produce], and spices. Well, you’ve got raw ag in the form of fruit, and nuts, and spices, and those are all going on top of chocolate. Really fancy chocolates with curry spices or whatever, they are getting out onto the market, but they are not going through the same rigor of testing that the food industry would have subjected them to.”

He concludes that many food safety insiders are waiting for the first big *Salmonella* or *Listeria* recall in the in the cannabis market. “It’s going to happen,” he adds. “It’s just a matter of time.”

### GMPs

To avoid becoming the company that suffers that recall, Deibel advises producers of infused foods to adhere to good manufacturing practices (GMPs) supplemented with aggressive sanitation programs, extensive training, and routinely validated equipment.

McKernan goes back even further: He suggests food producers source ingredients from cannabis cultivators offering “good genetics,” such as the cannabis cul-

tivars that exhibit pathogen resistance. “In [the] absence of fungi-resistant cannabis,” McKernan says, “testing for pathogen load throughout the cultivation process as opposed to just at the end is consistent with GMP. Gambling an entire crop on a single test at the end of the long growth and harvest process is not advised.”

Beyond that, McKernan joins Glauser in stressing that testing infused food and beverages for microbial contamination is done in the same manner as it is for non-infused foods, and that it should be done, whether or not FDA insists upon it.

Companies producing food products must expect to encounter pathogens eventually, says Deibel, whether FDA is testing the products or not. “Even the best company with all the right programs working in concert, they’ll still find a pathogen, *Salmonella* or *Listeria*, in their finished product, maybe once every five years—10 years if they’re lucky. But they find it. The pathogen is always waiting at your door.” ■

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## Mass Spectrometer

The Acquity RDa Detector featuring SmartMS is a time-of-flight mass spectrometer for small molecule analysis. The detector can be quickly deployed and operated and is optimized for small molecule applications. It operates on Waters Connect, an open-software platform, which provides an audit trail for data acquisition, processing, and reporting. **Waters Corporation, [waters.com](http://waters.com).**



## Steam Sanitizing Device

The SaniZap line of antimicrobial steam cleaners safely sanitizes almost any surface, leaving no residue, moisture, or harmful chemicals. The process is 600 times faster than chemical sanitization, making it ideal for following CDC guidelines that call for frequent sanitization. The portable equipment is available in different models to accommodate a range of facilities and price points. It can be used at lower steam temperatures with soap or detergent to quickly clean visible dirt and grime and can also be used at higher steam temperatures for antimicrobial sanitizing. **Bayzi Corporation, [bayzi.com](http://bayzi.com).**

## Vegan and Halal Food Testing Assays

Thermo Fisher has added assays for vegan and halal testing to its RapidFinder Meat and Fish ID Kit range. The real-time PCR-based species detection and quantification solutions fit within existing RapidFinder workflows. The workflow allows for DNA extraction from samples of up to 20 g, using either a manual or automated procedure for the higher throughput of multiple samples. The identification targets mitochondrial DNA for increased sensitivity and specificity. The kit, which tests for pork, records a sensitivity rate of 0.0005%. The new assays follow the same sample preparation and PCR procedures as other RapidFinder Meat ID assays, enabling them to be run together with existing workflows. **Thermo Fisher, [thermofisher.com/food-species-pcr-testing](http://thermofisher.com/food-species-pcr-testing).**

## IoT Supply Chain Monitoring Devices

Sensitech has expanded its suite of Internet of Things (IoT) devices to include air-carrier approved and non-lithium battery models for real-time tracking of shipments when cargo is traveling by plane. Data flows directly from the TempTale GEO and VizComm View products to a cloud-based visibility solution, alerting users to in-transit events such as temperature excursions or trends, location delays, or light events indicating that a truck or trailer door has opened. The platform's analytics engine provides real-time evidence and dashboard reporting to assess compliance and the trip's performance. **Sensitech, [sensitech.com](http://sensitech.com).**

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Virtual Event  
Visit [foodprotection.org/europeansymposium](http://foodprotection.org/europeansymposium).

### MAY 2021

#### 11-13 Food Safety Summit

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Visit [food-safety.com/food-safety-summit](http://food-safety.com/food-safety-summit).

### JULY 2021

#### 18-21 IAFP Annual Meeting

Phoenix, Ariz.  
Visit [foodprotection.org/annualmeeting](http://foodprotection.org/annualmeeting).

#### 19-21 IFT Annual Meeting

Virtual Event  
Visit [iftevent.org](http://iftevent.org).

### AUGUST 2021

#### 15-20 Conference for Food Protection

Virtual Event  
Visit [foodprotect.org](http://foodprotect.org).

#### 24-26 NAMI Meat Industry Food Safety Conference

Chicago, Ill.  
Visit [meatinstitute.org](http://meatinstitute.org).

#### August 27-September 2 AOAC Annual Meeting and Exposition

Boston, Mass.  
Visit [aoac.org](http://aoac.org) or email [aoac@aoac.org](mailto:aoac@aoac.org).

### SEPTEMBER 2021

#### 22-24 Petfood Forum

Kansas City, Mo.  
Visit [petfoodforumevents.com](http://petfoodforumevents.com).

#### 28-29 North American Food Safety & Quality

Chicago, Ill.  
Visit [foodsafetytna.com](http://foodsafetytna.com).

### OCTOBER 2021

#### 18-19 European Food Sure Summit

Milan, Italy  
Visit [foodsureeurope.com](http://foodsureeurope.com).

### JANUARY 2022

#### 25-27 International Production & Processing Expo (IPPE)

Atlanta, Ga.  
Visit [ippexpo.org](http://ippexpo.org).

### MARCH 2022

#### 5-9 Pittcon

Atlanta, Ga.  
Visit [pittcon.org](http://pittcon.org).

### OCTOBER 2022

#### 23-26 Pack Expo International

Chicago, Ill.  
Visit [packexpointernational.com](http://packexpointernational.com).

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# SCIENTIFIC FINDINGS

For access to complete journal articles mentioned below, go to “Food Science Research” in the April/May 2021 issue at [foodqualityandsafety.com](http://foodqualityandsafety.com), or type the headline of the requested article in the website’s search box.

## An Overview of Craft Beer

This article details issues concerning the history and legal definition, market, fiscal policy, innovation, safety, healthiness, consumer profile, and sustainability of craft beer. The term “craft brewery” generally refers to a brewery able to produce low volumes of beer, often made with traditional ingredients, but also with the addition of nontraditional ingredients as a distinctive sign of the master brewer. In many countries, the importance of the company size is



related to the opportunity to take advantage of reduced excise rates for low production volumes. In several countries, another important requisite of a craft brewery is represented by its independence from other alcohol industry members. Even in the presence of a great heterogeneity of the size of craft breweries in various countries, their number in the world is around 17,000. Craft beers are often not filtered or not pasteurized and, for these reasons, they are beverages rich in health compounds but have a reduced shelf life. As in the case of larger breweries, the environmental impact of craft breweries is mainly represented by water consumption and production of liquid and solid wastes. **Comprehensive Reviews in Food Science and Food Safety. 2021;20:1829–1856.**



## Food Flavoring Prepared with a Lemon Byproduct

Food loss/food waste totals a trillion dollars, and recent research shows minimal effort to redirect food waste/loss to improve the agri-food industry. Lemon peels are a solid by-product generated during lemon processing and are frequently discarded as agricultural

waste. In this research, we developed a value-added flavoring gel to use in food preparation, using lemon peels as the primary ingredient. The study evaluated opaque iota carrageenan as an effective thickening agent, with a 0.1% antioxidant as the most effective formulation for this product. The investigators created a small scale-up of three batches of varying size using thermal processing and the hot-fill-hold method. The resulting final product was analyzed for yield, pH, texture, and color. The findings of this study showed that lemon gel was thermally stable, safe, and high quality. **Journal of Food Processing and Preservation. Published March 26, 2021; doi: 10.1111/jfpp.15462.**

## Effects of Different Sweeteners on Wheat Starch Gelatinization and Cookie Baking

A variety of sucrose replacers (SRs) are increasing in popularity for reducing sucrose usage in low-moisture baked goods (cookies, biscuits, etc.). The goal of this study was to link SR physicochemical properties to their observed effects on starch thermal properties, including results from differential scanning calorimetry, rapid viscoanalysis, particle size analysis, and model wire-cut cookie baking performance. The 12 SRs examined in this study were Truvia, Splenda, Swerve, coconut palm sugar, monk fruit, erythritol, Benefiber, Miralax, blue agave syrup, yacon syrup, Sukrín Fiber Syrup Gold, and date syrup. The onset gelatinization temperature (T<sub>gel</sub>) of wheat starch increased significantly as sucrose and SR concentration increased (0 to 60% w/w), with significant variations in T<sub>gel</sub> found between different sweetener types at the same concentration. Generally, as solution concentration increased, the larger SRs decreased paste viscosity (peak and final), decreased granule swelling, and increased T<sub>gel</sub> compared with the control (water). The smaller SRs increased both

paste viscosity (peak and final) and granule swelling, unlike the larger SRs, and did not increase T<sub>gel</sub> as much as larger SRs. The SRs with similar performance to sucrose in model cookie baking and effects on starch properties were yacon, Sukrín, date syrups, and coconut palm sugar. The results linking sweetener physicochemical properties to their effects on starch gelatinization, pasting, and swelling can be used to guide reformulation strategies for potentially reducing sugar and/or increasing fiber content in foods. **Journal of Food Science. 2021;86:687–698.**





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