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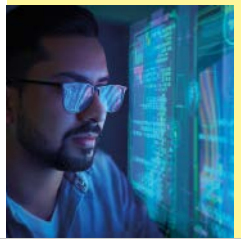

The food sector needs a specific approach to protecting critical information

BY ANDREA TOLU

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From The Editor

This is one of those rare times when there isn't much to say in the food industry, and I now understand the old joke: There's no news in good news. The food version is that there's no news in the headline "No One Got Sick Today." At the moment, our regulatory agencies are chugging along and industry is doing well. After the headlines of the pandemic's early days went from bad to worse, news of the pandemic is receding, and the infant formula shortages seem resolved. Egg prices have stabilized too.

Taking a step back, just a few short months ago the Silicon Valley bank failure reports loomed heavily over everything. Recession was a daily word. Now, they're not even mentioned anymore. Is this what they meant by the reports of a "soft landing" after the pandemic nightmare? There are plenty of jobs, inflation is lower than 3%, and there are even reports that wages are up. Even the Fed thinks we've dodged a recession. Smiley face emojis are making a comeback!

If there's anything negative to report, it's the weather. July 2023 will go into the record books as a really hot month, but I didn't react to that announcement. I preferred to keep basking in the glow of the good news bubble I was in. It's August and sweating every time you go outside is expected. Then I caught the words that finally burst my bubble, it's not just the hottest month here, or in the U.S., or this decade; it's the hottest month on record—ever—for the entire planet! The entire planet is too hot? That can't be good.

Vacationers report that the water at Miami Beach feels more like a hot tub. The water temperature in the Florida Keys hit 101°F. Soon, the coral reefs in Manatee Bay will die and "bleach out." Canada has wildfires instead of snow. This must be what climate change looks like; there won't be a big announcement or banners saying it's coming. Just step outside and you'll feel all the evidence you need.

The temperatures will drive up energy costs for manufacturers and cause severe weather that will be destructive to homes and facilities. More than anything, the temperature changes will negatively impact primary producers and produce growers. Water will be hoarded.

But, we'll deal with it, like we always do, just as we did during the pandemic. The food industry, like the entire U.S., is comprised of a pretty tough bunch and we'll figure it out.

For now, I'm staying inside to keep cool.

Patricia A. Wester
Executive Industry Editor

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NEWS & NOTES

FQ&S Wins APEX Award for Writing Excellence

Food Quality & Safety has received an APEX Award of Excellence for writing for the entire April/May 2022 issue. Read the award-winning issue on our website. The annual APEX Awards are given by Communication Concepts to recognize excellence in writing, digital content, graphic design, social media, public relations, and marketing. ■

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More than 40% of Foodborne Illness Outbreaks at Restaurants Related to Sick Workers, CDC Says

A new report published this week by the CDC found that more than 40% of foodborne illness outbreaks at retail food establishments were linked to ill or infectious food workers.

The report, published in the agency's *Morbidity and Mortality Weekly Report*, identified 800 outbreaks among 875 restaurants that occurred between 2017 and 2019 and were reported to the National Environmental Assessment Reporting System (NEARS) by state and local health departments. Norovirus and *Salmonella* were the most common pathogens associated with the outbreaks.

Although most managers interviewed said that their establishment had a policy requiring food workers to notify their supervisors when they were ill, these policies were often missing components intended to reduce the risk of foodborne illness. The investigators called for better enforcement of food safety policies such as handwashing and keeping sick staff from working.

The report authors said that food workers report numerous reasons for working when ill, such as loss of pay and perceived social pressure to not leave establishments under-staffed. NEARS data demonstrated that only approximately 44% of restaurants provided paid sick leave to their workers, which means that many staff were showing up ill or infectious.

Only 16% of restaurants assessed had policies that included the four recommendations of the FDA Food Code, including policies that require food workers to inform a manager when they are ill, specify all five symptoms workers need to tell a manager about, and restrict or exclude ill or infectious workers from work.

Read our cover feature, "From Shelf to Table," starting on page 20 for more on food safety challenges that the retail and foodservice sectors face. ■

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FDA Finalizes Limit for Inorganic Arsenic in Apple Juice

FDA has issued final guidance for the food industry entitled "Action Level for Inorganic Arsenic in Apple Juice." The final guidance identifies the action level of 10 parts per billion (ppb) for inorganic arsenic in apple juice, which was issued in draft by the agency 10 years ago, in 2013.

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Since the release of the draft guidance, the agency has identified some apple juice samples with inorganic arsenic levels higher than 10 ppb. FDA expects that the new action level, though nonbinding, will encourage manufacturers to reduce levels.

The agency will continue monitoring arsenic levels in the product and, if testing identifies levels higher than the limit it will consider this action level, in addition to other factors, to determine whether to take enforcement action. FDA says that, because lower arsenic levels are more protective of public health, it expects to revisit this action level as part of its "Closer to Zero" action plan. ■

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PFAS Levels in Food Pesticides "Potentially Dangerous": Report

BY KEITH LORIA

A new report released by the Center for Biological Diversity and Public Employees for Environmental Responsibility revealed that some of the most widely used food pesticides in California contain "potentially dangerous" levels of per- and polyfluoroalkyl substances (PFAS) These substances are a class of nearly 15,000 chemicals that are often used to make thousands of consumer products across dozens of industries. They get their nickname of "forever chemicals" because they do not naturally degrade.

The testing for the study was conducted by an independent, certified laboratory, and the results found PFAS in three out of seven agricultural pesticides tested. No PFAS were detected in concentrations above the detection limit in the two residential pesticide products that were tested. These results suggest that at least some of the identified PFAS contamination of agricultural products is coming from other unknown sources.

The study authors submitted the results to the Environmental Protection Agency (EPA) and the California Department of Pesticide Regulation and were accompanied by a letter requesting that these products be removed from use until the contamination can be addressed. The letter goes on to state that one result was "100,000 times higher than the allowed limits for drinking water." Statements such as this are often misleading; drinking water limits are set very low because they are based on daily consumption levels. Given how much water a human consumes, the daily limits set would be far lower than limits allowed in pesticides.

The toxicity of PFAS is not a new revelation. As far back as 1966, FDA rejected a petition from DuPont to use PFAS as a food additive, primarily due to animal studies indicating liver damage. However, the environmental and human health impacts of these chemicals have not been well researched. FDA began monitoring PFAS in food in 2019 and has detected them in some fruits and vegetables, but has not set any limits based on the low amount of data available.

A spokesperson for the International Fresh Produce Association noted that the science on PFAS is still developing, not just how it impacts produce, but also how it impacts items including cosmetics and nonstick cookware. Without more research on the topic, including studies on uptake levels for different commodities, any conclusions or regulatory responses right now are pure speculation.

To date, only a handful of European countries, including The Netherlands, Germany, Denmark, Sweden, and Norway, have taken steps to ban PFAS.

While most people are likely to have either consumed foods containing PFAS or used products made with the substances in the past, there is a need for a much better understanding of the causes of exposure within the food and agriculture industry. ■

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California Pushes Back Prop 12 Compliance Date

BY KEITH LORIA

In May, the Supreme Court ruled to uphold California's Proposition 12, a law that bans the sale of pork from hogs that don't meet certain production standards. Originally approved by the state's voters in 2018, the law calls for minimum space requirements based on square feet for breeding pigs—as well as veal calves and egg-laying hens—and prohibits the sale of meat and eggs from those animals when they are raised in a way that does not comply with the minimum requirements.

Prop 12 was originally due to go into effect on July 1, 2023; however, in June, Superior Court Judge James Arguelles modified his original order, granting temporary relief for noncompliant whole pork meat until December 31 of this year.

The National Pork Producers Council (NNPC) notes that this is not a delay of all of Proposition 12, but instead an adjustment related to the sale of whole pork meat.

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"This is an extension of time for the sale of non-compliant whole pork meat, provided that the meat is in the supply chain by July 1," an NNPC spokesperson tells *FQ&S*. "If it is in the supply chain by July 1, that product can be sold in California until December 31. Anything harvested after July 1, to be sold in California, will still have to be Proposition 12 compliant."

The reasoning for the adjustment had to do with economics. The state realized that if the change did not occur, consumers would most likely face increased food prices and a significant decrease in the amount of pork supplied to California.

"It is welcome news to America's pig farmers and consumers that California recognized the challenging situation the July 1 Proposition 12 implementation date will have on our industry and food supply," Bryan Humphreys, NNPC's CEO, said in a statement. ■

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FDA, FTC Issue Warning Letters to Companies Selling "Copycat" Food Products Containing Delta-8 THC

In early July, FDA and the Federal Trade Commission (FTC) issued warning letters to six companies for illegally selling copycat food products containing delta-8 tetrahydrocannabinol (delta-8 THC). The agencies say that these products can be mistaken for traditional foods such as chips, cookies, candy, gummies, or other snack food items. The warning letters were issued to: Delta Munchies, Dr. Smoke (also known as Dr. S) Exclusive Hemp Farms/Oshipt, Nikte's Wholesale, North Carolina Hemp Exchange, and The Haunted Vapor Room.

FDA is concerned that these products can be accidentally ingested by consumers, including children, or taken in higher doses than intended. "The products we are warning against intentionally mimic well-known snack food brands by using similar brand names, logos, or pictures on packaging that consumers, especially children, may confuse with traditional snack foods," said Janet Woodcock, MD, FDA's principal deputy commissioner, in a statement.

Delta-8 THC is a substance found in the cannabis sativa plant, of which marijuana and hemp are two varieties. It has psychoactive and intoxicating effects that may be dangerous to consumers and it has not been evaluated or approved by FDA for safe use in any context, including when added to food. FDA has received reports of serious adverse events experienced by people who have consumed these products, such as hallucinations, vomiting, tremor, anxiety, dizziness, confusion, and loss of consciousness. The agency is also concerned that companies are producing delta-8 THC in ways that could result in products with harmful contaminants.

In June 2022, FDA warned consumers about the consumption of food products the drug. As noted in the warning, the agency received more than 125 adverse event reports from January 1, 2021, through May 31, 2022, related to children and adults who consumed edible products containing it. Ten of the reports specifically mention the edible product to be a copycat of popular snack foods.

These warning letters outline violations of the Federal Food, Drug, and Cosmetic Act related to adding delta-8 THC to conventional foods. FDA has requested written responses from the companies that received warning letters stating how they will address these violations and prevent their recurrence.

USDA Approves Cultivated Chicken Products for Sale in U.S.

BY KEITH LORIA

Cell-cultivated chicken is officially part of the U.S. food system after a landmark approval by USDA's Food Safety and Inspection Service (FSIS) on June 21 that granted two companies the go-ahead to sell their lab-grown cell-cultivated chicken products in the United States.

USDA's Food Safety and Inspection Service (FSIS) issued grants to Upside Foods and Good Meat, which have both successfully completed FDA's pre-market consultation process for cell-cultured food products, and issued a grant of inspection to Joinn Biologics, a production facility affiliated with Good Meat.

"FSIS has issued the first three grants of inspection to establishments producing FSIS-regulated products derived from animal cells," a spokesperson for FSIS tells Food Quality & Safety. "FSIS has also reviewed and approved the labels for their products to ensure that they are truthful and not misleading. After an establishment receives a grant of inspection, FSIS conducts inspection activities at the facility at least once per shift to verify the production of safe and properly labeled product."

Both companies are planning to debut their products with celebrity chefs at popular restaurants in San Francisco and Washington, D.C.

In November 2022, Upside Foods received a "No Questions" letter from FDA signaling that its cultivated chicken was safe to eat, so this next step was expected. "USDA's approval of our label marks a major step forward toward our goal of creating a more humane and sustainable food system," Uma Valeti, CEO and founder of Upside Foods, said in a company statement.

COURTESY OF UPSIDE FOODS

Good Meat also received a "No Questions" letter from FDA earlier this year, paving the way for this announcement. Before USDA's decision, cultivated meat was only allowed for human consumption in Singapore, and was produced and sold by Good Meat. ■

Washington Report

Raw Milk Regulation

State bills that will loosen restrictions on the sale of raw milk have been appearing nationwide

BY **JESSE STANIFORTH**

Bill Marler, a lawyer with food safety firm Marler Clark, is quick to list the damage he's seen from pathogens in unpasteurized and unprocessed ("raw") milk. He cites an example in which one woman who contracted *Campylobacter* from raw milk developed Guillain-Barré syndrome, which paralyzed her for several years. There were children who consumed *E. coli* in raw milk and developed hemolytic uremic syndrome and acute kidney failure, requiring organ transplants. Others who contracted pathogenic infections from the product suffered strokes and brain injury, or had their large intestines removed. These cases continue to crop up: Marler cites a report from April 2023 documenting a raw milk-related *E. coli* outbreak in Tennessee that sickened two infants in 2022.

"These are not simple tummy aches," Marler says. "These can be devastating illnesses." There's a reason federal law bans the sale of raw milk across state lines, he stresses: "Raw milk was a leading cause of illnesses and deaths in the U.S. for decades."

Marler's opinion is not an outlier: CDC and FDA call unpasteurized milk one of the riskiest foods, and say that it can contain a variety of disease-causing pathogens.

New Legislation

In April, North Dakota passed a bill allowing farmers to sell raw milk direct to consumers—over protests from the Milk Producers Association of North Dakota, which believes that the bill will damage the industry and confuse consumers about the safety of milk products. This bill is one of a number of legislative actions intended to loosen rules that were restricting access to unpasteurized milk. In May, Iowa governor Kim Reynolds signed into law a bill allowing the sale of raw milk—provided it comes from a dairy of 10 or fewer cows, which are required to have annual veterinary checkups with monthly counts of bacteria in their milk. The law decrees such milk must be stored according to certain standards and sold within seven days of production and may only be sold directly from a "raw milk dairy."

Meanwhile, bills to loosen restrictions on raw milk have been tabled recently in Hawaii, Illinois, Minnesota, Mississippi, Oklahoma, and Rhode Island. The bills in Mississippi and Oklahoma died in committee and were vetoed, respectively; Rhode Island is recommending further study, and some have moved ahead toward becoming laws.

What these bills have in common, says Alex O'Brien, dairy safety and quality coordinator for the University of Wisconsin Center for Dairy Research in Madison, is "loosening the current restrictions and making raw milk more accessible. Otherwise [the bills] all differ in level of [con-

sumer] access, whether they require a cow share, the size of the farm that is allowed the exemption, and advertising (if it is legal or not), as well as labeling requirements."

O'Brien says there is a wave of regulation-loosening bills that are designed to either boost raw milk availability or legalize raw milk as a product in states where it was otherwise prohibited by law. "Alaska and Montana have legalized these sales in the past three years," he says, "and [in May] Iowa just legalized raw milk sales from total prohibition."

O'Brien is concerned about Montana—and other states that follow its lead—which limits its screening to "coliform testing results and only periodic pathogen testing of major pathogens like *Listeria monocytogenes*, *Salmonella spp*, and *E. coli* O157:H7."

"The trouble," O'Brien says, "is coliforms are just hygienic indicators, and some of the major pathogens are not even coliforms and won't show up on the tests. [In May 2023], Montana had a raw milk consumption advisory alert for *Coxiella burnetii*, which is not a routinely tested pathogen in finished dairy products. Other pathogens such as *Campylobacter* and a host of others are not routinely tested in finished [dairy] products, but are now open to cause outbreaks because these programs do not focus on these pathogens and only [screen for] the major pathogens."

The range of state approaches to raw milk is wide. Only New Jersey bans all raw milk products outright, while Florida, Indiana, and Maryland allow raw milk sales for pet food only. Farm-to-consumer sales of raw milk are legal in 18 states (including New York, Massachusetts, and Texas), while 12 states (including California, Pennsylvania, Washington, and Alaska) allow raw milk sales in retail stores. A further six states allow "herd shares," which means that consumers may procure raw milk directly from herds in which they purchase some interest.

Labeling

The labeling requirements alone, O'Brien says, reflect the enormous variability in state approaches to raw milk sales. Among the dozen states that allow retail sales of unpasteurized milk, each has different requirements. Michele T Jay-Russell, DVM, PhD, a researcher at the University of California Davis School of Veterinary Medicine, says that, in California, raw milk products are required to bear a warning label, but "you need a microscope to read it."

"Every state is different in terms of what it allows and what labeling is required," says Donald W. Schaffner, PhD, distinguished professor and chair of Rutgers' department of food science in New Brunswick, N.J. He notes that, in a recent survey of U.S. raw milk laws, there were "23 different instances where the word is used. Each time it is used to describe a different sort of label."

This means that, depending on the state, a label on raw milk products may simply declare the contents as such, may contain warning language, may declare them specifically to be "unpasteurized" with warning language, may specify potential health hazards, or may specify that raw milk is for pet food only.

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Legislation Variation

Dr. Schaffner sees the uptick in legislative loosening of raw milk regulations as complicated by the variety of different states' bills and their motivations. "As to why a particular state does or does not allow raw milk sales, that would be a question for the legislators who chose to vote in favor of some form of legalization," he says. "I suspect the reasons are as different as different individuals with different opinions. Some feel it's a matter of consumer choice. Others feel that it is the farmers right to sell such a product."

Advocates of the North Dakota bill described farm-to-gate raw milk sales as "a transaction between a willing buyer and a willing seller," and if that were always the case, Dr. Jay-Russell says she would be less concerned. While adults can be sickened by raw milk, she adds, "I don't think I would spend a huge amount of my time worrying about consenting adults going and getting some farm milk." The problem is the specific targeting of raw milk marketing at those consumers likeliest to be seriously sickened by it—children and the immunocompromised.

Rather than seeing them as growth toward settling the debate about unpasteurized milk, Dr. Jay-Russell says, Americans should understand recent legislative moves as part of more than a decade of a regulatory tug-of-war over the subject. "I think there's going to be this push back and forth continuously where they'll keep pushing for relaxed regulation," she says. "The problem with some of those bills is that there's no regulation."

She adds that these are the kinds of settings in which some bad outbreaks have occurred, even at farms with just three or four family cows. "We've seen kids get really, really sick," she adds, "so we'll have outbreaks, and [lawyers] and public health [officials] will push back, and that's how it's going to go in the United States."

Marler doesn't expect that the current liberal raw-milk legislation will remain in place forever, if only because these laws open producers to legal liability. ■

Staniforth is a freelance writer based in Montreal, Quebec, Canada. Reach him at jbstaniforth@gmail.com.

Legal Update

Label Claims

Federal agencies seek to revise food labeling rules

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

Claims on foods are ubiquitous, with almost every food now bearing at least one claim on its front packaging. Given the continued growth in the use of label claims, food regulatory agencies are revisiting the circumstances under which certain label claims can be used. FDA and USDA both recently announced efforts to review label claims, with the goal of increasing consumer trust in and reliance on label claims.

Front-of-Pack Nutrition Information

FDA is currently conducting a consumer study on the impact of front-of-pack nutrition labeling, with the goal of creating a standard front-of-pack labeling scheme for foods. Front-of-pack labeling is intended to provide consumers with high-level nutrient information to allow consumers to make quick decisions about which foods to purchase and consume. FDA's study will evaluate the effectiveness and usefulness of several proposed schemes. The study, and the anticipated future labeling scheme, are part of FDA's efforts to increase healthy eating, as directed by the White House.

Front-of-pack labeling schemes that currently exist on the market are not enforced by FDA, nor are these schemes expressly permitted by FDA regulations. Instead, FDA determined that the agency would exercise enforcement discretion as to companies that use certain industry standard front-of-pack labeling schemes. The Facts-up-Front Nutritional Panel is a good example.

Studies of consumer perception of food labels demonstrate that the vast majority of Americans are aware of front-of-pack nutrition labeling, and more than half of study participants stated that they do consider front-of-pack nutrition labeling when making purchase decisions.

FDA Dietary Guidance Claims

Dietary guidance statements are statements that state or imply a food may contribute to a particular diet pattern. FDA released a draft guidance detailing the agency's current thoughts on these types of statements. Though not binding, the guidance details the agency's considerations when determining whether a label is misleading. In the guidance, FDA states that dietary guidance statements are not nutrient content claims (and are therefore not subject to the regulations applicable to nutrient content claims). These state-

ments, however, must focus on the food or food group's contribution to or maintenance of a nutritious dietary pattern and cannot include references to or implications of disease risk reduction or treatment. Claims that a food or food group may serve to treat or prevent a disease would be considered impermissible health claims and would be subject to FDA's regulations and scrutiny.

Dietary guidance statements, however, should be based on consensus reporting endorsed by a group of experts that reflects the current thinking of the scientific community with regard to particular diet patterns. Companies can also rely on the dietary guidelines published by FDA and USDA as a consensus report to support a dietary guidance statement. Dietary guidance statements should reflect the key or principal recommendations provided in the consensus report. In addition, foods that bear a dietary guidance statement should meet nutrient limits identified by FDA.

"Product of the U.S.A." Claims

USDA FSIS current policies permit the use of "Made in the U.S.A." and "Product of the U.S.A." on meat and poultry products that are processed in the United States, regardless of where the animal was born, raised, or slaughtered. However, following petitions and studies to assess consumer understanding of these claims, FSIS has determined that this policy is misleading to consumers and does not align with consumer expectations. Therefore, FSIS has developed a proposed rule that would redefine the requirements for the use of these voluntary claims. Under the proposed rule, these claims could only be used on FSIS products where all FSIS-regulated components of the product are born, raised, slaughtered, and processed in the U.S., and any non-FSIS-regulated components (other than spices and flavors) are of U.S. origin. The proposed rule does not impact any required country-of-origin labeling.

In addition, qualified claims, such as "sliced and packaged in the United States from imported pork," would be permitted when truthful and not misleading. A description of the processing steps that occurred in the United States must be included in the qualified claim.

Animal Raising Claims

FSIS recently began an effort to evaluate and strengthen the approval and substantiation of animal raising claims. Animal raising claims include claims that state or imply that an animal was "humanely raised" or was antibiotic or hormone free. A 2019 labeling guidance issued by FSIS details the substantiation required to make animal raising claims; however, some advocacy organizations allege that FSIS does not consistently follow and enforce those requirements.

Claims that a food or food group may serve to treat or prevent a disease would be considered impermissible health claims and would be subject to FDA's regulations and scrutiny.

FSIS intends to issue an updated labeling guidance following the agency's evaluation. In addition, to specifically address "no antibiotics" claims, FSIS will conduct sampling to determine whether antibiotic residues are present in products bearing the claim. Currently, FSIS is requiring in-plant inspectors at establishments that slaughter cattle with "raised without antibiotics" claims to complete a questionnaire. The results from the questionnaire are then used to determine the appropriate sampling plan. In turn, the results from such sampling will dictate how FSIS moves forward in its efforts to reevaluate animal raising claims.

Safe Handling Instructions Requirements

FSIS regulations require that all raw and partially cooked meat and poultry products include federally mandated safe handling instructions on the product label. The specific text and formatting of the safe handling instructions are also defined by regulation, prohibiting companies from modifying the text or formatting of the instructions (9 CFR 381.125(b) and 9 CFR 317.2(l)).

Though these instructions have been required since 1994, FSIS conducted a study on the efficacy of the label in 2013. Following this study, the agency determined that FSIS should conduct consumer research and make changes to the required safe handling instructions. Since then, FSIS has conducted a number of consumer studies to evaluate possible revisions. Now, the agency has announced that it will be conducting consumer focus groups to evaluate safe handling label designs created in response to the learnings of the previous studies.

Consumer groups and other stakeholders have advocated consistently for updated safe handling labeling to ensure labeling requirements provide consumers with education and direction that reflects the changes in food safety science and best practices since the instructions were first adopted in 1994.

Organic Enforcement

USDA's Agricultural Marketing Service (AMS) is responsible for regulating the organic food industry. Recently, AMS published a final rule that strengthens oversight and enforcement of organic regulations. The rule is codified in 7 CFR Part 205 and will be implemented in March 2024. Once implemented, the rule will require additional businesses within the organic supply chain to be certified, improve and strengthen documentation requirements for organic products, and increase authority for inspections of certified operations. AMS developed this rule to respond to the possibility of organic fraud, where a product is sold and labeled as organic but was not, in fact, certified organic.

With a continual increase in claims made on food labels and an increased focus on consumer protection, regulatory agencies have committed to revisiting label claims that may require additional regulation or changes to existing regulations to improve compliance.

Stay tuned as these new approaches to labeling are refined and implemented by USDA and FDA. ■

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Allergen Control

Current GMPs for Controlling Food Allergens

Six cGMPs critical to control and prevention of undeclared food allergen residues

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

Editor's note: *This article is part one of a two-part series focused on the Preventive Controls for Human Foods Rule and the segments of that rule that relate to the control and prevention of undeclared food allergen residues. Here, we focus on cGMPs. Look for part two of this series, which will cover hazard analysis and risk-based preventive controls (HARP-C), in our December 2023/January 2024 issue.*

The recognition of the importance of undeclared food allergens as a public health issue has increased markedly over the past few decades.

Although the prevalence of food allergies in the U.S. is not precisely known, clinical surveys indicate that as many as 10% of Americans suffer from food allergies.

The nature and severity of symptoms vary among consumers with food allergies and are dependent to some degree on the dose of exposure. Although not common, fatal reactions can occur when the most highly sensitive of these consumers inadvertently ingest a sufficient dose of one of their allergenic foods. Consumers with food allergies are advised to completely avoid eating any foods that cause them to have allergic symptoms, so the presence of undeclared food allergens (allergic consumers tend to call them "hidden" allergens) is considered hazardous.

While allergic reactions to foods occur in homes and restaurants or other foodservice facilities, packaged foods have merited the most attention from regulatory authorities because the ingredient label on such foods should convey accurate

information about the components of the food products—critical information for a food-allergic consumer trying to adhere to a specific avoidance diet.

Undeclared food allergens have become a major reason for packaged food recalls in recent years. Consumers with food allergies and their caregivers are likely the most diligent label readers in the marketplace, as their health depends upon very careful selection of food products. For food-allergic consumers, the simple advice to avoid specific allergenic food(s) and ingredients derived from such food(s) can be quite challenging. Likewise, for the packaged food industry, the control of allergen residues in multi-use processing facilities also represents a challenge. In recent years, FDA and USDA's Food Safety and Inspection Service (FSIS) have promulgated regulations that have encouraged food manufacturing companies to develop and implement allergen control plans that reduce the risk to food-allergic consumers.

FDA Laws and Regulations

In the U.S., the first packaged food recalls for undeclared allergens occurred in the early 1990s, although packaged foods undoubtedly contained undeclared allergens with unknown frequency before that time. In 2004, the U.S. Congress passed the Food Allergen Labeling and Consumer Protection Act (FALCPA) which, for the first time, established a priority list of eight allergenic foods. The foods on the U.S. priority list are considered to be responsible for 90% or more of all food allergies. Other countries have also established priority allergen lists, although such lists are not identical around the world.

Very recently, the U.S. Congress passed a law requiring FDA to add sesame to the list of the priority allergenic foods effective in 2023 (see Table 1, p. 17, for the current list of priority allergenic foods). FALCPA also required food manufacturers to declare the presence of priority allergenic foods in plain English language, e.g. using the term "milk" rather than terms such as "casein" or "whey." This requirement is most commonly satisfied by use of a "Contains" statement adjacent to the ingredient listing on the package.

FALCPA also requires food processors to declare the source of any ingredient derived from priority allergenic sources. A provision in the law allows food manufacturers to obtain source labeling exemptions from FDA, although in practical terms, few source labeling exemptions have been approved. Source labeling exemptions do exist for highly refined oils and for raw agricultural commodities in their natural state.

In 2011, Congress passed the Food Safety Modernization Act (FSMA), which transformed the food safety system in the U.S. by shifting the focus from responding to foodborne illness complaints to taking steps to prevent foodborne illness. This preventive approach to food safety hazards had already been implemented to some degree in the U.S. through Hazard Analysis and Critical Control Points (HACCP). FSMA expanded that preventive focus. While much of the focus for FSMA was devoted to control and prevention of bacterial pathogens, FSMA also included food allergens within its scope. Since 2011, FDA has finalized nine major rules to implement FSMA.

> Dust can accumulate within the critical hygienic zone on surfaces that are not directly food-contact surfaces; these surfaces should be a focus of allergen cleaning operations.

The main focus of this article and the next one will be on the Preventive Controls for Human Foods Rule and the segments of that rule that relate to the control and prevention of undeclared food allergen residues.

Allergen Control Regulations

FDA has established a regulation entitled "Current Good Manufacturing Practices (cGMPs), Hazard Analysis, and Risk-Based Preventive Controls for Human Food" to implement FSMA. Food manufacturers must have a complete allergen management program that contains the three key elements of the regulation: cGMPs, hazard analysis, and risk-based preventive controls.

cGMPs

While cGMPs have existed for many years, they were updated by FDA in 2015 and again in 2022 to reflect the implementation of FSMA. They cover the entire range of food manufacturing activities and can be found in Title 21, Section 117 of the Code of Federal Regulations (CFR). Several cGMPs are primarily focused on the prevention of allergen cross contact within food manufacturing operations. In 21 CFR 117.3, allergen cross contact is defined as the unintentional incorporation of a food allergen into food. An undeclared food allergen resulting from allergen cross contact is viewed as a chemical hazard. Allergen cross contact can be prevented by implementation of selected cGMPs, showcased here.

1.Failure to provide employees with clean uniforms including gloves resulting in residues of allergen-containing product contaminating a product without allergens.

Among the best practices for prevention of this source of allergen cross contact is the use of color-coded uniforms associated with employees working in areas where uniforms are exposed to priority allergen residues. Selected employees who must work throughout a mixed-use facility such as maintenance workers can switch uniforms including gloves between allergen and non-allergen areas. Maintenance tools dedicated to use in priority allergen areas or a tool cleaning policy to minimize the potential for cross contact are other best practices.

2. Failure to design, locate, separate, or partition food manufacturing equipment in a manner that prevents or limits its allergen cross contact.

This provision can be especially challenging when implementing cGMPs for allergen management in manufacturing facilities that were not originally designed with such provisions in mind. The physical separation of equipment is critical, but allergen cross contact can also be prevented by effective use of partitions. The addition of partitions should be considered carefully to ensure that such additions do not inadvertently contribute to other food

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safety risks such as a microbial harborage point.

The control of employee traffic patterns is another best practice in such situations. The control of dusts and aerosols should also be considered. In our experience, when adjacent lines are running at typical speeds with typical product loads, allergen-containing dust does not often settle at rates that would allow the detection of residues in the adjacent product; however, in circumstances in which the adjacent line is idle for some reason, dust can accumulate and necessitate re-cleaning before commencing operation of the line. Also, dust can accumulate within the critical hygienic zone on surfaces that are not in direct contact with food; these surfaces should be a focus of allergen cleaning operations.

3. Failure to schedule the production of two different products appropriately, resulting in an allergen-containing product contaminating a product without food allergens.
Use of shared equipment of multiple SKUs is a fact of life in food manufacturing operations. A best practice in this type of scenario is the manufacture of the SKU with no or the least number of priority allergenic ingredients first, followed by a second SKU with perhaps one priority allergenic ingredient, and then another with that ingredient plus one more priority allergenic ingredient before stopping the line for allergen cleaning. Building upon the allergen profile of the products in this way can effectively control allergens while also minimizing the amount of time needed for allergen-level cleaning. When multiple processing lines are available within a facility, specific lines can be totally or partially dedicated to the most highly allergenic SKU while manufacturing of such SKUs on other lines is prohibited.

4. Failure to adequately clean between two different formulations of a product that do and do not contain allergens, resulting in an allergen-containing product contaminating a product without the allergen.
The cleaning of shared food manufacturing lines and facilities is of paramount importance. The goal should be to remove all detectable food allergen residues from food-contact surfaces and prevent them from coming into contact with the next product manufactured on the shared line. The development of SSOPs specific to individual processing lines and allergen-containing product formulations should be established and validated to be effective. For situations where the allergen residues are likely to be broadly distributed in the product formulation, the use of commercial allergen swabs is appropriate for the validation of the effectiveness of the SSOP. However, users must first ensure that the commercial swab is able to detect the form of the allergenic residue that exists in the product formulation. This can be done by testing the soiled equipment before cleaning but care must be taken because some allergen swabs can experience overload leading to false negative results. Other commercial swabs have overload lines that allow users to know if the load of allergen on the surface is too high. Particulate residues are especially important to remove because the particles can be large enough that ingestion of one particle could be sufficient to provoke an allergic reaction in the most sensitive individuals. Careful visual inspection of the cleaned line is the best approach to ensure that all particulates have been removed.

Utensils or containers used in the manufacturing operation must also be cleaned between formulations to prevent cross contact. A best practice involves the use of color-coded or otherwise labeled utensils and containers that are dedicated to specific allergenic ingredients or products.

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5. Failure to store allergen-containing ingredients separately from ingredients that do not contain allergens, where leakage of allergen-containing materials results in contamination of the non-allergen-containing product.
The storage of unprocessed ingredients is another critical component of a facility's allergen management program. Best practices include the establishment of specific bays or areas in the warehouse for ingredients containing different allergens, the sequestration of these allergen areas from areas in which ingredients with no priority allergens are stored, and the assurance that allergenic ingredients are never stored above ingredients having no priority allergens. A spill policy should also be established to promptly clean up any inadvertent spills of allergen-containing ingredients. Some food manufacturing companies have affixed icons or color-coded stickers to ingredients having different priority allergen-containing ingredients to allow easier identification in the warehouse. Such approaches are extremely useful for spotting misplaced ingredients.

The staging of ingredients is another common practice that is highly vulnerable to allergen cross contact. During staging, multiple containers of various ingredients may be placed in a location so that an employee has easy access to all of the ingredients that comprise the formulation. If partially used containers remain from such operations, they must be sealed shut to prevent cross contact from other ingredients. When such partially used containers are returned to the warehouse, a best practice is to store them together on a pallet labeled for use in the future with that same SKU. If the original label on the bag

or container is not visible when resealed, it is critical to affix a copy of the label or allergen information on the outer portion of the bags or containers to ensure this information is readily seen.

Incoming ingredients should also be visually inspected on arrival to ensure that no obvious cross contact has occurred at the supplier level. Cross checking the ingredient statement on the incoming bags or containers with internal records should also be conducted at this point to ensure the allergen profile aligns. Sometimes, testing of ingredients using commercial ELISA kits can also be a part of the allergen management program.

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

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

6. Failure to handle powdered allergens in a way that prevents particles from blowing onto foods or food contact surfaces for foods that do not contain that allergen.

Dust is probably overrated as a source of allergen cross contact as noted above, and can be very difficult and expensive to control in some facilities. Dust can settle onto idle processing lines and surfaces adjacent to food-contact areas, necessitating the need to cover open contact areas while they are idle or to re-clean these areas before resuming operations. Particulates tend to settle in close proximity to the line where they were generated. Cleaning operations can create concerns in certain situations. The use of compressed air hoses in dry cleaning must be restricted because the air can blow particulates quite far in certain settings. We have encountered the contamination of packaging film by water droplets when the packaging equipment was not properly shrouded during wet cleaning operations.

Additional cGMPs

Other cGMPs are also covered within 21 CFR 117. It is prudent to review this section of the CFR to ensure that your facility is managing all relevant cGMPs properly. Water reuse is an additional area that is not covered above, and the appropriate use of rework is another critical area that likely merits its own coverage in a future article in this series.

Part two of this series will cover hazard analysis and risk-based preventive controls (HARP-C). ■

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Q&A

Frank Yiannas on Traceability

FDA's former deputy commissioner of food policy and response talks to *Food Quality & Safety* about the importance of traceability initiatives in food safety

AS TOLD TO **PATRICIA A. WESTER**

Editor's note: *In the June/July 2023 issue of* FQ&S, *we talked to Frank Yiannas about the last 30 years of future of food safety, and what he envisions for the industry's future. Here, in part two of this series, he talks to us about traceability and some initiatives he started during his time at Walmart. This interview has been edited for length and clarity. For the full interview, visit foodqualityandsafety.com and look for our new video series,* ***"Leaders and Legends in Food Safety."***

Frank Yiannas, MPH, is FDA's former deputy commissioner for food policy and response, a position he held from in 2018 to 2023. Before joining FDA, Yiannas served in food safety leadership roles at Walmart and the Walt Disney Company, and as president of the International Association for Food Protection. He's authored two books, *Food Safety Culture* and *Food Safety = Behavior*.

Food Quality & Safety: **Food traceability is a massive undertaking. Tell us about FDA's Final Rule for Food Traceability.**

Frank Yiannas: Traceability is big initiative, but sometimes doing the right thing requires bold and large action, and sometimes doing the right thing isn't necessarily easy. There was always a provision of FSMA called Section 204. Congress told FDA to create additional recordkeeping for traceability purposes for certain foods. Congress never called them high-risk foods. In fact, in the final rule, FDA doesn't call them high-risk foods; people just started referring to them this way. But there were criteria around which foods should require the additional recordkeeping, and they were foods that were often involved in foodborne outbreaks.

If you're going to be in this profession and you want to lead change, you're going to have to have a little courage.

The Final Rule FDA issued last year will go into effect in January 2026. I would encourage everyone to become very familiar with the food traceability list. No. 1, find out if you're producing one of the foods the food traceability list, or whether you have a food that has an ingredient that's on the food traceability list. No. 2, read the rule in its entirety and understand the concepts of key data elements and critical tracking events in the traceability lock code. You need to understand the language that's evolving because it's a universal language to allow food traceability to happen at scale. No. 3, start benchmarking and talking to others, because some people are going to figure out how to do this more effectively and efficiently than others.

***FQ&S*: What are some challenges to compliance that you're hearing from industry?**

FY: The first one is that people want to comply in a way that doesn't require them to change what they're doing too significantly. It's difficult to change business processes and it's difficult to adopt new technology. Though the rule doesn't require technology, many companies want to use technology to comply with it. So, how can you comply with the rule without causing massive disruptions to your operations? It might be easier for some than they think it will be. If they're not really complying with consensus standards like PTI or if they're leveraging some of the GS1 offerings, they're probably well on their way to compliance and they don't require a lot of changes.

Another challenge that I'm hearing is that the rule, rightfully, requires traceability through point of service. One of the things we have found in outbreaks is that there tends to be a lot of finger pointing when it comes to food traceability. People like to say, it's the farmers; if the farmers could just get it right... And the farmers will say to me, if those darn retailers could just get it right... A major Achilles' heel has been not having good traceability records to point of sale, not knowing exactly what

was purchased or what was received at a retail grocery store, or not knowing with certainty what was received at a restaurant. When FDA and public health officials see these clusters, it's really hard to create that first link to be able to trace backward. So, the Final Rule does require traceability for the food traceability foods through point of sale. I'm hearing from retailers and restaurant chains that this is problematic because we don't scan cases at the back door in grocery stores or in a food service. Now, I'm an optimist: I think there are solutions that are going to emerge that are going to allow people to capture this information, whether they capture it with specificity at the D.C. level, knowing which stores are going to receive this product, or they capture it at the store or at the sea, but a unified low labor form of data capture is going to evolve. And that's why I encourage people to benchmark.

I think the third challenge is there is confusion about what foods are on the list. And if the food then ends up being an ingredient, does it require traceability? I don't think this will be that complicated, and that we'll figure out what foods are going to require it. If it's food that ends up in an ingredient that doesn't get a thermal process, that new food will still require traceability. But I don't think that'll be that complicated. But that's some of the early buzz that I'm hearing. But I think the labor challenges at retail food service are the biggest ones and that can be solved with innovation.

***FQ&S*: When you worked for Walmart, you tackled the supply chain. What challenges did you face?**

FY: Walmart was the world's largest retailer, with tens of thousands of suppliers. So, how do you reduce food safety risk early in the supply chain? When we started to ask what the gold standards of third-party audits are, we came across something that the Europeans were already utilizing—benchmark global food safety initiative (GFSI) standards. Some European retailers had come together to determine a gold standard and said, if you're a supplier to any one of us, if you get certified by one of these, you're going be recognized by all of us. We thought that was a pretty good, novel idea, and we became the first U.S. company of any significant size to start requiring food suppliers to meet one of the GFSI benchmark standards.

***FQ&S*: Did you take heat from suppliers for this?**

FY: I can remember sitting in my office and having some of the world's leading brands say they're not going do this. Fortunately, we had the support of senior leadership and the executives and CEOs at Walmart at the time, and we told this brand that we were serious. Little by little, hundreds, if not thousands, of suppliers had to make changes to meet these new standards and comply with the Walmart GFSI requirement.

Sometimes doing the right thing requires pushing against the social norm, pushing against what people are doing. On every major initiative that I've been privileged to be a part of, the teams I've worked with had to—to use Sam Walton's words—swim upstream. We had to push against the flow. GFSI wasn't popular. Food safety culture initially wasn't popular. Food traceability wasn't popular, but they're all the right things to do.

If you're going to be in this profession and you want to lead change, you're going to have to have a little courage. ■

From Shelf to Table

Food safety in the retail and foodservice sector

BY **KAREN APPOLD**

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These organizations often have stellar food safety programs which they try to implement uniformly across all of their operations. But challenges occur when inspectors on either side of a state line enforce different regulations, or when different jurisdictions interpret state food codes differently within a state.

—DONALD W. SCHAFFNER, PHD

No one entity can protect food safety on its own. In FSMA, FDA clearly stated that the role of industry is to produce safe foods. FDA's role is oversight in their jurisdiction, to ensure that industry is doing its job. Ensuring that food is safe requires a collaborative approach; government, industry, and consumers must work together to achieve the common goal of protecting public health. The fact that multiple agencies and inspectors have regulatory oversight over food safety at U.S. retail and foodservice establishments can create some definite challenges to achieving this goal, however.

At both the state and local levels, for example, health departments are responsible for inspecting and regulating foodservice establishments within their jurisdictions. At the federal level, FDA regulates food safety, including food processing, distribution, and labeling.

Furthermore, FDA's 2022 Food Code (10th edition) and The Voluntary National Retail Food Regulatory Program Standards is a framework for safeguarding public health and ensuring that consumers' food is unadulterated. USDA's Food Safety and Inspection Service (FSIS) inspects and regulates meat, poultry, and some egg products and plays a vital role in federal regulation. The CDC promotes food safety in retail environments.

Launched in 2000 by leading consumer goods companies, the Global Food Safety Initiative is a non-governmental global group organized after a number of food safety crises occurred. With the goal of reducing food safety risks and increasing consumer confidence in the delivery of safe food, these companies began requiring that manufacturers do more than the legal minimum required by the individual country of origin or destination, so they adapted an accredited certification model and a series of best practice standards applicable to their suppliers. "When retail and food establishments are required to follow different food safety regulations depending on their location, it can cause confusion, frustration, and loss of trust for operators and staff, which can ultimately result in unsafe food safety practices," says Melissa Vaccaro, a senior food safety program specialist at the National Environmental Health Association.

According to Donald W. Schaffner, PhD, professor, extension specialist, and chair of the department of food science at Rutgers University in New Brunswick, N.J., challenges are especially significant for national and regional retail and foodservice chains. "These organizations often have stellar food safety programs which they try to implement uniformly across all of their operations. But, challenges can occur when inspectors on either side of a state line enforce different regulations, or when different jurisdictions interpret state food codes differently within a state."

Every four years, FDA publishes a new version of the Food Code to ensure it's updated consistently to help jurisdictions adopt uniform food safety standards; however, many jurisdictions continue to use older versions because the timeframe to adopt a newer version can be long. In some cases it can take years, says Ashley Eisenbeiser, MS, senior director of food and product safety programs at FMI–The Food Industry Association, headquartered in Arlington, Va. In fact, one state, South Dakota, is still using the Food Code from 1995.

The variability and patchwork of Food Code adoption across the United States creates a significant challenge for retailers that have to know and comply with each jurisdiction's requirements in which they operate, Eisenbeiser adds. California is the only state that hasn't adopted any version of the Food Code, which is voluntary.

Although FSMA rules don't apply to retail food establishments, they do apply to most suppliers and manufacturers of food sold in stores, including the suppliers of ingredients and products used to prepare food in retail delis and fresh prepared departments in stores, Eisenbeiser says. Supplier programs play an important role in assuring food safety and that food is purchased from approved sources. FSMA includes a new Traceability Rule in section 204 that establishes additional traceability

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Understanding Agency Oversight

USDA and FDA are the two primary agencies that oversee food regulation in the U.S. USDA oversees meat, poultry, and some egg products, while FDA oversees almost everything else—roughly 80% of the U.S. food supply.

There are some peculiarities to the breakdown, however, including the fact that FDA regulates all seafood, except catfish, as well as whole eggs in the shell. USDA regulates egg products out of the shell, such as powdered and liquid eggs. In some instances, both agencies oversee the same facility if they manufacture vegetarian products and those with meat (e.g., cheese and pepperoni pizzas). Oversight can also depend on whether a sandwich is open- or closed-faced, and what percentage of meat it contains can shift who has jurisdiction over an operation.

While all of this can be confusing, issues can often be avoided by fostering good relationships with your local regulatory inspectors, Dr. Coffman says. Then, if a concern is identified, good communication lines will already be in place, which should expedite problem resolution.—KA

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recordkeeping requirements which will become effective January 20, 2026.

Best Practices to Overcome Challenges

Retail and foodservice establishments face ongoing challenges related to regulatory compliance with the Food Code. They include failure to have a strong hazard analysis (including identifying biological, chemical, and physical hazards); maintaining the highest standards of personal and facility hygiene, including strict handwashing practices; proper handling and labeling of allergens and avoiding allergen cross-contact; and proper temperature control of food items and monitoring temperatures during receiving, storage, preparation, cooking, and holding, says Tracy Fink, PCQI, director of scientific programs and science and policy initiatives at the Institute of Food Technologists in Chicago.

Fink advises maintaining a robust Hazard Analysis Critical Control Point (HACCP) system with a mindset toward preventive controls, even though they aren't universally mandated for all retail and foodservice establishments. "This system has been proven to be an effective approach to food safety and demonstrates a commitment to providing safe and high-quality food products to consumers," she says.

Fink also recommends conducting internal audits and working with external retail and foodservice auditing companies to conduct second-party audits to best protect consumers and public health.

Regarding hygiene, Vaccaro says poor personal hygiene is the root cause of norovirus, which is responsible for 58% of foodborne illnesses in the United States, according to CDC. Active managerial control, training, and accountability are key to ensuring that good hygiene is practiced within a food establishment's culture.

New allergens also pose challenges. On January 1, 2023, FDA named sesame as the ninth major food allergen recognized in the U.S. "Retail and food service establishments should now be aware of any ingredients that carry a potential risk of including this allergen," Dr. Schaffner says. "They should provide this information to customers by stating it on a product's label, including a notification on a menu, or through other means."

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The primary challenge is to ensure that food managers and employees use calibrated thermometers to take food temperatures after cooking, cooling, storage, or any other situations in which foods need temperature control. This should be a part of an establishment's food safety culture.

—MELISSA VACCARO

Temperature monitoring and holding time controls fall under the Food Code, and include but aren't limited to facilities and equipment. FDA's Current Good Manufacturing Practices for temperature control, and thermometer calibration programs are also applicable best practices, Fink says. Vaccaro adds, "The primary challenge is to ensure that food managers and employees use calibrated thermometers to take food temperatures after cooking, cooling, storage, or any other situations in which foods need temperature control. This should be a part of an establishment's food safety culture." Equally important is to develop and maintain Standard Operating Procedures for all aspects of food receiving, handling, preparation, storage, and service, including waste disposal.

Keeping Up With Regulations

To comply with the myriad regulatory requirements, Fink advises frequently checking the websites of regulatory agencies responsible for food safety in your region to obtain the latest updates on food safety regulations, recalls, and outbreak notifications. Sign up for email alerts or subscription services offered by regulatory agencies, as well as by health departments and food safety authorities. Consider joining industry associations and networks, which often provide members with information about industry best practices, regulatory changes, and emerging food safety issues. Additionally, it's imperative to collaborate with local health authorities and establish a positive relationship with regulatory officials in addition to following regulatory agencies on social media.

Have executive or C-suite buy-in for fostering a culture of food safety within an organization is another big area to manage alone. Senior level support can really help with budget development and training resources. "Create an environment that supports collaborating with local health authorities and industry associations to gain valuable insight and guidance on navigating compliance challenges," Fink says.

Recall notifications, market withdrawals, and safety alerts can be found at FDA's Recalls, Market Withdrawals, & Safety Alerts webpage; USDA's Recalls & Public Health Alerts webpage; and CDC's Foodborne Outbreaks webpage. Additionally, many government agencies and food safety organizations offer email or RSS subscription services that provide notifications about food recalls, outbreaks, and other food safety alerts, Fink says. Government agencies and news outlets often share food recall and outbreak information on their social media platforms.

Work with suppliers to ensure the quality and safety of ingredients entering your establishment. "Verify that suppliers meet food safety standards and request relevant documentation, such as a Certificates of Analysis," Fink adds, if that's applicable to the type of business involved.

Many organizations provide training programs, tools, and other resources to help retail and foodservice establishments stay compliant with regulations. Fink recommends that these establishments invest in comprehensive food safety training for both new and long-term staff and management. For example, the National Restaurant Association administers ServSafe, a food and beverage safety training and certification program that covers critical aspects of food safety and handling in the foodservice industry. It's accredited by the American National Standards Institute and the Conference for Food Protection, and has widespread recognition by the industry.

Stop Foodborne Illness has developed resources to help food establishments educate employees and advance their internal food safety culture. The organization's Alliance to Stop Foodborne Illness provides a free Food Safety Culture Toolkit with insights and resources for assessment, communication, and gamified learnings, says Vanessa Coffman, PhD, the progam's director at Stop Foodborne Illness in Chicago.

Current FDA Initiatives

FDA is embarking on some new programs to ensure food safety. In the third core element of its New Era of Smarter Food Safety initiative, New Business Models and Retail Modernization, FDA is working to address how to protect foods from contamination as new business models emerge and change to meet modern consumers' needs, according to an FDA spokesperson.

"The evolution of how food gets from farm to table continues with the emergence of e-commerce and new delivery models," an FDA spokesperson tells *Food Quality & Safety*. "Changes in how food is produced continue to occur as new business models advance innovations in novel ingredients, new foods, and new food production systems."

Regarding food sold at retail establishments directly to consumers, FDA is working with the Retail Food Safety Regulatory Association Collaborative to create tools and interventions to help regulators and industry implement science-based food safety laws and regulations, i.e., a Food Code adoption tool kit, and tools for industry to control risk factors for foodborne illness, i.e., use of Active Managerial Control and Food Safety Management Systems.

In October 2022, FDA and CDC entered into a memorandum of understanding (MOU) designed to reduce the incidence of foodborne illness in retail and foodservice. According to an FDA spokesperson, the MOU outlines three primary goals:

- Increase uniformity, consistency, and capacity of state, local, territorial, and tribal (SLTT) retail food protection programs;
- Promote the retail food store and restaurant industry's Active Managerial Control of foodborne illness risk factors and promote a culture of food safety; and
- Maintain a strong FDA National Retail Food Team and CDC National Center for Environmental Health workforce to assist SLTT retail food protection programs.

Since entering the MOU, FDA and CDC have established a steering committee with a dedicated charter to develop a strategic action plan by September 2023 and implement it by October 2023 that includes both short- and long-term initiatives. Some of the focus areas within the plan include:

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- Increasing focus on employee health practices and policies; SLTT regulators can provide training and tools to operators to help them create well developed and implemented employee health programs.
- Increasing SLTT retail food protection programs use of risk-based inspection methods and implementing environmental assessments during foodborne illness investigations.
- Achieving closer alignment to the national standard's criteria for Foodborne Illness and Food Defense Preparedness and Response documents; and
- Increasing the use of effective intervention strategies to reduce occurrences of out-of-compliance foodborne illness risk factors.

Food safety practices in the retail and foodservice space are of vital importance to protecting public health, and regulations and food safety culture at that level can reduce risks. "With many different regulatory requirements nationwide, it's important for retail food service facilities to know and understand the regulations that apply at each specific location," Vaccaro says. "The best rule of thumb is to always apply the strictest regulation to all establishments." ■

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The Redlegged Ham Beetle

This emerging threat to the pet food industry can cause big trouble

BY **IAN WILLIAMS, BCE**

The lesser-known redlegged ham beetle, also known as the copra beetle or ham beetle, can cause big issues in the pet food industry. These pests prefer to dwell in meat products with a high grease or fat content, making pet food highly favorable to the beetles.

The beetles are known to feed on—you guessed it—ham, but also other potential pet food ingredients such as dried bone meal, dried egg, and cured and dried meats. In the right conditions, females can lay up to 3,000 eggs, depositing them within the cracks and crevices of food items and surrounding areas. Food manufacturers are facing a growing problem as the prevalence of these metallic blue-green pests continues to increase. Without sufficient pest management strategies, a puppy's dinner may double as a beetle's habitat.

Not originally native to the United States, the redlegged ham beetle has recently been identified as a serious concern to food manufacturers. As the presence of this beetle is likely to continue to increase in the coming years, pest control providers are at the forefront in identifying, managing, and partnering with manufacturers to stay ahead of the curve.

Help Protect Your Facility

This pest can have serious financial implications in food warehouses and stores if infested items are transported from manufacturing plants. If you notice the following signs around your facility, you may be facing a redlegged ham beetle issue:

- Damage to food items and packaging;
- Live larva and adults; or
- White silken cocoons on infested food items.

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

Most food-handling businesses likely have heard of IPM programs, especially if they are regularly audited by food quality and safety inspectors. These programs are implemented by qualified pest control technicians in collaboration with a business's food safety and quality assurance team to help deter pest activity and prevent infestations. IPM programs focus on preventive techniques such as exclusion, sanitation, and maintenance to keep pests where they belong—outside of your business. When it comes to the increasing threat of the redlegged ham beetle, there are a variety of techniques that can help keep these pests at bay:

- **Proper inspection** of products are necessary to check for introductions, infestations, and potential harborage areas or areas that require cleaning;
- **Sanitation** is the most effective way a manufacturer can keep their products safe and untouched, so having a routine cleaning schedule of any cracks and crevices that may contain grease that draws beetles will help prevent introduced beetles from settling in;
- **Proper storage** of products including protective packaging and product rotation will help to preserve the integrity of the product;
- **Exclusion measures** such as installing screens on windows and ensuring doors shut properly and are equipped with door sweeps help keep products from being exposed to beetles; and
- **Insect pheromone monitoring devices**, which are also available to help with early detection and management of pests like redlegged ham beetles.

Infestation Prevention

In case of an infestation, it is important to quickly remove any infested items and ensure un-infested items are stored properly in protective packaging. Treating cracks and crevices near food resources with cleaning agents, probiotic treatments, and/or other special treatments are all

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Quality

The Nonalcoholic Beer Revolution

While the market for these products is on the rise, there are still challenges to overcome in the brewing process

BY **JESSE STANIFORTH**

The writing is on the wall for brewers: Consumers are drinking less alcohol than ever before. But this hasn't kept them from drinking beer—they're just drinking nonalcoholic (NA) offerings from both traditional brewers and smaller upstarts. In 2022 alone, sales of NA beers grew by 20%, and worldwide, NA beer had become a $22-billion industry—projected to reach $40 billion in the next decade, according to a 2023 report from Global Market Insights.

In a $750-billion global beer market, $40 billion might seem like a drop in the bucket, but it's a drop that major brewers are taking seriously. Among the most significant indicators of the market shift toward NA offerings is the news that brewing colossus AB InBev, owner of Budweiser and Corona as well as many other beers, aims to make 20% of its beers NA by 2025.

The Challenges

Despite a similarity in taste and texture between NA and traditionally brewed beer, the two products are made very differently. The challenge appears from the very beginning, says Richard Preiss, co-founder and lab director at Guelph, Ontario's Escarpment Labs, which cultivates and produces a variety of yeasts for both professional and home brewers. "The most important thing is going to sound pedantic," Preiss says, "but what makes regular beer different from nonalcoholic beer is alcohol. And we have to also consider what alcohol is. It doesn't just have intoxicating effects; it defines the product in every other way imaginable. Even if everything else was exactly the same on a molecular level, the fact that there's not alcohol changes the taste and everything else about the product, so it is really important. Alcohol is one of the flavors that brings these things all together. You take it away and the whole system is thrown out of balance."

Bryan Donaldson is brewing innovation manager for Petaluma, Calif.-based Lagunitas Brewing Company, which saw enough success as a craft brewer over past decades that Heineken ultimately bought a 50% stake in the company. He's blunt about the vacancy created by the absence of alcohol. "Turns out, alcohol is a great carrier of flavor," Donaldson says. "Without alcohol in the product, the challenge of replicating flavors becomes almost infinitely more difficult, but it also challenges you to become more creative."

Preiss agrees, saying, "Alcohol can make certain flavor molecules much more

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flavor-active to us. It can make other flavor molecules less active to us. In the context of regular beer, that is part of what creates the sort of standard flavor profile and quality. Alcohol is super critical from a flavor perspective. Immediately, if we take the alcohol out or don't produce it, we have some gaps we need to fill in."

Both Preiss and Donaldson underline the preservative, antimicrobial role that ethanol plays in regular beer; in its absence, brewers have been forced to figure out their own food safety protocols.

John Walker agrees. He is co-founder of Athletic Brewing Company, a brewery that produces only NA beers that has grown to command a significant share of the American NA market. As Athletic was developing its products, Walker says, there was no literature on food safety for NA beer. "So, we were trying to figure a lot of stuff out," he adds. An added challenge was the fact that with NA beer, because you need this microbially stable product, you lose out on a number of steps that you usually get to enjoy in normal brewing with ethanol as a preservative, such as adding fruit safely during or after fermentation, or dry hopping. "All these things that add complexity to the brewing process become either not doable or an extreme challenge in nonalcoholic," he says.

Brewing Without Alcohol

A primary challenge in brewing NA beer is simply learning how to create beer without alcohol; humans have brewed beer for more than 10,000 years, but only in recent years have brewers begun committing themselves to creating alcohol-free beer. Accordingly, brewers cannot simply brew NA products using the yeasts, tools, and processes they've developed for traditional beers.

Preiss identifies four main processes for brewing beer without alcohol. Two are technical alcohol-removal processes that dealcoholize beer originally containing alcohol, while two processes involve yeast and fermentation to produce beer with low alcohol content from the beginning. "There are really two subcategories of technology [to dealcoholization]," he says. "There's distillation, usually done through a vacuum distillation process so it's a little bit more gentle on the actual product in terms of flavor stability. And there's also membrane technology, basically reverse osmosis, to remove alcohol through high pressure and filters."

Each of these technologies requires significant investment in retooling, Preiss says. Whether for vacuum distillation or for membrane osmosis processes, Preiss warns that a brewery should be ready to spend "mid-six-figures." He advises brewers to "have really done your homework before you commit to that."

Meanwhile, says Walker, "If you have a process where you're removing alcohol or separating a finished product and then blending it back, you're going to have a whole different level of sophistication that you need to understand—how to make things consistent after they've been adulterated in the first place. So there's one challenge there."

Fermentation

The second method to produce NA beers involves fermentation alone, and it's broken down into two approaches: arrested fermentation, or fermentation with a maltose-negative yeast. Arrested fermentation is exactly what it sounds like: A brewer makes a standard beer wort, which is the liquid extracted from the mashing process during the brewing of beer, albeit lower-strength than a wort for regular beer. The brewer then allows it to ferment until it reaches the upper limit of 0.5% alcohol, which is the standard ceiling for NA beers across most places in North America.

At that point, the brewer stops fermentation by either dropping the temperature to stop fermentation, or deliberately killing or removing the yeast entirely. "One way or another, you basically have to stop the yeast before it makes more alcohol," he says, explaining that, while this process is simple, it also takes place fairly quickly (it can be done within four hours) and is popular with breweries that operate 24 hours a day, since there's always someone on hand to check hourly and stop fermentation the moment it approaches the critical 0.5% threshold.

"It's a great method," Preiss says, "but because you're not doing a complete fermentation, you don't get the complete flavor. So that's number one. And the other, the number two, is that you have fermentation intermediates that don't really get resolved until the end of a normal fermentation. One of the primary ones is called diacetyl: It tastes like butter popcorn. You have to use an enzyme that breaks it down. That's an enzyme that would never enter into the production of traditional beers."

The other fermentation method uses a yeast that is maltose-negative, meaning that it doesn't ferment the sugar maltose and therefore generates significantly less alcohol. "Maltose-negative yeast basically has the fundamental ability to make a beer with the desired parameters for non-alcoholic: being under half percent and tasting fermented and beer-like."

These yeasts don't ferment maltose and malt sugars—the vast majority of sugars that appear in unfermented beer wort. "If you add a yeast that doesn't ferment those [sugars]," Preiss says, "it'll only really touch the simple sugars like the glucose. Luckily for us in beer wort, if we make a low strength beer wort about half the strength of normal, and we add a negative yeast, it's really, really easy to have that recipe and process designed so that it's sort of set-it-and-forget-it. You don't have to babysit the batch. The yeast ferments the glucose and fructose and yields under 0.5%."

In many ways beyond beer, innovations are more troublesome because we don't have the same experience and, often, the equipment is not ideally suited to making things aside from beer. The fun of it all, for brewers like us, is to identify the challenges and figure out how to overcome them while still making something delicious.

—BRYAN DONALDSON

However, there's a challenge that comes with maltose-negative yeasts, Preiss says. They're not conventional yeasts that brewers are familiar with, and often they taste different than standard yeasts. "Most of the dozens of [maltose-negative] options that we screened just didn't taste good," Preiss says with laugh. "They had flavor, but they didn't have good flavor."

In short, this means that any brewer developing NA beers faces a challenge. For Walker ad Preiss, this called for a lot of trial and error. Preiss talks about how developing NA beers requires the commitment both of capital and creative energy, and Walker embodies the exertion of creative drive in developing NA products.

Trial and Error

At the beginning, Athletic Brewing was a two-person operation run by Walker and his partner Bill Shufelt. Walker recalls arriving and looking at the small brewing system Shufelt had procured for the company and reporting that the system was still far too large for R&D purposes. "I told Bill we needed to start off in home brew batches, which is five gallons at a time," Walker says, "because we needed to be able to crank out a ton of iterations of this process and development so that we could learn more about it, and split batches in three ways to see how different treatments reacted. It's all about trial-and-error R&D, paying close attention to the small tweaks you make at each step. Then, [it's] trying to hone that in on the process that will work and will make a great product."

Walker and Shufelt spent the beginning of Athletic Brewing creating test batches based on what Walker calls a "clean, neutral beer recipe" as a baseline for R&D. "We picked that brew to proof our process because we know it's very lean, it's very clean, it's very simple," Walker says. "We know exactly what the expression of the hops is going to be like. And so we knew that that beer would help showcase any flaws in our process."

The goal, above all, was to make NA beers that had the same appeal to consumers as traditional products, that drinkers would experience in much the same they would beers with alcohol. "We wanted to mimic and recreate the beer experience, but in that non-alcoholic format," Walker says. "So that comes in the mouth expression of the product—it's the minerality, it's the body, it's the mouthfeel, but it's also the marketing component: How do you make this product feel celebratory and positive? We looked at the traditional brewing process and started from ground zero with the target as the end experience."

Donaldson at Lagunitas says that "as brewers, we know what levers to pull with regard to flavor and composition; it is just slightly more difficult [with NA]. Ultimately, we are still making beer. That being said, we also always believe there is room for improvement, so every batch just about turns into R&D, with the caveat that it is all still saleable. In many ways beyond beer, innovations are more troublesome because we don't have the same experience and, often, the equipment is not ideally suited to making things aside from beer. The fun of it all, for brewers like us, is to identify the challenges and figure out how to overcome them while still making something delicious."

A Growing Market

For Preiss, the future of NA beers might well be full of new flavors—provided enterprising brewers do the work of exploring new maltose-negative yeasts and discovering their possibilities. While there is significant challenge in such R&D, Preiss notes that as more brewers begin offering NA options, new flavors offer crucial brand differentiation in a market growing saturated with NA hazy IPAs. "As that market develops, there's going to be a need for more differentiation," Preiss says. "Again, this comes down to recipe design and also branding and marketing. How does a brewery position a brand to be unique and have its own space in the market as well, so that it can be long lasting? We have to make sure that [NA beers are] a whole genre of beverage. There's a lot that can be done, but you have to think about long term: If I'm going to put this energy into developing this process and this brand, how do I make sure that this is actually going to pay off in the long run?"

The big breweries have developed NA lagers that Preiss acknowledges are "actually quite good," but he's happy to report that "there are holes left for market challengers to emerge."

Preiss says there are many opportunites left on the table and product gaps left in the market. He believes those gaps will be filled with new flavors from yeast collectors. A big part of the future of NA beers, he predicts, will involve advanced experimentation with new yeasts. "We haven't screened everything [in our yeast collection] either," Preiss says, "so there's likely potential for more flavor diversity. It becomes a big challenge to even uncover that in the first place. Maybe one strain is disgusting in normal wort, but with the right ingredients, it's not. Maybe the reason it tastes horrible is because we didn't give it great nutrients. In terms of fermented low-alcohol, non-alcoholic beverages, you actually have a pretty huge diversity of organisms that you can work with. You can also work with bacteria to make sour beverages. There's lots of potential."

Walker agrees, noting, "we've been very public about the fact that we're hoping that other people join this category, but they need to do it in a thoughtful way. We want this category to grow exponentially. And we think that it has the room and the ability to grow over the next couple of decades." ■

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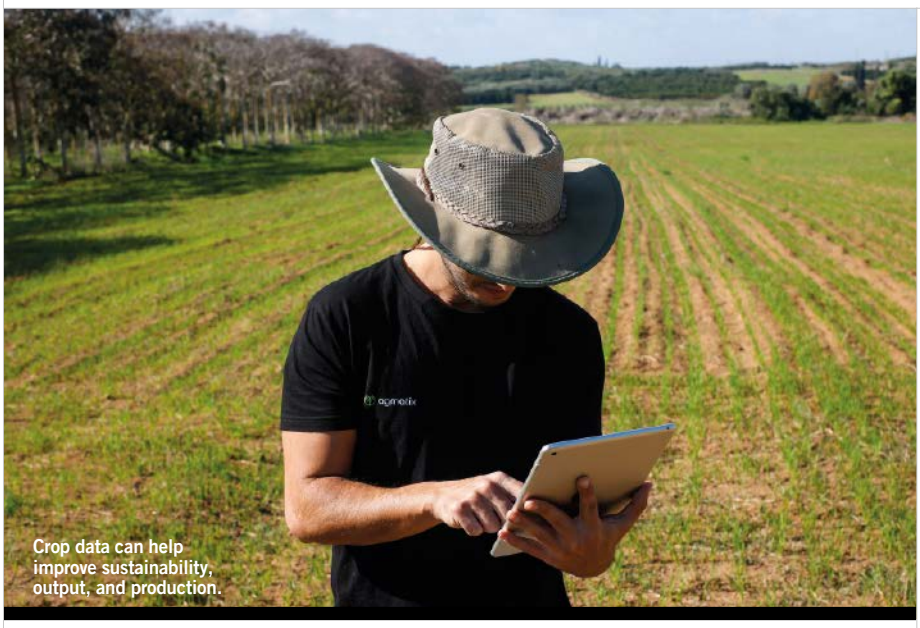

Crop data can help improve sustainability, output, and production.

Growing Smarter

Artificial intelligence and big data can help optimize the production process, starting in the field

BY **RON BARUCHI**

Over the past few decades, the food industry has boomed, prompting a remarkable transformation. In the past, consumers would visit their local grocers to purchase fresh fruits and vegetables, usually in a small store offering limited choices sourced from local farms. Today's consumers, however, have a huge variety of options, including multiple supermarkets in every town, online shopping, and even same-day delivery. Suppliers are now competing on a global scale in which stores receive produce from much further afield. This explosive growth in the food market has led to increased expectations among consumers, who now demand a wider variety of high-quality products, year round, at lower prices.

To meet these ever-evolving demands, the food industry has started to leverage the power of artificial intelligence (AI) and big data analytics to optimize every stage of the production process, starting with the growing of raw ingredients in the field.

For food manufacturers, the challenge lies in balancing these demands with the increasing costs of food production. As we have seen recently with inflating costs of food products and intermittent supply chain interruptions, this task can be incredibly challenging. If food producers are unable to keep up with the rising costs of energy and other inputs, it means that food production is no longer a viable business option. In countries like the UK, this challenge has led to a shortage of various ingredients, a scarcity first seen in eggs and then extending to a huge host of fruits and vegetables such as peppers, cucumbers, and raspberries. In the U.S., we have also seen food suppliers struggling with staving off viruses in products such as lettuce and oranges, efforts that, in turn, are creating a national and global shortage.

Crop Quality

The food supply value chain encompasses a vast network, stretching from selecting and planting the initial seeds to stocking the shelves of stores and supermarkets with finished products. Big data can now be harnessed right from the outset of food production, particularly during the crucial growing stage. These tools assist with fundamental tasks such as fertilization, irrigation, and crop disease management; however, the applications and benefits of this data go far beyond these underlying aspects, extending further along the production line, especially to the food manufacturing process, where crop quality becomes paramount.

Traditionally, food manufacturers have paid a fixed price per truckload of product, regardless of the quality of the load. Unfortunately, any issues related to quality often surface only during the manufacturing process, when the goods have already been received and paid for. For example, consider the case of pomegranates: Nutritional inputs during the growing stage of the fruit determine its acidity levels, which influence whether the pomegranate is suitable for juice production or for sale as a fresh fruit, showing the knock-on effect of agricultural practices on the food manufacturer, months down the line. This inconsistency in fruit quality poses a significant challenge for juice producers who strive to maintain a consistent product standard for consumers; not only is their supply of fruits for juice variable, but the flavor of the fruits can vary dramatically, producing inconsistent batches.

Similar variability can be observed in almonds, where properly fertilized trees yield almonds with superior oil qualities. Higher quality almonds offer better health benefits, as well as a longer shelf life, enabling producers to offer a healthier, longer-lasting product to their customers.

When a truckload of produce fails to meet a food manufacturer's quality criteria, it may have to be completely discarded. This results in substantial waste but, crucially for the food manufacturer, it means an uncertain output of their final product per truckload. In the event of large quantities of low-quality input ingredients, food manufacturers must pay for additional sorting to salvage the useable portions while covering the added cost of uncceptable product disposal. Lastly, they must make up the difference by finding last-minute additional produce, usually at a significantly higher price. Although rare, should manufacturers receive higher-quality, higher-yielding produce, they may need to source costly storage space to cope

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with the additional raw manterials and yield produced. These challenges have a direct impact on the bottom line for food manufacturers and lead to additional costs throughout the supply chain. For many players in the industry, this can lead to increasing product prices and risking their competitive advantage in the market.

Crop Data

To ensure consistently high output and minimize costs, it is imperative for food manufacturers to improve the quality of their input ingredients. Fortunately, a solution to the unpredictable nature of these ingredients lies in balanced crop health and nutrition. Leveraging the power of big data and AI enables growers to accurately calculate and tailor crop nutrient requirements to individual crop types and growing conditionss. Data such as rainfall, temperature, and soil type can be combined with fertilization and yield data specific to each crop variant. This comprehensive understanding of the individual crop's nutritional and management needs allows for local adjustments in growing protocols based on changing conditions. Digital solutions are now able to take into account local conditions such as soil and weather and adjust these growing protocols in real time to account for conditions in a specific location.

The next stage is to employ advanced AI algorithms to analyze this data, empowering food manufacturers to ensure that their growing practices are efficient, cost effective, productive, and sustainable. By providing personalized, real-time crop nutrition plans to their growers, food manufacturers can guarantee top-quality ingredients and predictable truckloads from their suppliers. This approach unlocks further environmental benefits by reducing waste and minimizing disruptions to production processes.

The potential benefits of leveraging crop data extend far beyond pomegranates and almonds. Agricultural technology (agtech) innovations offer the means to improve the production of numerous food products across the wider industry. These technologies play a pivotal role in making crop nutrition plans more advanced and accessible than ever before, providing essential decision support systems for both growers and food manufacturers. Where this information used to take years to produce, it can now be produced at the click of a button. As a result, innovation and improvement can occur faster, allowing a spiral effect of further innovation and improvement, facilitating long-term, measurable benefits across the food industry. By implementing these digital solutions at the field level, manufacturers can adopt a more vertically integrated role in the food supply value chain, ultimately leading to increased profitability.

The digital nature of these AI solutions also creates opportunities for extensive collaboration, enabling agronomic research on a global scale. Researchers can combine their data with a wealth of global knowledge on specific crop varieties, disease management, nutritional needs, and more. By pooling resources and expertise, stakeholders can collectively address industry-wide challenges.

Sustainability is a long-term concern. Globally, we know that food production accounts for a large portion of our carbon emissions; however, calculating this accurately is very difficult. Tracking these emissions on an individual basis is also difficult, but it's essential in order to improve the sustainability of food production at the field level and mitigate the impact of climate change. Recent developments in this area show promising progress, leading us toward more accurate and efficient carbon emission tracking in agriculture.

By implementing these digital solutions at the field level, manufacturers can adopt a more vertically integrated role in the food supply value chain, ultimately leading to increased profitability.

Data-Driven Strategies

Ultimately, technological advancements like these are instrumental in improving quality standards and sustainability, as well as enabling food manufacturers to meet consumer demands for high-quality products at competitive prices. With the rapid development of AI and the increasing prevalence of digital solutions throughout the food supply value chain, the positive impact on the wider food industry is evident.

By embracing data-driven strategies, food manufacturers can secure a quality crop and maximize their output. Additionally, they are enabling food manufacturers to track and improve carbon emissions associated with their product. The benefits of harnessing data extend beyond those involved in crop harvesting and have the potential to revolutionize the food industry. ■

Digital solutions at the field level can increase profitability.

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Testing

Mycotoxins: On the Rise

Climate changes and hightened demand for plant-based products contribute to the increase of this toxin

BY **WAYLON SHARP**

Mycotoxins are on the rise. These toxins can be found in everyday foods such as corn, wheat, soy, peas, and peanuts, and can cause acute and long-term health effects if ingested. Additionally, they are heat tolerant, meaning they can be present in foods that are processed and prepared under conventional temperatures (80°-121°C), affecting the finished product.

Mycotoxins impact a number of commodities including grains, produce, spices, alcohol, and coffee. They can even reach dairy products through secondary exposure from animal feed. Further, these toxins are resistant to decomposition and are not removed by traditional food safety measures such as cooking, washing, or sanitizing.

Not only do they impact humans, but they also put many pets at risk, as they affects core pet food ingredients. Testing pet food is especially important, because pets typically eat the same food every day, and their food is traditionally stored at room temperature and served at the floor level.

There are six major types of mycotoxins that are consistently detected in food and pose safety risks: aflatoxins, trichothecenes, zearalenone, fumonisins, ochratoxins, and patulin. The side effects vary from food poisoning to cancers and long-term health issues.

Why Are Mycotoxins on the Rise?

Rain creates a damp environment for mycotoxin growth. A recent study, published in late 2022 in the journal *Geophysical Research Letters* (doi: 10.1029/2022GL099955), concludes that climate change is causing more intense rainfall across the country. In tandem, an uptick in consumer demand has trickled down to manufacturers and farmers who, in adapting to deliver more sourcing materials, are extending the growing season. Farmers cannot wait for the dry conditions to balance the consumer demand, which has exacerbated the problem. This has created a perfect storm in which mycotoxins can thrive, resulting in more food safety concerns across the supply chain.

Dietary Habits Have a Direct Impact

Food is a circular economy: Consumer demand and dietary habits drive agriculture production, and so on. Dietary shifts toward alternative meats and vegan-based meals increase demand for raw materials such as soy and pea protein. A March 2022 report from Acosta, a research firm based in Jacksonville, Fla., concluded that 40% of consumers purchased plant-based meat and/or dairy products within the prior six months.

As a result, more farmers are expanding their crop offerings to support this trend. As consumer demand increases, processors need product more rapidly and, in some cases, farmers are harvesting prematurely, before their crops dry out. As this trend expands, producers will likely try to harvest in new areas that may be susceptible to mycotoxin production.

Food Testing Poised for Growth

Food testing is critical to verify that foods that are at a higher risk of containing mycotoxins are not reaching consumers. The goal is to get more testing upstream and catch mycotoxins early on. Domestic grain elevators present a strong testing location, as it consolidates supply across various suppliers. Inspectors at the beginning of the process they can scan shipping containers and conduct sampling for analysis at the source. The key is for food inspectors to be efficient, providing quick turnaround for customers. It's equally important that testing is accessible across all geographies, especially as farming areas expand and new crops are established.

Preventing Mycotoxins

There are things we can do today and in the futureto prevent the spread of mycotoxins and ensure food safety. In the short-term, strong testing practices and procedures must be put in place in food manufacturing plants to ensure that mycotoxins don't reach store shelves. Regulations are already in place to ensure that this occurs at manufacturing facilities. Farther up the chain, preventive measures can help reduce incidence. Certification and employee training comprise the first step, informing suitable areas to grow crops, seasonality, and best practices such as separating lots, depending on the crop. Armed with this knowledge, we can reduce the risk of mycotoxin exposure early in the process, as opposed to discovering contaminated foods at the end of the production cycle.

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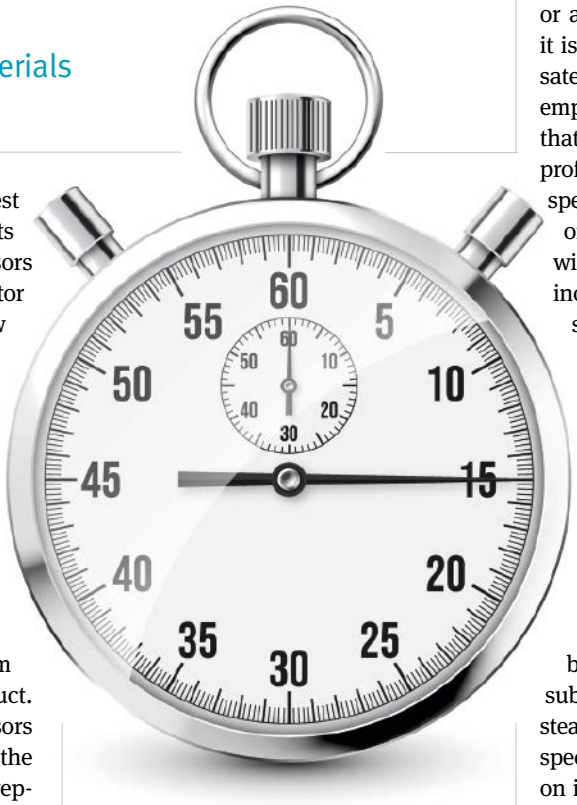
Bringing the Lab to You

The case for rapid testing of contaminants in raw materials

BY **PATRICIA JACKSON**



To ensure that only the best and safest food products reach consumers, processors constantly test and monitor contaminants in their inbound raw materials, which is not an easy feat. That's where high-sensitivity analysis and accurate data comes in, allowing decision makers at the quality management level to effectively screen raw materials to determine their suitability for use, and to ensure product value, safety, and compliance.

Proper screening ensures that contaminants don't exceed the maximum residue levels (MRLs) in the food product. Compliance risk aside, food processors want to put their brand name on only the highest quality food products. Brand reputation suffers when a product's quality does not line up with the brand promise stamped on its packaging. For example, "all natural" or "100% organic" claims may invite further scrutiny if it's revealed the food contains higher levels of contaminants. The impact can be far-reaching, leading to media attention, a loss of consumer trust, recalls, and costly litigation.

A New Way To Test for Residue

Processors know that early detection of contaminants, such as glyphosate and mycotoxins, within inbound products saves time and money; however, such testing historically requires sending samples to a qualified lab for analysis by liquid chromatography (LC), sometimes coupled with advanced detection using mass spectrometry (MS). It can take days or even weeks for the test results to come back from the lab.

Imagine this all-too-common experience for food and agricultural facilities: A supplier pulls up with a truckload of grain. You collect and send a sample of the grain off to a lab to be screened for mycotoxin or pesticide residue. In the meantime, the grain sits in storage, risking cross-contamination with other raw materials. While waiting for laboratory results to arrive, you are left wondering how much time—and money—you could save if you could screen the raw materials for contaminants before the supplier unloads or leaves the premises?

The good news is that on-site testing technologies are available that can produce precise results in minutes, not days or weeks. The aim of both a laboratory-based analytical technique, such as high-performance liquid chromatography (HPLC), and a rapid test is the same: to measure whether a sample contains certain compounds. That's where the similarities end. LC requires an accomplished laboratory technician to extract the target analyte from the sample and perform the analysis with an organic solvent according to a well-documented standard operating protocol (SOP).

Everyone is familiar with lateral test strips, the same format used with COVID-19 diagnostic test kits. Quantitative lateral flow strip tests can, in a matter of minutes, alert test users to the presence or absence of a specific target, whether it is SARS-CoV-2, mycotoxins, or glyphosate. Further, unlike LC, rapid test strips employ a water-based extraction method that any company owner, quality control professional, USDA or FDA licensed inspectors, or factory worker can perform on site. Administering on-site testing with lateral test strips is less costly and increasingly more sustainable given that samples never leave the site, which eliminates the packaging, shipping costs, and transportation emissions necessary to send samples to a lab for analysis.

The benefits of rapid on-site testing are that data-informed decisions can be made in the moment, allowing time for action and remediation. Processors can decide sooner whether to use a particular batch of raw materials or to source a substitute or replacement ingredient instead. Quality control managers can make specific plans for each raw material based on its quality. Operational efficiency improves and quality teams can have greater confidence in the quality of the inbound materials faster, eliminating the worry and uncertainty that attends untested inbound raw materials until they are confirmed clean. All of these are reasons to turn to rapid test methods at the food manufacturing facility.

Out of the Lab

Still, as with any new form of technology, some will remain hesitant or skeptical about implementing a new, unfamiliar way of testing. After all, results so important to their business and human safety cannot be left to chance.

Continuous learning is a proactive way to ensure ongoing success with any monitoring tool. Implementing rapid test methods outside of the lab is no exception. Annual retraining and simple procedure posters hung around the facility with QR codes that lead straight to full guides or step-by-step videos online help to improve the confidence of test operators and help to ensure consistent, accurate data

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In The Lab

PFAS Testing Regulations

Understanding these substances and how to test for them can help manufacturers get ahead of regulations and respond proactively to increasing consumer concerns

BY **CRAIG BUTT, PHD**

In the U.S. and Europe, food manufacturers are preparing for a number of new regulations that target per- and polyfluoroalkyl substances (PFAS), a class of "forever chemicals" that persist in the environment and can harm human health.

Testing for PFAS and tracing them through supply chains and life cycles is a daunting task, but labs are rising to the challenge. New techniques make it possible to identify more PFAS than ever before, with increasing sensitivity and confidence.

Food suppliers should take advantage of new gains in PFAS testing and take the time to understand the substances' occurence in supply chains. These actions can help suppliers get ahead of regulations and respond proactively to increasing consumer concerns.

A Brief History of PFAS

The first PFAS were created in the 1930s. These chemicals repel both oil and water and are used in everything from food packaging to firefighting foam, fracking liquid, and consumer products such as lipstick and electronics. Some studies have found that the chemicals can cause cancer, kidney disease, and immune problems, among other ailments, and can persist indefinitely in the environment.

The first and most studied PFAS, perfluorooctyl sulfonate (PFOS) and perfluorooctanoic acid (PFOA), have been mostly phased out from use, but they remain in the environment and in our food systems. In the meantime, thousands of other PFAS compounds have proliferated. For most, there is little toxicity data available and the risks are unknown.

Testing for and analyzing PFAS requires liquid chromatography-mass spectrometry (LC-MS) capabilities, which were not available in most labs until the early 2000s. A validated method for testing for PFAS in drinking water was first set by the U.S. Environmental Protection Agency (EPA) in 2009. Over the past few years, the EPA also began exploring methods for identifying dozens of PFAS in groundwater, biosolids, and the air.

In January 2023, the European Union proposed the most wide-reaching PFAS regulation yet; it would ban 10,000 PFAS chemicals from use in most products. Whatever shape the final EU regulation takes, this new ban and other similar ones have created a need for more extensive PFAS testing.

In March 2023, the EPA proposed nationwide, legally enforceable limits for six PFAS chemicals in drinking water, and it is currently exploring limits for 23 other PFAS that can be identified and monitored using existing tests. These new standards are much stricter than existing recommendations. Still, drinking water is just one piece of the problem. Food is also a major source of PFAS exposure.

How PFAS Can Enter the Food Supply

A March 2023 study published in the journal Environmental Research found PFAS in freshwater fish in rivers, lakes, and streams across the country (*Environ Res*. 2023;220:115165). The researchers concluded that catching and eating one fish could be as toxic as drinking contaminated water for a month. Other recent studies have flagged high levels of PFAS in imported clams, dairy milk, and a variety of seafood, with lower levels in just about everything else.

A 2017 study (*Enviro Sci Technol Lett*. 2017;4:105-111) concluded that food can become contaminated by the chemicals when it touches wrappers or "biodegradable" forks and bowls that are made with them; the study found that people who ate out more had higher levels of PFAS in their blood. As a result, 11 U.S. states have implemented bans on PFAS in food packaging, most of which will go into effect by 2025.

But packaging is only one pathway for food contamination; PFAS are also located in soil and groundwater as a result of industrial uses, in the landfills where consumer products wind up, and even in the air.

Even our best attempts at a sustainable, circular food system can increase PFAS exposure in food. Fertilizers made from biosolids reclaimed from sewage treatment plants were once lauded as a sustainable farming solution, but most of these biosolids were never tested for PFAS, and tainted sludge can contaminate fields for decades, harming both farmers and consumers.

Best Practices in Testing

These different sources of PFAS can create food safety risks. Because food can be contaminated directly through packaging or indirectly through environmental pathways, food suppliers will increasingly need to identify and address PFAS sources to update supply chains.

Most states with PFAS packaging bans have banned specific substances, which can be identified through targeted analysis. But some states, like California, have set limits for total organic fluorine as a proxy for thousands of other PFAS, including some that may not have been added on purpose. This requires a non-targeted approach and quick and robust testing, as PFAS detection begins to impact critical business decisions and more companies request tests. Mass spectrometers allow testing labs to detect very low levels of PFAS contamination. In addition, they are very selective, increasing confidence in the lab results and ensuring that they are not detecting a false positive.

To reduce the amount of PFAS entering supply chains indirectly, the Environmental Defense Fund recommends that companies test proactively. The organization suggests prioritizing testing first for food grown near known sites of high

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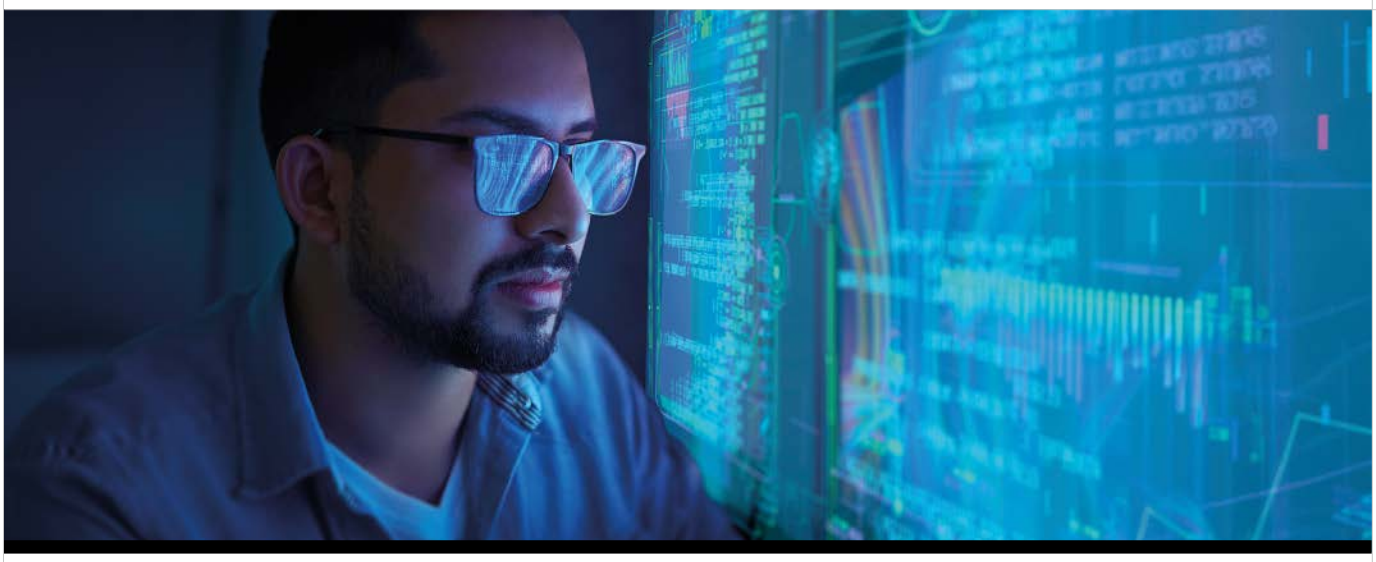

Cybersecurity in the Food Industry

The food sector needs a specific approach to protecting critical information

BY **ANDREA TOLU**

According to data from the Food and Agriculture Information Sharing and Analysis Center on the 200 to 300 ransomware attacks tracked each month in the U.S., approximately 10 to 20 are directed at agrifood businesses. The most famous case in recent years was the attack on JBS in May 2021, which resulted in an $11 million ransom payment after the meat giant had to close all of its beef plants across the country.

Even when no ransom is paid, the consequences of a cyberattack include high direct costs, disruptions up and down the supply chain, and damaged brand reputation, with the possible addition of theft of trade secrets and legal consequences. In April 2023, a network breach forced cold storage and logistics company Americold to take compromised servers offline, blocking all inbound and outbound deliveries. "With an attack like the one that hit Americold, you'll have damages on both sides of the equation," says Michael Delaney, corporate attorney at legal firm Bryan Cave Leighton Paisner, based in St. Louis. "The manufacturer will have to either stop production because they don't have enough storage space at the plant, or find an alternative distributor. On the other side, the distributor cannot get the product out to the retailer. The manufacturer may sue the distributor, while the retailer may sue both, if they breached the contract."

Although most cases of cyberattacks that we read about on the news affect large public companies, smaller businesses are not exempt from risk. In an FBI notification issued in September 2021, the agency warned that larger agrifood businesses "are targeted based on their perceived ability to pay higher ransom demands, while smaller entities may be seen as soft targets."

Food Safety Risks

Ransomware attacks tend to hit IT environments, which focus on data storage and communication. For food manufacturers, however, the risk extends to the operational technology side of the business that controls production. In a hypothetical attack, cybercriminals could exploit the vulnerability of industrial control systems (ICS)—the hardware and software that control equipment and processes—finding their way to the production floor and putting the quality and safety of food products at risk. "ICS systems control all sorts of devices, such as temperature sensors, gate valves, or automatic sampling systems," says Col. John Hoffman, senior research fellow with the Food Protection and Defense Institute at the University of Minnesota in St. Paul. "By taking control of them, one could increase the temperature of an oven, shut down a refrigerator, or change parameters of a recipe, possibly adding an unwanted allergen."

Most ICS systems used in the food industry are built on legacy technology that wasn't designed to be connected to the internet. Now that they are plugged in

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for data collection and remote monitoring and servicing, their lack of protection is putting production plants at risk. Their gradual replacement with modern IoT devices might actually create new vulnerabilities, rather than reduce them. "Smart devices that send and receive data over the internet tend to bypass a lot of the security measures—such as firewalls—that protect both modern and legacy systems, exposing them to attacks," says Rich Witucki, principal industrial consultant at industrial cybersecurity company Dragos.

As Eran Fine, CEO and co-founder of NanoLock, an Israel-based developer of cybersecurity solutions for industrial systems, says, connectivity itself is a variable that increases risk: "Hybrid systems are not necessarily more secure, but create different problems. While legacy technology is extremely vulnerable, it's also less connected. IoT devices bring about more connectivity. They may be harder to breach, but once that happens, intruders may jump from the legacy into the new and vice versa."

Even a single act of sabotage could have disastrous consequences. In 2015, 300,000 chickens in South Carolina were killed after someone tampered with the barn's climate controls. In 2018, 1,200 pigs died of suffocation in an automated barn in the Netherlands, due to a malfunction of the remotely-controlled ventilation system. Although neither case was a cyberattack, as the industry is relying more on remotely controlled equipment, autonomous tractors, and smart sensors, the risk of something similar being done by cybercriminals is real.

Cyberattacks may start long before they are discovered: "Cybercriminals usually do some kind of recon first, looking for vulnerable targets," says Witucki. "Once they're in, they try to elevate their user privileges so they can exploit other pieces of software. For example, they might move from the enterprise resource planning (ERP) to the manufacturing execution system (MES), to the supervisory control and data acquisition (SCADA) system, which monitors and controls all phases of food preparation, such as recipes, time, and temperature."

In most cases, what allows the intrusion is human error: "Employees are the biggest vulnerability," says Hoffman. "They may compromise their home computer and then use it to log into the company's system to clock in work hours or check their email on their work computer and click on something they shouldn't click on. Insufficient cyber hygiene is a big issue."

National Security

Ransomware cases are increasing across all industries, as they are a quick and effective way to make money. But a criminal's motive can be more than purely financial: "Companies sometimes are targeted by competitive moves," says Hoffman. "Imagine a supplier that won a bid for a large contract, and a competitor breaks into its ICS to compromise the quality and safety of products. The company wouldn't be able to comply with its obligations, eventually losing the contract. These attacks occur especially in China and Asian markets, but we're beginning to see them in the U.S. and Europe, too."

The breach can also be caused by insiders: "A criminal might pay a disgruntled employee one year's worth of salary just to plug a USB stick into the system during a night shift, to change the ingredients' dosage and cause severe quality issues," says Fine.

But motives could be even more worrying. The Cybersecurity and Infrastructure Security Agency (CISA) identified food and agriculture as one of the 16 sectors that are critical to the country's security, health, and safety. Such strategic importance makes the industry an appealing target of state-sponsored cyberattacks: "If you wanted to take out a country, the first thing you would do is contaminate their food and water," says Kristin Demoranville, CEO and founder of AnzenSage, a cybersecurity advisory consultancy for the food sector. "Thankfully, right now, cybercriminals are financially motivated, so they're not going to kill anybody, at least not intentionally. But if they decide to flip the switch, the food supply chain is still so legacy driven that it could have horrible consequences."

Recent attacks on producers of staple foods offer a glimpse of what could happen on a larger scale. In 2021, an Iowa farming co-op had to go completely offline and use manual processes after being hit by a ransomware; in 2022, a similar attack forced H.P. Hood Dairy to close its 13 plants; in 2023, a cyberattack shut down 10 water controllers in agricultural areas in Israel, temporarily halting the irrigation systems. "A synchronized cyberattack that completely disrupts the supply of water, bread, or milk could bring a country to its knees," says Fine. "Besides, food is necessary not only for consumers, but also to armies. And when you starve an army, you're in a better position to win."

Risk Aversion in the Food Industry

The increasing attacks on agrifood businesses are a signal that the response to these threats is still insufficient: "In the food industry, cybersecurity is usually considered of secondary importance compared to production uptime and safety," says Demoranville. "With food contaminations, the reaction is instant and visceral, because it's clear to everyone that people might die. The same goes for cyberattacks, but people don't understand it yet."

"Many companies have an 'if it ain't broke, don't fix it' mentality," says Hoffman. "The legacy operating systems they've been using for years still work fine, and they like the convenience of connectivity, so they decide to keep them without segregating them into a separate network."

One symptom of insufficient cybersecurity culture is lack of alignment within organizations: "Cybersecurity officers and production managers speak different languages," says Fine. "While one will want to implement stronger passwords and multifactor authentication, the other needs to keep up with the production schedule and might see those measures as a waste of time."

The risk of such a siloed mentality is to leave large portions of a company's network unprotected: "Devices such as electronic door locks, security cameras, and door security systems aren't part of a food production line, but are usually connected to the network," says Hoffman. "A lot of companies don't realize that those devices are exposed too: Bad guys could get into the camera's firmware, and from there to more critical items."

Fine believes the food sector needs a specific approach to cybersecurity: "Food manufacturing is not like a bank, which is very structured and allows you to control who gets in and who stays out. It's a

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Food Quality & Safety
FARM TO FORK SAFETY

New Technology and Connectivity Software

New software can assist challegens in food manufacturing

BY **CODY P. BANN**

Manufacturing is being squeezed by labor and skills shortages. The numbers of people older than 55 in the technical workforce in the U.S. are increasing, signifying that not enough young employees are not replacing older ones. Meanwhile, technical demands for manufacturing have grown, making it difficult to hire the right workers. These companies need workers with the same skills as the workers who are currently retiring. For the most part, these are highly skilled people who have gained their expertise over 25 to 30 years.

The latest report released by Deloitte and the Manufacturing Institute predicts that as many as 2.1 million manufacturing jobs could be unfilled through 2030. The report warns that the worker shortage will hurt revenue and production, and could ultimately cost the US economy up to $1 trillion by 2030.

With these looming statistics, manufacturers face enormous pressures to stay competitive. But it's not all doom and gloom: To combat these labor challenges, manufacturers are increasingly looking to technology and connectivity to expand productivity, decrease labor costs, increase uptime, and slash error rates.

Increased Plant Automation

Automation helps manufacturers reduce errors and costs while increasing productivity, quality and safety standards. With the increased data coming from the production line, it's now much easier to determine ways to improve efficiency and productivity and reduce error rates. Through an increased use of sensors and the Industrial Internet of Things (IIoT), machines can talk to each other and seamlessly react to any problems that arise. If a machine spots an issue, it can quickly alert other machines and employees, allowing the issue to be addressed in real time.

Using smart machines that can communicate with each other means that full traceability and transparency are possible across the entire food manufacturing value chain. That capability, in turn, reinforces food safety and helps a business meet regulatory needs in the most efficient manner.

Sensors and SCADA

Adding technology such as sensors that monitor whether a machine is working properly instead of having someone check out a problem is an ideal solution for areas with worker shortages.

Sensors pick up on performance aberrations that simply can't be detected through manual spot checks and personnel monitoring. By detecting the underpinnings of potential issues in real time, sensors can alert maintenance teams of the need to investigate and prevent a machine failure before it happens.

Supervisory control and data acquisition (SCADA) is a system of hardware and software elements used to control processes both locally and remotely. Such sys-

Case Study: Night Hawk Frozen Foods

Austin, Texas-based Night Hawk Frozen Foods quickly adapted to meet the growing frozen food consumption during the pandemic. The company implemented a full-scale expansion, which included a new engine room with added compressors to support the increased production.

Night Hawk has a state-of-the art refrigeration system with a large cooler and freezer rooms that keep products at precise temperatures. To help reduce maintenance expenses and ensure minimal unplanned equipment downtime, the refrigeration maintenance crew uses Wonderware InTouch software to oversee and manage their control systems hardware. Integrated with this SCADA system is remote alarm notification software to continuously monitor the alarms and provide important security updates on the entire refrigeration system. This configuration allows a maintenance technician or engineer to easily see the refrigeration equipment inflows and outflows status via remote view from the main office computers to closely watch temperatures, ammonium levels, and other critical metrics.

When a monitored change occurs, an alarm notification immediately comes through, notifying the crew through email and SMS. Having this information available at a moment's notice is key. Subtle changes can have serious impacts on inventory or crew safety if left unattended. Having access to remote alarm notifications enables the company's refrigeration crew to respond faster to maintenance requirements and keep the supply line set at optimal levels. The longer it takes plant personnel to respond and repair equipment, the more damaging the interruption will be.

Night Hawk successfully increased overall production by 50% percent using their current control systems and advanced supply chain practices. The remote alarm notification software played an important role in empowering the company to effectively scale up along with consumer and operational demands, while reducing unplanned downtime.

tems are crucial for organizations as they help maintain efficiency, process data for more well-informed decisions and communicate system issues to help mitigate loss and downtime. SCADA systems perform data acquisition and communication, information and data presentation, and monitoring and control.

These functions are performed by sensors, controllers, and a communication network. The sensors collect and send the information to the controller, which displays the status of the system. The operator can then give commands to the components of the system, depending on the status. SCADA systems allow communication between the operator and the connected devices. Real-time systems have thousands of components and sensors; each gathers data and helps ensure that every part of a facility is running effectively. The real-time applications can also be controlled remotely. Access to real-time information allows entities to make data-driven decisions about how to improve processes. Without SCADA, it would be difficult to gather sufficient data for consistently well-informed decisions.

Remote Monitoring

Another way to reduce unplanned downtime is with remote alarm notification software, which allows fewer employees to monitor many more assets using devices that people already have, such as smartphones and tablets. Uninterrupted remote availability is essential to ensuring systems can be continuously monitored, even without staff onsite or with fewer people working at the facility.

Remote monitoring of critical plant systems has been extended beyond email, texts, and phone calls to include apps that feature time-saving tools like real-time alarm acknowledgements, team chats to troubleshoot and resolve plant problems, and detailed reporting for preventing future incidents. Not only does this mean fewer emergency shutdowns, but it also means fewer resources are spent on overtime and maintenance.

A mobile alarm notification app is software that seamlessly integrates with the SCADA or HMI software of an industrial operation, allowing an employee to monitor, receive and acknowledge plant and machine alarms on their smartphone or tablet, freeing them up to work from home or any other remote location. Hardware and software are available that can constantly monitor equipment and, by applying machine learning to historical data, warn when a breakdown or other problem is imminent. Bolstered by wireless technology and IIoT, these customizable systems have the potential to bring predictive maintenance to a new level.

The benefits of using a remote monitoring and notification software system via a mobile app include:

- **Streamlining decision making.** Push notifications let users quickly see what is wrong, send an acknowledgment, and monitor alarm condition changes in real-time, right from smartphones.
- **Promoting team problem solving.** Chat helps the entire team converse, brainstorm, and share solutions on the fly, from anywhere—whether in the plant, at home, or on the road.
- **Working more efficiently.** Team visibility shows who has seen an alarm as well as who has acknowledged it, reducing guesswork and redundant responses.
- **Providing multiple communication channel support.** Ensures resiliency through voice notification and SMS messaging in the event of internet connectivity issues.

Remaining Competitive

Rapid globalization, technological advancements, changing consumer preferences, and evolving government policies are reshaping the manufacturing industry. Trying to meet these challenges with manually intensive processes and outdated technology is difficult; however, by seamlessly integrating advanced technology such as remote alarm notification software, manufacturers can increase productivity and efficiency, and reduce maintenance costs. ■

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Cybersecurity in the Food Industry *(Continued from p. 34)*

high-traffic and chaotic environment, where hundreds of people can influence production. Floor staff, but also visitors and vendors, may—knowingly or unknowingly—bring malware in when they connect to your equipment. Trying to outsmart the bad guys is futile: They have enough time, resources, and motivation to find the vulnerability. What we see companies do is try to detect attacks, while what they should really do is prevent and protect and realize that cyberattacks can come from any direction."

If attacks can come from anywhere, the best defense, says Witucki, "is a layered structure, with firewalls in front of the legacy devices, network monitoring, and regular backups, so if somebody exploits a vulnerability to attack your system, you could get back up to speed relatively quickly. Also, you should have an incident response plan specific to ICS, so you would know what to during an emergency."

When responding to an attack, it's also important to address all possible legal implications: "You should immediately check the contracts and purchase orders with your customers to see if you are under obligation to report the incident to them and if you have any liability. The next step is to check if you have any insurance coverage," says Delaney.

For Demoranville, the change to increased security must come from the top: "The executive level and the board need to agree that cybersecurity is a priority," she says. "If that doesn't happen, anything that gets done will be disbanded quickly. More companies should set up a strong change management board where representatives from all departments, including production and quality, meet once a week to discuss what's happening in their environment. Ultimately, you can save lives and money if you do that properly."

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The Redlegged Ham Beetle *(Continued from p. 24)*

ways to immediately reduce populations and help ensure they don't have easy places to return to. In cases of extreme infestation, more aggressive pest treatments such as fumigation may be necessary.

Investing in a staff training plan to teach your employees how to spot signs of pests is also an effective way to prevent infestation on the front end. Your employees—mainly those on the production floor of your facility—see and hear more than you might know, which makes them invaluable in helping to identify pest issues. Trained staff, paired with an effective monitoring program, helps ensure that beetles are found quickly. Most pest control providers offer complimentary staff training, making this tactic cost-effective for your operations. Once your staff know the types of pests that frequent your facility, persistent hot spots, and the process for reporting activity, they'll be able to help you address pest issues quickly and effectively.

Make a Plan

Now that you understand the threat of this beetle and ways to help prevent and control an infestation, don't forget to review your unique IPM plan with your pest control provider. As the prevalence of this pest continues to grow, your pest control provider should stay informed, monitoring your facility year-round to ensure quality and cleanliness. If you don't have a relieable pest control provider or an IPM program in place, now's the time to implement a plan before this pest becomes a costly issue. Redlegged ham beetles pose a growing threat to pet food manufacturers around the world, and staying on top of the issue will help keep your products and facilities pest free. ■

Williams is a technical services manager for Rollins.

Mycotoxins: On the Rise *(Continued from p. 30)*

As the current workforce ages, it's important to upskill existing employees and keep them abreast of the latest food safety standards and best practices. Continue to train all employees involved in the process to avoid loss of this knowledge.

Ultimately, we can all be better stewards to our planet to slow climate change, avoid extreme weather, and create stability in the food ecosystem. Sustainability has become a larger focus for individuals and corporations as people seek to reduce their environmental footprint over time.

Food safety is closely coupled with consumer demand, dietary preferences, and environmental impact. Hightened demand creates a chain reaction from fork to farm and farm to fork. The presence of mycotoxins can be expensive for food producers and an ongoing threat to public health. Preventing a toxin from entering the food chain requires consistent and reliable analytical testing. Testing and certification remain integral to overall consumer safety and the future of food production to minimize the increased impact of mycotoxins in today's changing landscape. ■

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Bringing the Lab to You *(Continued from p. 31)*

collection. Scientist or not, the user's confidence in their ability to perform the test will make all the difference in day-to-day work satisfaction, as well as obtaining sensitive, and accurate results.

On-site testing is a first line of defense in keeping low quality raw materials out of the facility and out of the global food chain. Access to rapid strip test screening kits has the potential to change the way raw materials are cultivated, harvested, and processed. Being able to customize a cultivation plan or harvest crops in a way that minimizes worker exposure to contaminants or microfungal toxins enables producers to make data-informed decisions that impact how they perform their jobs. Ultimately, the highest value is to protect consumers by ensuring food is free of contamination. Rapid test technologies mitigate risk much earlier in the value chain, which bolster preventive strategies and offers a more holistic approach to food safety. ■

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PFAS Testing Regulations *(Continued from p. 32)*

contamination, then testing meat and seafood and finally testing products containing fat and oil. Forensic testing techniques can help suppliers examine which types of PFAS may have originated in their supply chains, so they can implement new practices or change suppliers accordingly. This will be especially important for producers exporting to Europe if the proposed EU ban on PFAS goes into effect.

A Foundation for the Future

Finding a capable PFAS testing partner now will prepare you to weather the quickly shifting regulatory winds. Having a strong testing partnership in place can also help you respond quickly to other emerging risks. After all, PFAS are not the only environmental contaminant of concern. The chemicals that we already know to test for are just the tip of the iceberg: If the story of PFAS teaches us anything, it should be to expect the unexpected.

The EPA estimates that there are 12,000 forever chemicals on the market today. Many are affecting our food supply and environment in ways that are not yet known. More regulation is needed, but for chemicals already in the supply chain, improvements in testing provide a starting point for defining the problem. ■

Dr. Butt is the manager of applied markets, global strategic technical marketing, for SCIEX.

NEW PRODUCTS

Reject Management System

Eagle Product Inspection has launched the Maximizer RMI, a solution for the poultry processing industry. Hygienically constructed with a commitment to enhancing bone detection and reducing labor related to product rejects, this solution is designed to maximize product throughput and profitability while ensuring that safety standards are met. Key to the solution is its integration with the Eagle RMI 400 X-ray machine. The machine is equipped with Eagle's image analysis software, SimulTask PRO, and dual energy detector, PXT. This combination provides bone and metal detection, reducing false rejects and minimizing operational challenges related to manual labor. The result is a streamlined production process that increases overall efficiency.
Eagle Product Inspection, eaglepi.com/maximizer-rmi

Air Disperser

INDCO has released the model HSD06 pneumatic, variable speed benchtop disperser with a 1-gallon capacity, which delivers flexibility for many industrial settings. A needle valve for speed control allows this ½ HP disperser to operate from 500 to 5000 RPM, with maximum agitation achieved when supplied with 100 PSI at 71 CFM. The stainless-steel shaft is drilled and tapped on end for bolting on a two-inch-diameter design A dispersion blade. All wetted parts are stainless steel for chemical resistance. The disperser can be raised and lowered by hand and a support clamp securely locks it in place. The air motor weighs less than the electric model and is inherently safe in combustible environments. The high shear disperser is ideal for laboratory, production operation settings, and can incorporate a variety of materials including food ingredients.
INDCO, indco.com

Oil Tanks for Foodservice

Frontline International has redesigned its used oil tanks for the foodservice sector. With their new square shape, the tanks can easily tuck into corners and take up less room. The tanks make recycling easy, keep workers away from hot grease, and maximize the profit-potential of every gallon.
Frontline International, frontlineii.com

Clutch/Brakes

Posidyne clutch brakes can be ordered with special pads cast into the main housings to mount an adjustable motor base, allowing the motor to sit atop the clutch brake in a space saving "piggyback" design. Ideal for precise positioning applications with tight space constraints where an inline arrangement is not feasible, this arrangement also includes a gear belt drive from the motor to the input shaft and an enclosed belt drive guard. Designed for tight quarters, the brakes feature oil shear technology that allows rapid and precise stopping, starting, speed change, and positioning, all without adjustment or maintenance. The brakes are well suited for applications with frequent start/stop cycles, and high cycle rates (up to 300 cycles per minute), which place a high priority on maximizing production and minimizing downtime. The Posidyne clutch brake can be actuated by air or hydraulic pressure for use in a plant or outside remote applications. The hydraulic actuation package includes a hydraulic pump, solenoid valve, regulators, and a filter. A heat exchanger can be added for additional cooling.
Force Control Industries, forcecontrol.com

Barrier Papers for Packaging

Pixelle Specialty Solutions has launched the Armor brand of barrier paper solutions, featuring FlexArmor for uncoated applications and SelectArmor with a coated surface for enhanced printability. The barrier papers portfolio features a wide range of capabilities from oxygen, aroma, and mineral oil barriers to chocolate, OGR, and moisture vapor. Barriers can be applied individually or layered to enhance packaging performance. The products are PFAS and plastic free. Both product lines are available as FDA approved for direct and indirect food contact. Basis weights range from 20 lbs to 150 lbs, with functional one-side and functional two-side performance options. Wet strength is available along with bleached and unbleached options.

Pixelle Specialty Solutions, pixelle.com

Lot and Date Coder

Primera Technology has announced the AP-CODE Lot & Date Coder. AP-CODE is compact, affordable, and easy to use. It is designed to work with Primera's AP360 and AP362 label applicators, including new and existing installed units. With no tools required, AP-CODE installs quickly to Primera's AP360 and AP362 label applicators. It doesn't need a separate power supply and includes a full-color touchscreen to enter data and configure date and lot codes. The print fields are free-format and can include letters, numbers, and many symbols. Formats can be stored for later use, speeding up production.

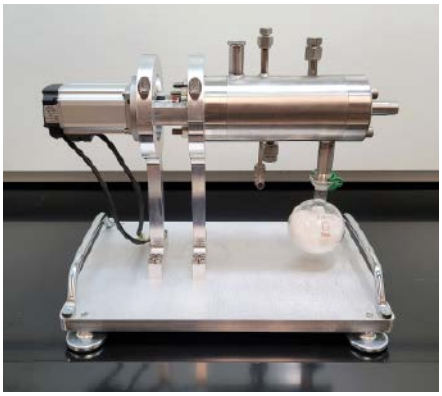
Primera Technology, primera.com

Dishwashing Machines

Auto-Chlor now offers the A4 WaterSaver single rack in-line low-temperature dishwashing machine, equipped with an environmentally safe sanitizing solution that offers the low water and chemical use. The low temperature method fully meets all regulatory criteria at only 120°F while reducing the energy required to heat the water used during the cleaning and sanitizing process. Combined with Auto-Chlor WaterSaver design, the A4 dishwasher provides an energy-efficient and water-conserving solution. Also offered is the A5 model, which combines the features of the A4 with a compact corner design that optimizes space without compromising efficiency. The standard A4 and A5 dish machines have a 17" wash cavity height and are also available in tall configurations that feather a 27" height in the wash cavity.

Auto-Chlor, autochlor.com

Continuous Lab-Scale Evaporator



The Rototherm Mini is designed for continuous evaporation and liquid-to-powder drying of heat-sensitive materials. Unlike vertical evaporators, the evaporator has a horizontal orientation, which provides researchers with complete control over residence time. This allows for liquid-to-powder drying in a single pass and improved product yield. The instrument features a high-speed rotor that uses centrifugal force to create an agitated thin film. It is capable of processing viscous or foaming liquids and slurries. In addition, the stainless steel fixed-clearance rotor provides for easier cleaning. It also provides researchers with the ability to develop continuous processes at lab-scale that can be scaled-up for production. **Artisan Industries, artisanind.com.**

Oil Monitoring Solution

Krohne is highlighting its Optiwave 5400 to level measurement of refined edible oil. The radar offers continuous monitoring of oil levels in tanks. It is a two-wire, 24 GHz radar (FMCW) level transmitter for liquids in basic process applications and offers continuous, non-contact level measurement in closed tanks or open air and can be equipped with a 316L metallic horn antenna or PP drop antenna. Automating the measurement process with the device allows organizations with edible oils to replace imprecise, irregular manual measurements, such as the dipstick method, which can be labor intensive and prone to human error. Manual measurements are also periodic, and so they cannot achieve continuous level measurement and control. The device provides level readings directly in the control room, which can then be used for further analysis and stock management. The radar can also provide readings in processes with fast-changing levels, such as when tanks are being filled or emptied. Remote level monitoring of edible oil tanks also allows stock control from a central location. **Krohne, krohne.com**

SCIENTIFIC FINDINGS

For access to the complete journal articles mentioned below, go to "Food Science Research" in the August/September 2023 issue at foodqualityandsafety.com, or type the headline of the requested article in the website's search box.

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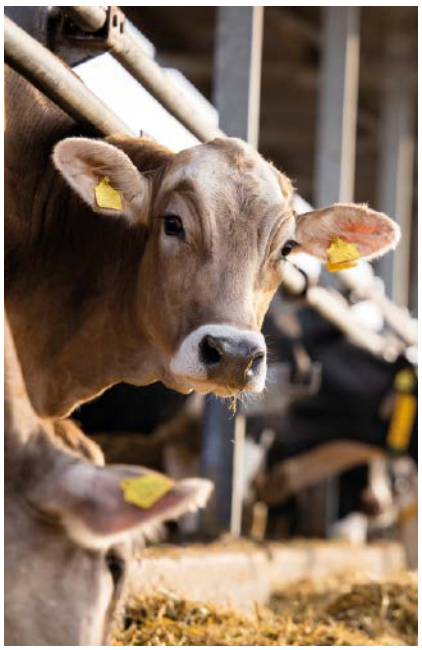
Sustainable Clean-In-Place in Dairy Processing

Cleaning-in-place (CIP) is the most commonly used cleaning and sanitation system for processing lines, equipment, and storage facilities such as milk silos in the global dairy processing industry. CIP employs thermal treatments and nonbiodegradable chemicals (acids and alkalis), which require appropriate neutralization before disposal, resulting in sustainability challenges. In addition, biofilms are a major source of contamination and spoilage in dairy industries, and it is believed that current chemical CIP protocols do not entirely destroy biofilms. Use of enzymes as effective agents for CIP and as a more sustainable alternative to chemicals and thermal treatments is gaining interest. Enzymes offer several advantages when used for CIP, such as reduced water usage (less rinsing), lower operating temperatures resulting in energy savings, shorter cleaning times, and lower costs for wastewater treatment. Additionally, they are typically derived from natural sources, are easy to neutralize, and do not produce hazardous waste products. However, even with such advantages, enzymes for CIP within the dairy processing industry remain focused mainly on membrane cleaning. Greater adoption of enzyme-based CIP for cheese industries is projected pending a greater knowledge relating to cost, control of the process (inactivation kinetics), reusability of enzyme solutions, and the potential for residual activity, including possible effects on the subsequent product batches. Such studies are essential for the cheese industry to move toward more energy-efficient and sustainable cleaning solutions. ***Comprehensive Reviews in Food Science and Food Safety.*** **Published July 17, 2023. doi: 10.1111/1541-4337.13206.**

Potential Cattle Contribution to Leafy Green Outbreaks

Recently, multiple reports from regulatory agencies have linked leafy green outbreaks to nearby or adjacent cattle operations. While they have made logical explanations for this phenomenon, the reports and data should be summarized to determine if the association was based on empirical data, epidemiological association, or speculation. Therefore, this scoping review aims to gather data on the mechanisms of transmission for pathogens from livestock to produce, identify if direct evidence linking the two entities exists, and identify any knowledge gaps in the scientific literature and public health reports. Eight databases were searched systematically and 27 eligible primary research products, which focus on produce safety concerning proximity to livestock, provided empirical or epidemiological association and described mechanisms of transmission, qualitatively or quantitatively were retained. Fifteen public health reports were also covered. Results from the scientific articles provided evidence that proximity to livestock might be a risk factor; however, most lack quantitative data on the relative contribution of different pathways for contamination. Public health reports mainly indicate livestock presence as a possible source and encourage further research. Although the collected information regarding the proximity of cattle is a concern, data gaps indicate that more studies should be conducted to determine the relative contribution of different mechanisms of contamination and generate quantitative data to inform food safety risk analyses, regarding leafy greens produced nearby livestock areas. ***Comprehensive Reviews in Food Science and Food Safety.*** **Published July 8, 2023. doi: 10.1111/1541-4337.13200.**



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Detecting Transgenic Oilseeds and Oils

Transgenic technology can increase the quantity and quality of vegetable oils worldwide. However, some are skeptical about the safety of transgenic oil-bearing crops and the oils they produce. To protect consumer rights and avoid transgenic oils being adulterated or labeled as nontransgenic oils, the transgenic detection technology of oilseeds and oils needs careful consideration. This paper first summarizes the current research status of transgenic technologies implemented at oil-bearing crops. Then, an inspection process is proposed to detect a large number of samples to be the subject rapidly, and various inspection strategies for transgenic oilseeds and oils are summarized according to the process sequence. The detection indicators include oil content, fatty acid, triglyceride, tocopherol, and nucleic acid. The detection technologies involved chromatography, spectroscopy, nuclear magnetic resonance, and polymerase chain reaction. It is hoped that this article can provide crucial technical reference and support for staff engaging in the supervision of transgenic food and for researchers developing fast and efficient monitoring methods in the future. ***Journal of Food Science*. Published July 17, 2023. doi: 10.1111/1750-3841.16705.**

The Impact of Seasonal Variations in Milk Composition on Cheddar Cheese

Variability in milk composition and physicochemical properties impact both manufacturing process performance and the end-use functionality of cheese. Such variability may be attributed to seasonal calving patterns, production systems, breed, weather patterns, and feed type and significantly impacts concentrations of macro- and microconstituents and ultimately cheese composition and quality. This article reviews technological approaches (e.g., milk standardization protocols and calcium addition), and predictive strategies (e.g., predictive models for coagulation and curd cutting time, in-line sensors), used to mitigate the effects of seasonal changes in milk composition and their impact on process efficacy and functionality in cheddar cheese manufacturing. ***International Journal of Dairy Technology*. 2023;76:449-467.**

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Effect of Oven Roasting on Chemical Components in Cereals

Oven roasting (OR) could induce hierarchical structural changes in starch, which is fundamental for altering the pasting and hydration properties of cereal flour. OR makes proteins denatured and peptide chains unraveled or rearranged. OR could alter compositions of cereal lipids and minerals. Although OR may degrade phenolics, their release from bound forms is predominant when mild/moderate conditions are exerted. Hence, some OR-modified cereals even exhibit many physiological functions, such as anti-diabetic and anti-inflammatory activity. Furthermore, these minor components interplay with starch/protein via physical entrapment, non-covalent interactions, or cross-linking. The structural changes and interactions modulate functionalities of OR-modified cereal flour, its dough/batter property, and related staple food quality. Compared with hydrothermal or high-pressure thermal treatments, proper OR even induces greater enhancement in technological quality and bioactive compounds release. Given the simple operation and low cost, it is worth using OR for the development of sensory-appealing healthy staple foods. ***Journal of Food Science*. 2023;88:2740-2757.**

Enhancing the Traceability of Wheat Quality

With the growing global population, the need for food is expected to grow tremendously in the next few decades. One of the key tools to address such growing food demand is minimizing grain losses and optimizing food processing operations. Hence, several research studies are underway to reduce grain losses/degradation at the farm (upon harvest) and later during the milling and baking processes. However, less attention has been paid to changes in grain quality between harvest and milling. This paper aims to address this knowledge gap and discusses possible strategies for preserving grain quality (for Canadian wheat in particular) during unit operations at primary, process, or terminal elevators. To this end, the importance of wheat flour quality metrics is briefly described, followed by a discussion on the effect of grain properties on such quality parameters. This work also explores how drying, storage, blending, and cleaning, as some of the common post-harvest unit operations, could affect grain's end-product quality. Finally, an overview of the available techniques for grain quality monitoring is provided, followed by a discussion on existing gaps and potential solutions for quality traceability throughout the wheat supply chain. ***Comprehensive Reviews in Food Science and Food Safety*. 2023;22:2495-2522.**

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