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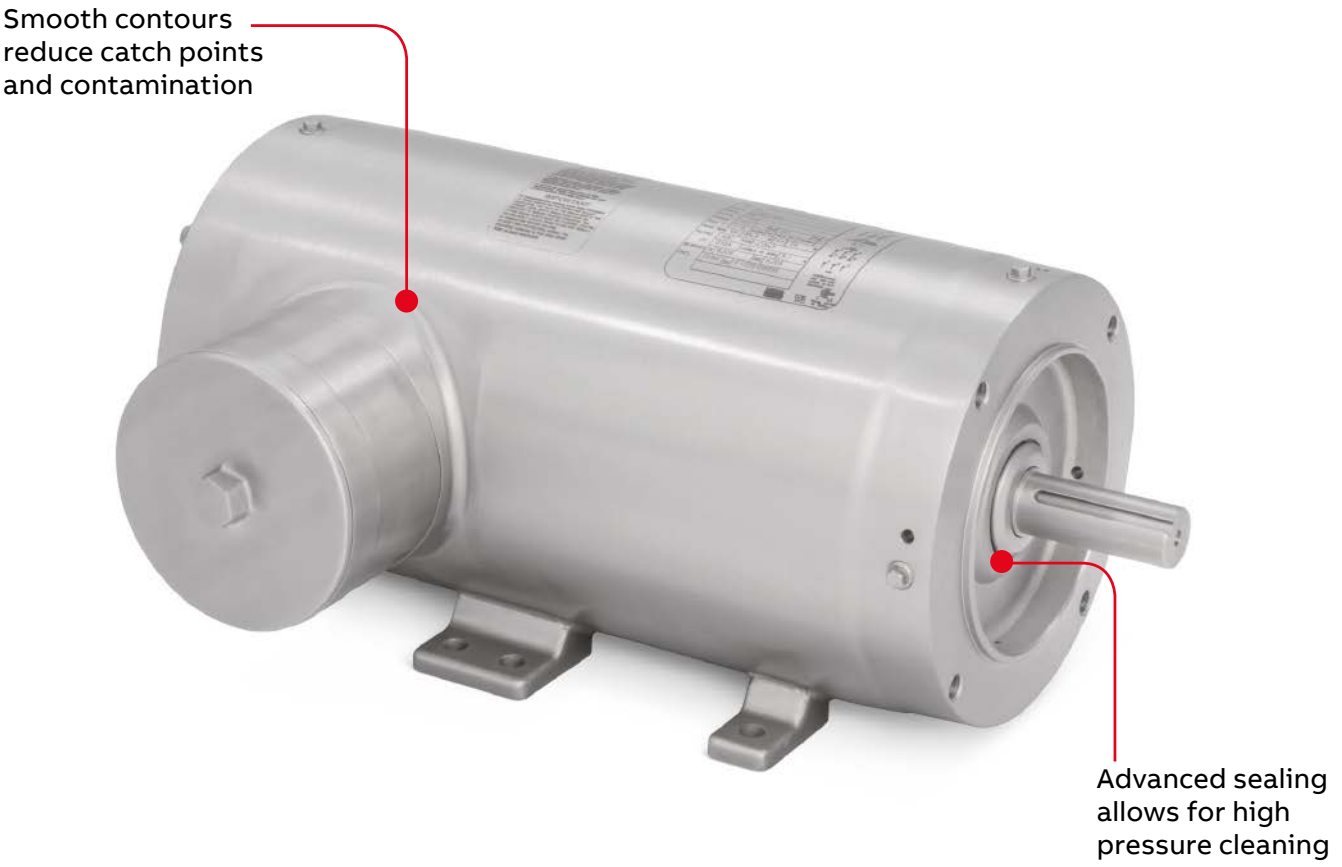
Volume 24 Number 6
DECEMBER 2017 / JANUARY 2018

Food Quality & Safety

FARM TO FORK SAFETY



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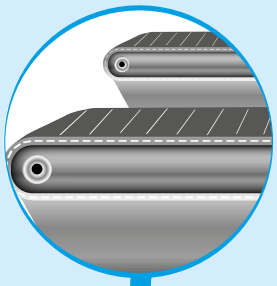

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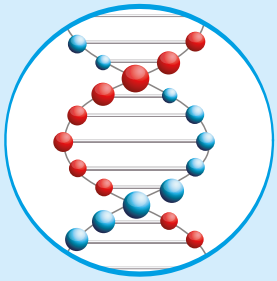

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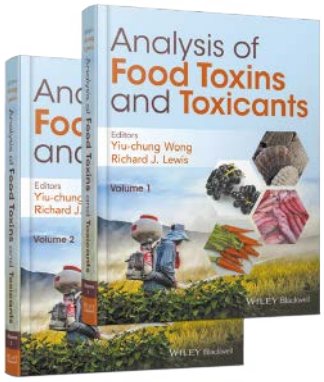

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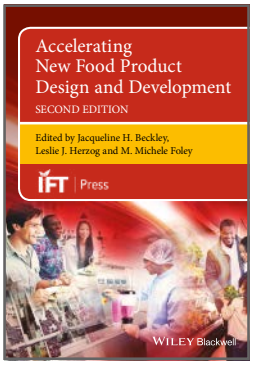

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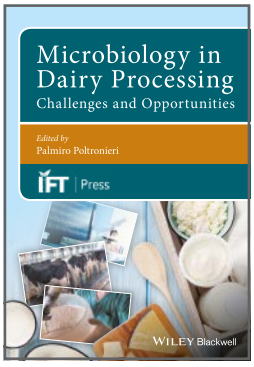

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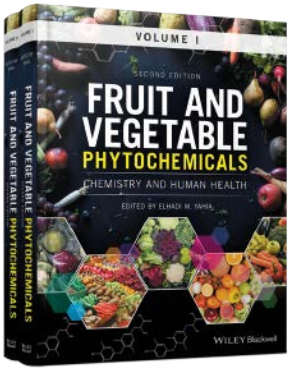

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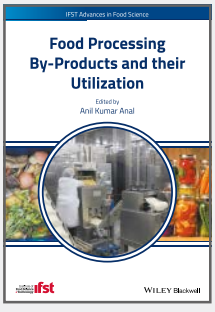

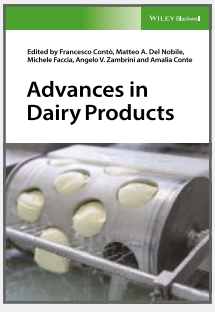

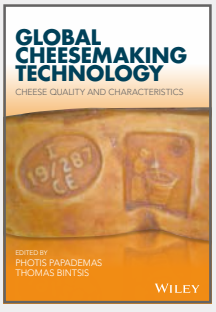

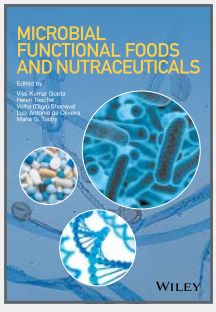

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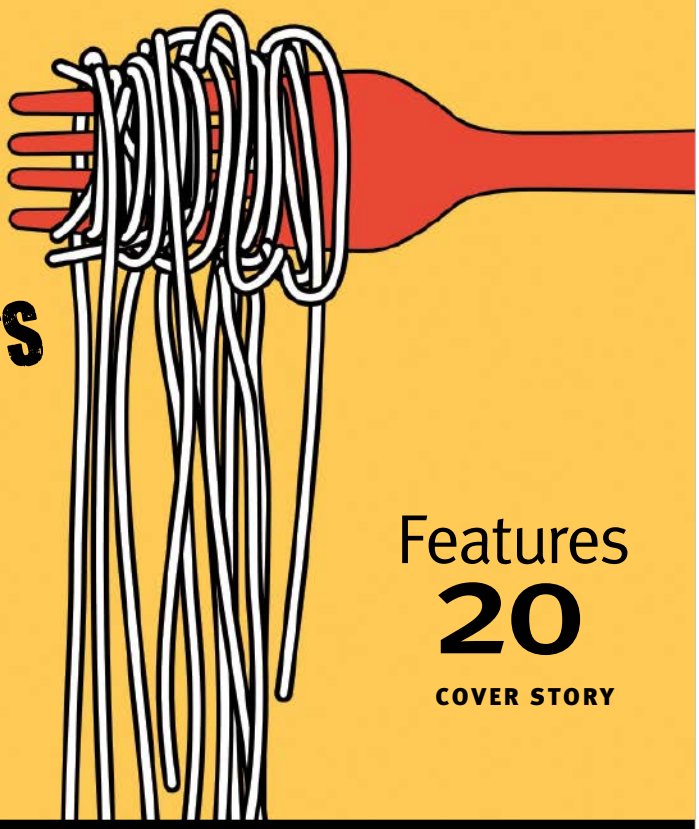

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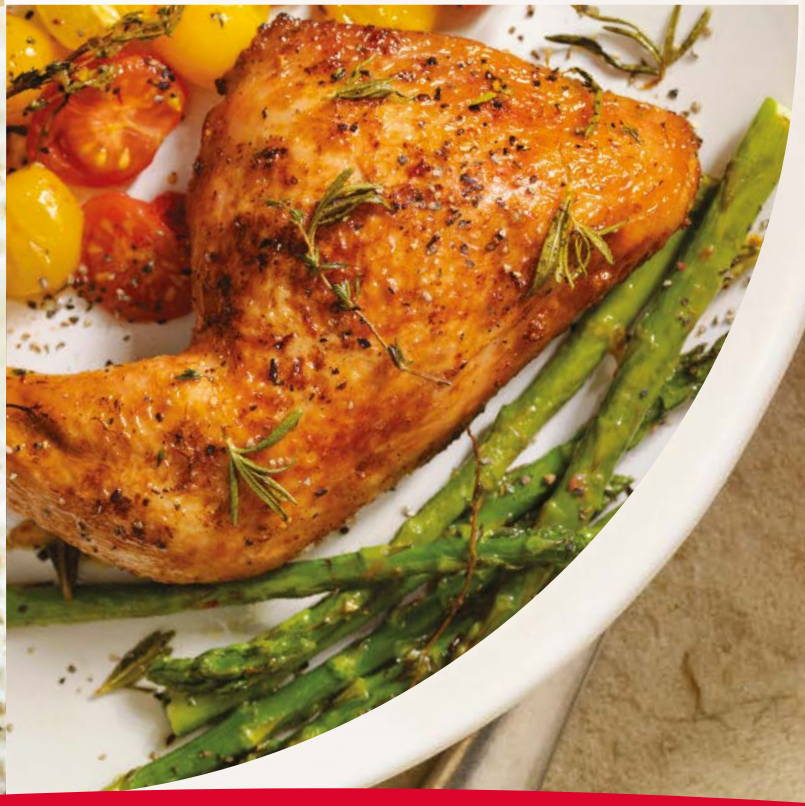

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From The Editor

No FSMA rule has garnered as much discussion as the Produce Rule. There were so many facets to the rule when it was conceived, it's no wonder there are concerns surrounding it at every turn.

On Nov. 27, the U.S. Government Accountability Office released a new report in response to its original report in 2016 on FDA's use of an information clearinghouse to respond to industry concerns about these standards. The new GAO report found that since the issuance of its 2016 report, 2,665 more questions were submitted to FDA's Technical Assistance Network. Most Produce Rule-related questions concerned agricultural water standards, such as methods for testing water. FDA has taken steps to evaluate and respond to business concerns, including funding training for industry and visiting farms. FDA is also reviewing the rule's water standards and published a proposed rule in September 2017 to extend the compliance dates.

Not everyone is happy about a possible delay, however. The Center for Science in the Public Interest and the Center for Food Safety publically disputed the Trump administration's proposal to delay enforcement of the Produce Rule. These nonprofit food safety watchdog groups say that under the new proposed delay, growers would not have to test water for *E. coli* contamination until between 2022 and 2024 (11 to 13 years after FSMA's passage), which would contribute to further illnesses and deaths from produce tainted by animal feces.

And then there are the skeptics to the rule's overall impact on farmers and foodborne illnesses. "I would assess this [FSMA] more as a Band-Aid than a cure-all," says John Bovay of the University of Connecticut, in a press release from the Agricultural & Applied Economics Association. Bovay is part of a team of researchers that looked at the impact of FSMA from several points of view in the paper "Economic Effects of the U.S. Food Safety Modernization Act," which appears in the Oct. 26 issue of the journal Applied Economic Perspectives and Policy.

Bovay used the produce aspect of FSMA, specifically the fresh tomatoes industry, as a case study. The paper looks at the impact on farmers, both large and small, and why some benefit from FSMA more than others.

"FSMA will reduce the number of foodborne illness cases by some unknown amount," says Bovay. "Even if FSMA is effective, because it is similar to many private and state rules and regulations already in place, I don't have a lot of confidence that this is going to drastically diminish the number of illnesses."

With so much uncertainty surrounding this one rule, many in the industry are indeed left wondering if it will have any influence in preventing the abundant amount of foodborne illnesses tied to fresh produce in its current state.

Marian Zboraj
Editor

What do you think? Email me at mzboraj@wiley.com with your opinions, and we'll post some of the answers.

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FARM TO FORK SAFETY

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NEWS & NOTES

Food Safety in Japan by 2020 Target

The Japan Local Group of the GFSI set themselves a target of 2020, when Tokyo welcomes thousands of athletes and sports fans from around the world for the Olympic games, for over 6,000 food production sites to become certified to a GFSI-recognized certification program or to embark on GFSI's Global Markets Program, a pathway to certification. Katsuki Kishi, GFSI Board Member and Chair of the Japan Local Group, says benchmarking and recognition of food safety certification programs and GFSI's Global Markets Program will improve Japanese market access internationally. "We have a golden opportunity ahead to ensure that all food produced and purchased for the 2020 sporting event adheres to strong food safety standards, either certified to a GFSI-recognized certification program or benefiting from GFSI's capability building program," he says.

Challenges in FDA's Food Facility Inspections

A new report by Department of Health and Human Service's Office of Inspector General raises some red flags about the inspections program. The report states that while FDA is on track to meet the domestic food facility inspection timeframes for the initial cycles mandated by FSMA, challenges remain as FSMA requires FDA to conduct future inspections in timeframes that are 2 years shorter than the timeframes for the initial cycles. Also, inaccuracies in FDA's domestic food facility data result in FDA attempting to inspect numerous facilities that are either out of business or otherwise not in operation at the time of the visit.

Baking Soda Best for Washing Pesticides Off Apples

Washing apples in water with a dash of baking soda is the most effective way to remove pesticide residue, new research shows. Reuters Health reported that the mix outperformed Clorox-spiked water for getting rid of the chemicals, and also worked better than plain water. Researchers coated apples with thiabendazole, a fungicide, or phosmet, which is used to kill a variety of pests, and washed them with water or water mixed with bleach or baking soda. Using super-sensitive, high-tech tests, the researchers checked on and within the apple for pesticides and measured pesticide concentration within plant tissue. Rinsing the fruit in the baking soda solution for 12 minutes was most effective for removing thiabendazole, they found, while a 15-minute baking soda rinse was most effective for getting rid of phosmet. Findings were reported in the Journal of Agricultural and Food Chemistry.

Collaborating for a Common Cause

The Association of Food and Drug Officials (AFDO)'s "Partners With a Common Purpose" initiative is intended to generate equal partnership between industry and regulators at meetings and forums. The initiative seeks to realize a shared vision that can be embraced and pursued between the two in an effort to improve food safety and public health. AFDO will serve to ensure that collaboration is successful in engaging all stakeholders and agreeing on a common purpose.

Business Briefs

Epson America and **TEKLYNX International** form GHS-compliant labeling partnership.

PURE Bioscience signs an agreement with, and receives an initial order from, **iGPS Logistics** for the use of PURE Hard Surface disinfectant.

eMeals adds **AmazonFresh** grocery delivery and pickup service to its list of fulfillment choices.

The recently established **TriStrata Group,** a 100% subsidiary of Wheatsheaf Group, acquires the technology and assets of **Ozone International.**

CERTUS expands partnership with **Solus Scientific** for the immediate distribution of the Solus Pathogen Testing System across the U.S. food safety market.

Anheuser-Busch InBev and **Agrible** establish a global partnership to help farmers around the world access better data and predictive analytics on crop management and climate effects.

Q Laboratories opens Food Virus Detection Laboratory at its Cincinnati, Ohio location to test food, water, environmental swabs, and food surface swabs for norovirus and hepatitis A.

The **United Fresh Produce Association** and **Western Growers** enter into a formal marketing agreement to jointly promote the Western Growers Shield, an insurance program designed to protect food companies from recall liability.

Universal Pasteurization and **Universal Cold Storage** changes to a new name: Universal Pure.

Cargill signs a binding agreement to acquire **Diamond V** in order to participate in the animal feed additives market.

Scanbuy provider of QR Code mobile technology services that includes SmartLabel capabilities, and **Kezzler** form a strategic partnership that brings Internet of Packaging to SmartLabel.

Brisan acquires **Product Dynamics,** a division of RQA, to offer clients a complete suite of ingredients and consumer and sensory research and product development services.

Craft Brewers Craft Food Safety Plan

The Brewers Association Quality Subcommittee's new resource, the Food Safety Plan for Craft Brewers, is an extension of its 2016 Good Manufacturing Practices for Craft Brewers guide. As alcohol products now fall under FDA regulation and are subjected to FSMA policies, the new guidance from the Brewers Association is meant to help craft brewers design and implement a food safety plan at their brewery. The plan addresses several specific issues that commonly exist at craft breweries to help these breweries enact good manufacturing practices.

'Game Over' for Aflatoxin

Mars, Inc. and several partners release a series of aflatoxin puzzles on "Foldit," a gaming platform that lets users explore how amino acids are folded to together to create proteins. Gamers will compete to redesign and improve the starting enzyme that has the potential to degrade aflatoxin, so that it can be neutralized. All designs will remain in the public domain, free of patents, to maximize the impact that this project could have on food safety, and the top designs will be synthesized and then tested at the labs in UC Davis for their real-world potential to combat aflatoxin.

Past Food Date Labels Expire

The Consumer Goods Forum—a network of 400 of the biggest consumer goods companies across 70 countries—and Champions 12.3 approved a Call to Action to standardize food date labels worldwide by 2020. The new initiative will seek to not only simplify the labels, but will also urge companies to increase consumer education by partnering with nonprofit organizations and government agencies to better understand the labels. The companies' commitment is in the shared goal of reducing food waste worldwide to meet the goal of Sustainable Development Goals Target 12.3 by 2020.

Washington Report

FDA Slammed Over Lax Enforcement

One in five significant food facility violations go unaddressed

BY **TED AGRES**

Despite tougher enforcement tools granted by the Food Safety Modernization Act (FSMA), FDA took no advisory or enforcement actions in response to 22 percent of the significant inspection violations it uncovered from 2011-2015, according to an audit by the Office of the Inspector General (OIG) at the Department of Health and Human Services, FDA's parent agency.

And when the FDA did take enforcement action, it was often slow in coming. Of particular concern, FDA most commonly asked facility owners to voluntarily correct serious violations, which didn't always happen, instead of taking advantage of new powers granted by FSMA, including suspending a food facility's registration, issuing a mandatory recall, or administratively detaining certain foods.

In one example, OIG said FDA inspectors found *Listeria monocytogenes* in a facility that also had rainwater visibly leaking through the roof directly above the food preparation area. The facility also had cracks and holes in walls and floors that prohibited adequate cleaning. Soon after the inspection, FDA issued a warning letter requesting prompt corrective actions. But the violations went uncorrected for two years, despite three additional inspections that documented ongoing unsanitary conditions and the continued presence of *Listeria*.

"This facility was not unique," the report says. "If FDA does not take swift and effective action to ensure that all violations are corrected, it is unable to guarantee that the food handled by these facilities is safe and free from disease-causing organisms, chemicals, or other harmful substances."

The September 2017 OIG report, "Challenges Remain in FDA's Inspections of Domestic Food Facilities," focuses on inspections conducted during FSMA's first five years (2011-2015). FSMA requires FDA to inspect high-risk facilities at least once during an initial five-year inspection cycle and then at least once every three years afterward. Non-high-risk facilities must be inspected at least once during the initial seven-year cycle and then at least once every five years afterward. Prior to FSMA there were no such set timeframes.

FDA reported inspecting all but nine of the 21,086 high-risk U.S. facilities as required by the end of 2015, and had also inspected about two-thirds of the 61,010 non-high-risk facilities by that time. With two years to go for the latter, the agency was on track to finish the rest of the non-high-risk facilities by the end of 2017.

OIG agreed to this assessment, but also noted that FDA counted a facility it *attempted* to inspect—but didn't—as having been inspected. Most often, such a facility was out of business or otherwise not operating at the time of inspection. These non-inspections comprised more than 25 percent of all the facilities FDA counted as inspected.

FDA 'Cop-Out'

"Attempted inspections occur when an investigator visits a facility but it is out of business or not in operation, but FDA counts those facilities in its inspection numbers related to meeting the mandates," says David Acheson, MD, a former associate FDA commissioner for foods. "Reading between the lines, I don't think OIG really approved of that strategy and saw it as a cop-out by FDA."

After excluding these facilities, OIG says the total number of completed inspections actually decreased over time, from about 17,000 in 2004 to only 16,000 in 2015, despite an increase in the number of facilities coming under FDA jurisdiction. As a result, the proportion of facilities inspected by FDA has decreased substantially over time, from 29 percent in 2004 to just 19 percent in 2015.

Further, the proportion of non-high-risk facilities that FDA attempted to inspect, but didn't, increased during the first

cycle, from 6 percent of the total in 2011 to 68 percent of the total in 2015. Some of these facilities, such as seasonal facilities or those that were closed temporarily, still need to be inspected. But FDA doesn't have an effective rescheduling policy in place, OIG says.

As a result, FDA could be challenged to meet future FSMA inspection mandates, which are to be shortened by two years. "Unless FDA increases its current pace of inspections of non-high-risk facilities, it will not be able to meet the mandates of future inspection cycles," the report says.

FDA officials explained that they also had been engaged in other public health protection activities, such as responding to food recalls and collecting samples, records, and other evidence to identify the source of outbreaks.

5 Percent Enforcement

Of the 1,535 actions FDA took in response to significant inspection violations from 2011-2015, nearly three-fourths (73 percent) were advisory in nature, such as warning letters, untitled letters, or regulatory meetings, all seeking voluntary correction, despite having powers under FSMA, the report says. FDA undertook judicial actions, such as seizures or injunctions, in only 4 percent of the cases and initiated administrative actions, such as food detention, in only 1 percent of the cases.

FDA was also slow in taking action. Almost half of all warning letters were issued after the 4-month response timeframe, and 20 percent were issued after more than six months; 2 percent were issued more than one year after the inspection. Even when the agency took strong actions, facilities could continue to operate under unsafe conditions. In one case, FDA took 1.1 years for a seizure and almost two years for an injunction. And for almost half of all significant inspection violations, FDA did not conduct timely follow-up inspections within one year to ensure correction.

"I am alarmed that the OIG found a decrease in the number of facilities being inspected from 2011 to 2015," said Rep. DeLauro (D-CT), a leading food safety advocate in Congress. "The FDA also counted facilities no longer in operation as being up to standard, thereby over estimating that number to make their results more favorable. Finally, I am outraged that the FDA only took enforcement measures against 5 percent of significant facility infractions, impacting food safety and consumers," she said in a statement.

In a brief notice published in the Federal Register in September, innocuously titled "Improving Customer Service," USDA proposed moving the Codex Alimentarius ("Food Code") program from FSIS into the Undersecretary for Trade and Foreign Agricultural Affairs.

FDA spending on domestic facility inspections increased from $78 million in 2004 to $137 million in 2010, and then to $140 million in 2011, the first year of FSMA. Afterward, however, spending dropped to $130 million in 2015.

The Trump Administration's Fiscal 2018 budget request, submitted to Congress in May 2017, would slash FDA's budget by more than $870 million, or nearly one-third, from about $2.76 billion to $1.89 billion. Food safety activities would be cut by $83 million largely by not filling vacant staff and inspector positions and cutting back on food safety research activities. However, as of this writing, Congress and the White House appear to be in agreement in maintaining federal agency funding at 2017 levels, at least through the end of the year.

"It is clear that the FDA needs more resources to efficiently and effectively inspect food facilities and enforce infractions to keep our food supply safe," Rep. DeLauro said.

OIG makes four recommendations: 1) identify facilities that do not need to be inspected because they are out of business and remove them from the list, 2) take the most effective actions to achieve compliance, using FSMA tools more frequently, 3) initiate regulatory actions promptly, and 4) conduct timely follow-up inspections.

FDA concurred with all four recommendations, noting that it already was developing systems to better track agency and company activities associated with each violation. Dr. Acheson urges companies to take this as a warning. "We can expect FDA to come down very hard on facilities that have violations and to follow up aggressively," he says. "Likely some companies will be made an example to get everyone in line. Maybe we will see more suspensions of registration. I would not be surprised."

USDA Under the Gun

The Trump Administration may be excused for FDA's poor performance because it occurred during the Obama Administration. But such is not the case when it comes to USDA, which recently proposed shifting responsibility for international food safety issues from the science-based Food Safety and Inspection Service (FSIS) to its promotion-oriented Trade and Foreign Agricultural Affairs office.

In a brief notice published in the Federal Register in September, innocuously titled "Improving Customer Service," USDA proposed moving the Codex Alimentarius ("Food Code") program from FSIS into the Undersecretary for Trade and Foreign Agricultural Affairs. USDA's Codex office helps formulate U.S. policy at the Codex Alimentarius Commission, part of the UN Food and Agriculture Organization and the World Health Organization. The 180-nation commission formulates international standards for food labeling, additives, pesticide residues, procedures for assessing food safety, as well as governmental import and export inspection and certification systems for foods.

The proposed USDA reorganization caught many off guard. "FDA strongly believes that moving Codex to the oversight of a trade promoting, non-science organization could undermine the credibility of U.S. Codex as a science-based enterprise," wrote Stephen Ostroff, MD, deputy FDA commissioner for foods and veterinary medicine, in comments that FDA took the unusual step of making public.

Such a transfer "would build a perception that the United States places a stronger priority on advancing trade over public health," Dr. Ostroff said. "This perception would be damaging to U.S. credibility, and FDA is highly concerned that this would compromise the effectiveness of U.S. delegates who participate in Codex, a majority of whom are from FDA."

(Continued on p. 42)

Innovative Tech

Intelligent Super Tools of the Trade

Food industry information technology is advancing by leaps and bounds | BY **LINDA L. LEAKE, MS**

Information may not be able to change the course of mighty rivers or bend steel in its bare hands, but one could say data today are faster than a speeding bullet, more powerful than a locomotive, and even able to leap tall buildings in a single bound.

With each passing day, information technology is increasingly more diverse, creative, adaptive, and influential, offering all components of the food chain unprecedented efficiency and flexibility, 24/7. Voluminous amounts of useful business management information are being communicated in various forms over long distances as fast as Superman flies through the air.

Here's the scoop on some new data tool developments.

Data Intelligence Tool

In July 2017, SafetyChain Analytics, a new business intelligence tool, hit the marketplace, courtesy of SafetyChain Software, Inc., San Rafael, Calif., a purveyor of real-time food safety and quality management solutions.

SafetyChain's suite of software, including Supplier Compliance, Food Safety Management, Food Quality Management, and CIP (Cleaning in Place) Optimization & Material Loss, helps companies ensure program compliance; identify and manage issues early on; be ready 24/7 for inspections, inquiries, and audits; and more effectively evaluate and improve performance across their operations, according to Jill Bender, SafetyChain's vice president of marketing.

"With one centralized data repository, and use of our data analytics tool, companies are able to get real-time business intelligence that goes beyond just measuring compliance, but actionable data," Bender says.

"SafetyChain Analytics offers 24/7 on-demand access to food safety and quality data intelligence, including supplier performance, food safety and quality tasks, and all their measured and recorded attributes across multiple locations," Bender emphasizes. "Live operational monitoring of exception-based trending and process control, including a holistic view of food safety and quality data, are included. Additionally, the software allows the sharing of reports and charts with key stakeholders, auditors, and inspectors via dashboards, reports, filtering, and drill-down capabilities."

GFF, Inc., City of Industry, Calif., producer of Girard's Dressings, is using the SafetyChain Analytics program.

"Based on the data that we are collecting, seeing, reviewing, and signing off on in SafetyChain, we are able to instantly track the issues that might arise in the day-to-day production, in real time," says Aisha Kalley, Girard's food safety and compliance specialist. "If we suspect there's an issue based on the data we're seeing, SafetyChain Analytics has a function where we can build a report around that and it will automatically help us pinpoint the challenges and determine the root cause."

"As an additional angle, the new SQF Edition 8 Quality Code requires statistical process control monitoring with graphical representation, which SafetyChain's new analytics tool has," Bender mentions.

Online Incidents Database

In July 2017, Global ID Group, Fairfield, Iowa, introduced HorizonScan, an online database that contains more than 85,000 records of global food safety and authen-

ticity incidents affecting hundreds of commodities from nearly 16,000 suppliers in 180-plus countries, according to Mark Cohen, the company's vice president of global marketing.

Global ID Group is a food safety and quality company and provider of testing, certification, training, consulting, and specialty services. The company is the exclusive distributor for HorizonScan in North America, Brazil, and Germany.

"The HorizonScan food safety management system monitors safety and integrity alerts worldwide, collecting data daily from over 110 food safety agencies and other reliable sources to deliver timely alerts on emerging food safety issues," Cohen relates.

HorizonScan's web-based food safety software displays the most important issues with pertinent, actionable facts, Cohen elaborates. "One uses a computer or mobile device to search by commodity, country of origin, type of threat, supplier, date of event, and more," he explains. "Users can set up automatic alerts for the commodities and issues most important to them."

Events that HorizonScan can track include microbial contaminants, pesticide residues, mycotoxins, allergens, genetically modified organisms, heavy metals, dioxins, polychlorinated biphenyls, polycyclic aromatic hydrocarbons, residues of veterinary drugs, adulteration, and fraud.

Advanced search capabilities; graphs, trends, data, and analytics; the ability to identify high-risk suppliers; the latest news feeds, including the newest events from the last 48 hours; and original event reports are all afforded by HorizonScan, Cohen notes.

Great Lakes Cheese Co., Inc., Hiram, Ohio, recently starting using HorizonScan, according to Julie Simcox, the company's senior manager of corporate quality regulatory and food safety.

"We chose HorizonScan to facilitate our ingredient and supplier risk assessments as part of our FSMA (Food Safety Modernization Act) compliance work," Simcox relates. "HorizonScan provides a dynamic risk assessment tool that allows our organization to stay ahead of emerging risks and identify risks of concern to our organization in raw materials/suppliers we may previously not been aware of."

End-to-End Sourcing Tool

If you love free stuff you might want to check out the ReposiTrak MarketPlace, launched in March 2017 by Park City Group's ReposiTrak Inc., Salt Lake City, Utah, a provider of compliance management and trace and track solutions for the grocery and food service industries. Park City Group is a software-as-a-service provider.

"ReposiTrak provides food retailers and suppliers with a robust solution to help them protect their brands and remain in compliance with the Food Safety Modernization Act," says Randall Fields, CEO of Park City Group. "But, it's really a platform for managing compliance across all vendors, both food and nonfood, as documentation such as W-9s, supplier agreements, proof of insurance, and audits are required by all trading partners."

MarketPlace enables ReposiTrak's retailers and wholesalers to search its

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community of more than 40,000 compliant supplier connections, and bring new products to market in a fraction of the time, Fields relates.

"MarketPlace is easy to use and free to all suppliers," he notes. "The goal was to automate and guide the sourcing process from end to end, and go beyond discovery to include supplier qualification, order negotiation, and the on-boarding of a new supplier."

A big plus of MarketPlace is its inclusion of diverse types of suppliers, Fields adds. "To keep up with consumer demand, companies' needs include smaller, local suppliers which can be hard to find," he explains. "Then there are the short-term suppliers that supply product specifically for holidays, events, and themes, and lastly there are the suppliers needed to replace those who can't or are not willing to comply with your business and/or safety requirements. MarketPlace includes many such specialty suppliers."

Environmental Monitoring

Autoscribe Informatics, Inc., Lakeville, Mass., added the Matrix Gemini Environmental Monitoring module to its portfolio in July 2016. Autoscribe Informatics offers database management applications, including laboratory information management systems and quality management systems, according to Samuel Clark, the company's sales manager for North America.

A popular FreshCode model prior to activation.

"This newest software provides a framework to document environmental sampling procedures, results of environmental monitoring, and corrective actions taken," Clark says. "The trending features provide an early warning of sanitation problems before they become violations."

> "With one centralized data repository, and use of our data analytics tool, companies are able to get real-time business intelligence that goes beyond just measuring compliance, but actionable data," Bender says.

Clark explains that Matrix Gemini provides a complete historical record of facilities' testing. "If there is a problem, the system demonstrates when it started to occur and what was done to correct the issue," he relates. "The complete audit history of all testing clarifies early signs of deteriorating sanitation and serves as a proactive inspection regime to avoid problems in the first place."

Touting benefits, Clark says Matrix Gemini encapsulates food safety/food sanitation monitoring best practices; proves FSMA/HACCP (Hazard Analysis and Critical Control Points) food safety compliance and current Good Manufacturing Practices requirements; and links sampling point locations, test results, and corrective actions taken. "Moreover, the software tracks samples and stores results, with complete version control, meaning keeping track of every change to a file over time," he says.

Temperature Monitoring

In November 2016, Varcode, Ltd., Ra'anana, Israel, launched commercially what it calls its signature technology, the FreshCode temperature monitoring solution. Varcode bills itself as a global innovator in cold chain monitoring.

FreshCode is a patented smart barcode recorder that captures temperature abuse throughout the cold chain, says Aaron Boyll, president and CEO of Varcode North America, St. Louis, Mo.

"The recorder can be read by any smartphone via our free app or any standard barcode scanner," Boyll relates. "The smart barcode recorder indicates if a product exceeded its threshold temperature for multiple timeframes, and can monitor for up to two years with no on-board power needed."

Boyll says FreshCode recorders can be manufactured to the time-temperature specifications of customers' specific cold chains. "Threshold temperatures range from -4 degrees Fahrenheit to 99 degrees Fahrenheit," he elaborates. "Cumulative time and status intervals range from 10 minutes to 48 hours."

Minimal training and no special equipment purchases are required to use FreshCode, Boyll emphasizes. "This low-cost solution includes a cloud-based system that enables fast and easy data analysis and decision making," he says. "FreshCode is customizable to fit each cold chain, supporting HACCP plans with data and records, providing real-time alerts to management, maintaining permanent electronic records, and interfacing smoothly with legacy information technology systems."

White Labs, San Diego, Calif., a purveyor of liquid yeast and enzymes for commercial and home brewing of beer, started using FreshCode in February 2017. "We ship products in quantities of 500 milliliters to 20 liters throughout North America and globally, and they need to stay cold throughout transport," says Neva Parker, the company's vice president of operations. "So we worked with Varcode to determine the optimum temperature range for shipping and we are soon placing, at no extra charge, a FreshCode barcode recorder in each package, some 1,500 boxes per week."

Parker is quick to point out that using FreshCode has been a huge value-added benefit for White Labs and those they serve. "Our customers can use our app, where we have integrated the Varcode platform, so they can monitor the temperature of products throughout shipment," she relates. "Using FreshCode gives our customers confidence in our quality control efforts, and it shows them that we are willing to take the extra step to ensure they receive a quality product at the optimum temperature and that we care how the product arrived at their destinations." ■

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For bonus content, go to December/January 2018 issue on FoodQualityandSafety.com and click on "Intelligent Super Tools of the Trade."

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FSMA Update

Water Usage and FSMA Compliance

Focusing on post-harvest uses of water for produce, specifically for cooling and washing that involve direct food contact

BY **ERIC WILHELMSEN, PHD**

Water has many food-related uses. Many of these uses will impact compliance under the Food Safety Modernization Act (FSMA). Pre-harvest uses of water and FSMA compliance have recently been re-opened by FDA to address the concerns brought forward by many parties in the agricultural community across the country.

At this time, specific new rules have not been promulgated under FSMA regarding cooling or wash water. However, the general guidelines of FSMA apply, implying that one needs to know: 1) What is the process? 2) Why is it the process? 3) How do you know that you did the process?

It is important to recognize that cooling and washing are part of the process and that there is generally no kill step to mitigate failures in control when dealing with produce. Frozen products that are blanched are the major exception.

To address these three questions, it is easier to start with why it is the process. Cooling rapidly removes field heat and slows the metabolism of the product, conserving sugar and thereby preserving shelf life. Washing removes foreign matter and reduces microbial load to some degree. It's essential to do no harm during both the cooling and washing of these products. For doing no harm, the most important food safety objective associated with both of these processes is mitigation of cross-contamination by managing the water chemistry. This management is complicated by the reuse of water in these processes to reduce energy costs. In any event, allowing trace sporadic contamination to spread is not acceptable. Increasing the microbial lethality of wash processes to a 4 log kill remains the holy grail of produce washing. Unfortunately, a 4 log kill remains out of reach without rendering products unacceptable, but there may be improvements on the horizon.

Challenges

At this point, a diligent processor who wishes to comply with FSMA encounters three important challenges relative to mitigation of cross-contamination. First, there is no gold standard process for washing or chilling that has regulatory standing and that by definition controls cross-contamination. There is no safe harbor. Unfortunately, it is also unreasonable to expect FDA to provide a safe harbor as it would absolve the industry from utilizing the best practical process. Second, there is no standard assay or objective measure for cross-contamination. Without a procedure, no numeric standard can be established. A qualitative standard, such as "no detectable cross-contamination," is a meaningless bandage unless a procedure sets a standard for how hard one must look. Existing analytical tools such as most probable number (MPN) techniques permit detection of minute levels of cross-contamination. And third, there are limited options for testing whether cross-contamination is mitigated. Taking even a benign organism into a food processing facility is unacceptable. Intentionally inoculating a food or a processing line should not be done. Additionally, no acceptable surrogate has been identified. SafeTraces continues to develop a non-living surrogate but much work remains before it has a commercial product for demonstrating cross-contamination control.

Controlling Cross-Contamination

According to Journal of Food Protection's "Guidelines to Validate Control of Cross-Contamination During Washing of Fresh-Cut Leafy Vegetables," featured in the February 2017 issue, authors suggest three options for demonstrating cross-contamination control: 1) Using a surrogate to demonstrate cross-contamination control; 2) Using antimicrobial sensors to demonstrate that a critical antimicrobial level is maintained during worst case conditions;

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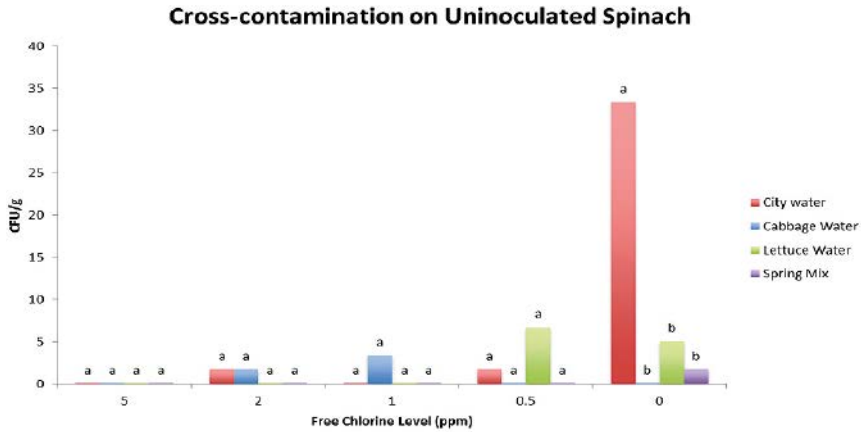
or 3) Validate placement of sensors to assure that a critical antimicrobial level is always maintained.

Option 1 is direct but subject to all the problems just considered. Options 2 and 3 assume a critical level is known. A critical level can only be established with a standardized assay for cross-contamination and an objective target for control. Neither the assay nor the objective target exist as discussed above. Option 2 also requires an understanding of the worst-case conditions. It is frequently asserted that the worst-case conditions are at high organic load. Research done in the SmartWash Solutions pilot plant using spent water from a commercial operation shows that used water provided better cross-contamination control than fresh water as shown in Figure 1. This figure shows a model system in a Product in Tote washer with steady state free chlorine control provided by a SmartWash Solutions ASAP, cross-contamination from inoculated spinach to uninoculated spinach is largely mitigated even at low chlorine concentrations in spent process water for three commodities in a system where fresh city water failed to control the migration of *E. coli* inoculum. The spent water included residual SmartWash Solutions SW. Measures sharing a letter within chlorine levels are not significantly different. The identification of the worst-case conditions is more complex than most people realize.

There is an evolving literature surrounding cross-contamination control, however it is nowhere near as developed as heat penetration studies for thermal processing. Most of the experiments are bench scale without steady state control of the antimicrobial level. It is tempting to generalize based on these limited studies to all systems. Very few studies have been done at commercial scale, so recommendations are largely extrapolations to large scale systems. Good studies will insure steady state control of the product flow, the contaminant flow, and the water chemistry including antimicrobial level and pH. The use of any wash adjuvants should also be noted as they can improve wash chemistry performance. There are indications that the sequestering power of some adjuvants, such as SmartWash, mitigate the problems of high organic loading.

Returning to our diligent processor, he or she must make some decisions about how to proceed with incomplete and imperfect information. For the balance of this discussion, let's assume that he or she has digested the available literature, has generated some of his or her own data, and has pushed his or her suppliers for information. Based on this information, the diligent processor can make a best effort to define his or her process, thus answering the first question. This process will allow cooling and foreign material removal and avoid cross-contamination to the best of their ability. The quality of this process will depend on the quality of the information inputs. The diligent processor can expect to have his or her reasoning questioned during an FDA inspection. To date, FDA has not made an inspection of this type. Until such an inspection occurs, the industry does not know what FDA will find acceptable. However, months and years of safe operation with good control should weigh into this discussion, taking us to the

Figure 1.



SMARTWASH SOLUTIONS

third question, how do you know that you did your process? Contrary to many wishes, it is unreasonable to expect the FDA to accept a 10 ppm control point for free chlorine as sufficient to define an acceptable process given that FDA has not provided a safe harbor, as already discussed.

To prepare for this third question, it is recommended that the diligent processor use an automated control system that automatically logs the key operational parameters of the defined process. Antimicrobial level and pH are the two most fundamental parameters. Temperature should also be considered if it is part of the defined process that the processor developed. However, generating and logging this data is insufficient. The data must be vetted and used.

The data vetting process involves loaded terms such as precision, accuracy, verification, validation, calibration, standards, reference, and many more. Vetting is the process for insuring that the generated and logged data are useful and meaningful. The diligent processor needs to be able to articulate why he or she trusts the logs of operational parameters. "Garbage in yields garbage out" is an oft cited aphorism that clearly applies in this situation. If the processor is using the suggested controller, the supplier of this controller should be able to demonstrate the utility of the generated data. Utility of the data is considered because all measurements inherently include error and therefore are to some extent wrong. A measurement can be expected to be no more accurate than its reference. A reference should have a traceable pedigree that instills confidence.

The inherent error is normally discussed in terms of variance and statistical probabilities. These tools can be used to establish the probability or confidence that all of the product received the defined process. At present, there is no regulatory

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Going Gluten-Free: What Manufacturers Should Know

Get a handle on market trends and challenges, including labeling and certification

BY **KAREN APPOLD**

The gluten-free market has grown from essentially unmeasurable to a multi-billion dollar industry over the last 20 years. Estimates of the value of the global gluten-free market range from a projected $4.7 to $7.9 billion in 2020, up from $1.7 billion in 2011, according to Financial Times.

Gluten is a collective name for proteins found in wheat, rye, barley, and triticale as well as derivatives of these grains, such as barley malt and wheat germ. These proteins are present in a wide variety of ingredients commonly used in food production, and play a vital role in a food product's volume, texture, and appearance. Gluten can easily hide in foods such as malted milkshakes, herbal teas, artificial flavors, candy, bouillon cubes, and lunch meats.

Some individuals have a severe intolerance to consuming gluten called celiac disease, a hereditary autoimmune disorder. When they eat gluten, damage to the small intestine occurs and they can't properly absorb nutrients into the body—resulting in nutritional deficiencies. Other symptoms might include chronic fatigue, osteoporosis, anemia, and reproductive health issues, says Alice Bast, CEO, Beyond Celiac, Ambler, Pa., a non-profit organization dedicated to raising awareness of celiac disease. If undiagnosed or untreated, celiac disease can lead to further complications such as the onset of other autoimmune diseases and some cancers. Go.BeyondCeliac.org says approximately 1 percent of Americans have this condition; diagnosis rates continue to rise as awareness of the disease grows.

"Individuals with celiac disease can only tolerate small trace amounts of gluten, so any presence must be low enough to be undetectable by scientific methods," points out Genelle Chetcuti, senior director of marketing, RW Garcia, San Jose, Calif., which manufactures gluten-free snacks.

A 100 percent gluten-free diet is the only existing treatment for celiac disease, says Sue Newell, education manager, Canadian Celiac Association, Mississauga, Ontario. Drug treatments undergoing testing by the U.S. FDA are designed to supplement a gluten-free diet, not replace it.

Up to 6 percent of Americans, or 18 million people, exhibit similar symptoms to those with celiac disease when consuming gluten, according to Go.BeyondCeliac.org.

This is called a non-celiac gluten sensitivity.

Having to eat gluten-free in order to stay healthy is quite burdensome. Gluten-free consumers have to become expert label readers and be on the lookout for gluten hidden in food and beverage products. "While wheat is one of the top eight allergens that are required by law to be called out on food labels, rye and barley ingredients are not, putting the responsibility on consumers to recognize sources of gluten that may be hiding in the ingredients list," Bast says. It's also difficult for people with celiac disease or gluten sensitivity to dine out, due to potential cross contact in commercial kitchens.

Perceived Health Benefits

Some consumers who haven't been diagnosed with a gluten sensitivity or intolerance are attracted to a gluten-free diet. They may perceive it as healthier or as a way to lose weight. "But this is not necessarily true," Bast says. "While many naturally gluten-free foods are very nutrient dense (e.g., legumes, green leafy vegetables, dairy, and lean proteins), many packaged gluten-free products are not. Manufacturers should focus on product development not only for tasty gluten-free foods, but also for ones that are healthy."

A nutritional comparison shows that gluten-free products are generally higher in calories, fat, and sugar and are lower in fiber, iron, and B vitamins than their regular counterparts, Newell notes. Gluten-free flour and baked goods are generally not fortified to the level of their wheat-flour equivalents.

But it is not surprising that someone might feel better when they first go gluten-free, however. "They will generally decrease the amount of highly processed foods and the number of restaurant meals they consume," Newell says. "But this benefit is not necessarily related to gluten."

Recent research indicates that eating gluten-free may increase the risk of heart disease and type 2 diabetes, perhaps because of a reduction in whole grain consumption, adds Newell. Gluten-free consumers are also at risk for higher levels of arsenic and mercury, depending upon the amount and source of the rice they consume to replace gluten grains.

Bast says, "Manufacturers should focus on product development not only for tasty gluten-free foods, but also for ones that are healthy."

Gluten-Free Requirements

Gluten-free labeling is voluntary. However, in order to be considered a "gluten-free" product in the U.S. and Canada, products must have a gluten content of less than 20 parts per million (ppm), which is equivalent to 20 mg of gluten per kg of product, says Kristopher Middleton, technical manager, Eurofins Food Safety Systems, a Des Moines, Iowa, company focused on food safety. The FDA has included the requirements for "gluten-free" labeling as part of the Food Allergen Labeling and Consumer Protection Act of 2004. The FDA published a final rule, which became effective Sept. 4, 2013, and outlined the requirements in place for gluten-free products under its jurisdiction. The USDA also requires gluten to be less than 20 ppm in products labeled gluten-free. Health Canada, Canada's only food regulatory body, also requires products to contain less than 20 ppm of gluten in order to be labeled as "gluten-free," "no gluten," "free of gluten," or "without gluten."

In addition to the 20-ppm rule, Zeb Blanton, global food technical manager, SGS, a food inspection, verification, testing, and

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certification company in Rutherford, N.J., says manufacturers may label a food "gluten-free" if the food does not contain any of the following:

- An ingredient that is any type of wheat, rye, barley, or crossbreed of these grains;
- An ingredient derived from these grains that has not been processed to remove gluten; and
- An ingredient derived from these grains that has been processed to remove the gluten proteins, if it results in the food containing 20 or more ppm gluten.

Like the U.S., Canada has set a 20-ppm threshold in order to label a product gluten-free, says Laura Allred, regulatory and standards manager of Auburn, Wash.-based Gluten Intolerance Group (GIG), which certifies gluten-free products and food services.

The Assessment Process

The process of becoming certified as gluten-free is extensive. The first step of the process is to complete an application for all products and facilities that will be inspected and considered for certification from the organization they are seeking certification from, Chetcuti says. An auditor will conduct an inspection of the facility where the product is manufactured, or hold a consultation. Additionally, annual inspections of every facility are required, as well as regular testing of products and facilities. Inspectors may also make unannounced visits to a company's facility, or collect products from grocery store shelves for testing. Overall, the process averages six to 18 weeks to complete. Here's an overview of four certification organizations and what they offer.

Gluten-Free Certification Organization (GFCO). Developed by the GIG, this gluten-free certification program asserts that finished products and their ingredients contain 10 ppm or less of gluten. To gain certification, the product must also exclude any barley-based ingredients, Blanton says.

GFCO requires ongoing testing of products and equipment, and an annual audit. Manufacturers must also comply with all government regulations regarding allergens, gluten-free labeling, and Good Manufacturing Practices (GMP).

Allred points out that GFCO offers true accredited product certification as defined by the International Organization for Standardization (ISO) 17065 Standard. Certifications offered by organizations other than GFCO are referred to as "self-certifications," in which a manufacturer decides if it has produced the gluten-free product safely. Some other certifiers require that the independent companies performing their certifications be accredited to a different ISO standard, 17021, which allows them to certify a company's management system, but not the products themselves.

Gluten-Free Certification Program (GFCP). Administered by the Allergen Control Group and endorsed by North American Society for the Study of Celiac Disease, the GFCP employs a Hazard Analysis Critical Control Point (HACCP)-based standard that addresses incoming and process hazards, including undeclared gluten, as part of a manufacturer's overall food safety management system, Blanton says.

The ingredients used in GFCP-certified products must contain 20 ppm or less of gluten, and the facility must have an auditable GMP/HACCP-based food safety system or equivalent in place. It must also undergo an annual audit from a GFCP-licensed auditing company or certification body.

Middleton says Eurofins Food Safety Systems chose to partner with the Allergen Control Group by using their GFCP because of its strict requirements to ensure that products are gluten-free. Another benefit is that it can be easily paired with a Global Food Safety Initiative certification audit, which is in high demand by many in the industry.

SGS Solutions: Independent Gluten-Free Certification. SGS is the only independent certification body offering manufacturers a choice of gluten-free certification schemes, Blanton says. With its global network of laboratories and specialists, it has the expertise to help manufacturers adopt effective gluten-free risk management policies.

Crossed Grain Symbol Gluten-Free Product Certification. Administered by the Association of European Coeliac Societies (AOECS), this scheme certifies that a product has 20 ppm or less of gluten. It involves a stand-alone audit against AOECS' gluten-free standard, Blanton says. Manufacturing facilities producing

The Codex Alimentarius standard states that gluten-free products must not contain oats and must not exceed 20 ppm.

AOECS-certified products must be audited, with finished products being tested annually by accredited laboratories.

Oats: A Controversial Grain

Although oats are biologically gluten-free because they aren't a type of wheat, barley, or rye, commercial oats universally contain wheat and barley, starting with contaminated planting seed to shared processing equipment.

"Most consumers with celiac disease tolerate oats grown under a purity protocol well," Newell says. "Attempts to clean the wheat and barley contamination using mechanical and optical processes are controversial because contamination occurs in hotspots throughout batches. One bite might be safe, the next might cause illness."

Countries have different requirements regarding oats. In the U.S., oats fall in the category of non-gluten grains; they can be called gluten-free if they contain less than 20 ppm gluten.

Gluten-Free Beer from Witkop Teff Grains

The Journal of Agricultural and Food Chemistry reports that beers made with Witkop teff grains may be a good alternative to traditionally brewed barley beers.

Breweries have traditionally explored alternative grains, such as corn, rice, and buckwheat, to replace barley in the malting and brewing process. Teff, a small cereal native to Ethiopia that doesn't contain gluten, is another possibility. And now, for the first time, researchers are exploring the potential of a variety of teff called Witkop as a raw material.

Researchers examined the Witkop teff malting process, in which grains are steeped, germinated, and dried, to determine the optimum conditions. Witkop teff took longer to malt than barley, and the team found that the teff had different enzymes to break down sugars than barley. The researchers concluded that Witkop teff grains have potential as a raw material for beer production but would likely require custom malting equipment on an industrial scale.—*FQ&S*

Canada does not allow the use of regular oats in gluten-free products, Newell says, but GMP may bring the cross-contamination level below 20 ppm, meeting the requirements to use the label "gluten-free oats."

The Codex Alimentarius standard states that gluten-free products must not contain oats and must not exceed 20 ppm. "The Codex definition includes oats as a source of gluten, but most countries have decided that oats that are free of contamination from wheat, rye, or barley can be considered gluten free," Allred says.

Challenging Aspects

Understanding and complying with an organization's standards is probably the most challenging requirement for manufacturers. "Most companies fail to completely read, analyze, and implement a standard's requirements and how it will be perceived by the auditor when they visit their facility to conduct the audit," Blanton says. "It is important to fully review a company's standard operating procedures, employee practices, written policies, food safety manuals, and so forth to ensure they meet a standard's provisions."

Think of the standard as a guide to compliance and how you would present evidence to the auditor to ensure they see that policies and procedures meet that goal. A good example is most standards require manufacturers to have an organizational chart showing who is responsible for each phase within the organization. "The auditor is not going to be able to assess a facility's reporting lines unless he can see a clear chart showing the areas of responsibilities and their reporting lines for each position starting at the top," Blanton says.

Allred recognizes that the diligence of the certification process requires a number of steps and documentation, and having a good grasp of all of the steps and requirements for certification is probably one of the most challenging aspects for clients. "We encourage them to stay in close contact with their customer service representative, who can let them know where they are in the process and what will occur next," she says. ■

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How Language Learning Translates to Food Safety

Training employees with limited proficiency in English can help prevent foodborne illness incidences

BY **CHRIS BROTHERSON**

As one of the largest employing industries in the U.S., the restaurant industry currently provides jobs for 14.7 million people across the country, and the need for restaurant workers shows no signs of slowing down any time soon. In fact, analysts predict an additional 1.6 million jobs will be created over the next decade.

Still, this workforce is headed for a significant shift. Although the restaurant industry already has a higher concentration of foreign-born workers than any other sector in the country (more than 23 percent of individuals employed at restaurants are foreign-born, versus 18.5 percent for the overall economy, according to QSR Magazine), that number will continue to grow astronomically, as many of these new jobs will be filled by foreign-born employees and their immigrant children. The skills gap that currently exists for many of these workers who are not proficient in English will also grow, especially in cities such as Miami and Orlando, which are expected to receive an influx of workers coming from the Virgin Islands and Puerto Rico looking to build new lives and find work following the aftermath of recent hurricanes. Now, more than ever, it is critical that the industry take action to give its workforce the tools and resources it needs to communicate effectively.

Dominating nearly every part of retail food service, foreign-born workers hold jobs as cooks, waiters, bussers, dishwashers, kitchen staff, food prep staff, frontline food workers, service and maintenance workers, and hosts. In fact, the National Restaurant Association found that "a full 43 percent of restaurant chefs are foreign-born."

While it is undeniable that these workers are a vital part of the food service industry, it cannot be ignored that many of them possess limited proficiency in English, referred to as LEP, a staggering factor that can negatively impact profits of food service restaurants and the professional confidence of the employee. Lacking basic English communication skills, LEP workers often unknowingly put themselves, fellow food service workers, and customers at risk.

For example, a Massachusetts family is suing Panera Bread after their 6-year-old daughter suffered a violent reaction and had to be hospitalized after eating a grilled cheese sandwich containing peanut butter—despite warnings from the parents about their child's peanut allergy when they had placed the order. According to the Boston Globe, the manager of the Panera Bread franchise outlet "blamed the incident on a 'language' issue...conceivably [by] an employee with limited English." Less than one month later, a different family experienced a similar incident at another Panera Bread location.

These incidents show firsthand how detrimental miscommunication within the food service industry can be, even leading to potentially life-threatening mishaps. While usual tactics such as food allergen training are often a part of food safety training, what's intended to be a clear lesson on handling food allergies, intolerances, and sensitivities isn't so clear when it gets lost in translation. The truth is that instances similar to the ones that occurred at Panera Bread are highly likely to occur time and time again when language training is left out of the equation.

The good news is that employers can take proactive action to help prevent these mistakes and help their teams grow and develop at the same time.

An Essential Element

Implementing a language training program has become a common practice with many food service businesses and should be implemented as an integral part of food safety training. Treating it as an important building block within the foundation is

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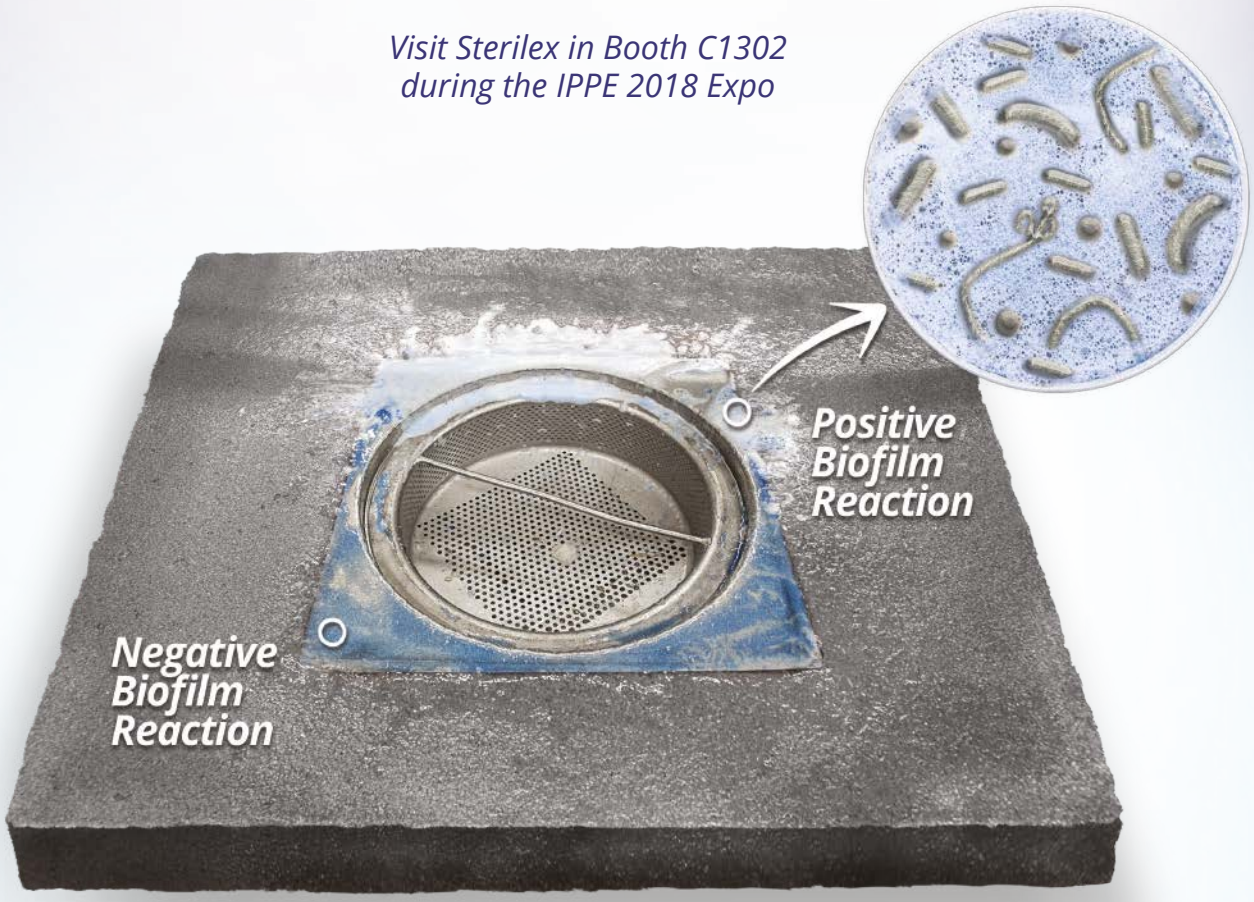

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(Continued from p. 24)

critical, because without it, communication can have crippling effects.

As a complex industry made up of many moving parts, language barriers pose a large safety problem for food service managers and owners in particular, including the following.

High risk of litigation. LEP workers with an inadequate grasp of safety or food prep protocols open restaurants and food service outlets to a higher incidence of lawsuits. A Chili's Grill & Bar, Charlotte, N.C., was cited by the county health department when an employee was unable to explain proper healthy policy, while a man brought a suit against an Oregon steakhouse after going into anaphylactic shock after his food order was prepared incorrectly.

Jeopardizing other employees. LEP workers who don't have a clear comprehension of evolving safety guidelines, store policies, and job protocols put fellow employees at a higher risk for injury.

Increased safety risk to themselves. Trends show a disturbing rise in problems for LEP workers. A 2016 report from the Food Chain Workers Alliance and Solidarity Research Cooperative found that "non-fatal rates of injury and illness in food production jumped from 4.6 cases per hundred workers in 2010 to 5.5 in 2014."

Increased workplace fatality rate. SafetySkills, a safety training company, found that "Hispanic and Latino workers have the highest workplace fatality rate of any group, nearly 50 percent higher than the overall rate...largely attributed to language barriers..."

Major impediment to food safety. One report from Journal of Extension estimates that "59 percent of the foodborne illnesses originate from retail food service establishments." LEP workers only compound the problem.

Solo Not the Solution

Since LEP workers play such an integral role within food service, each of the consequences outlined above can greatly jeopardize the productivity and profitability of the industry. It's crucial for managers and operators to come to the table with proactive solutions before these risks become a reality and threaten the future of the establishment. Many LEP workers want to improve their language skills, and as many as 31 percent have noted the desire to participate in learning opportunities but have not been able to according to the National Skills Coalition, and learning on their own tends to be a challenge due to obstacles they face. This is where managers and operators need to come in and offer language training for their employees to solve the existing skills gap and better protect their customers, workers, and overall business.

Common obstacles that LEP workers face with language training on their own include the following.

Lack of financial resources. The unpredictability of income earned by LEP workers in the food service sector and scant monetary assets create a major impediment. An analysis by the National Skills Coalition found that a whopping 84 percent of service sector workers enrolled in formal degree or certificate programs received no financial support from their employers.

Lack of time. LEP workers are squeezed for time, perhaps more than other classes of workers. Child care and family responsibilities consume a big chunk of whatever "free" time workers have, according to the National Skills Coalition.

Inconveniently scheduled programs. The time and location of adult education classes were often incompatible with the work schedules of LEP workers, according to a Brookings Institution report.

Long waiting lists. Adult education classes historically have had lengthy waiting lists for registration, but the situation seems to have gotten worse. For example, Los Angeles had a waiting list of 16,000 people for adult education classes in 2016, "especially the English as a Second Language programs."

A Good Investment

In order for LEP workers to improve their English language skills most effectively, their employers must play a role. However, not only will employers be enhancing the abilities of their staff by implementing onsite language learning, they'll also be ensuring the future success of their establishments.

By investing in language training programs for employees, managers, and operators would gain substantial advantages across their businesses and beyond, including the following.

Skillful customer assistance. According to Food Chain Workers Alliance, as "82 percent of food chain workers are in frontline positions," LEP workers with a competent command of English can provide better customer service and ensure a higher rate of returning customers.

Lower risk of accidents. As a report in the Journal of Extension makes clear: "...it is expected that food handling behaviors will improve due to improved knowledge and result in safe food handling practices, thus reducing the incidence of foodborne illness."

> ...what's intended to be a clear lesson on handling food allergies, intolerances, and sensitivities isn't so clear when it gets lost in translation.

Customized training. Managers will be in charge of designing their own onsite language training program, determining the kind of content—such as job-specific language comprehension—that they want their LEP workers to learn.

Thanks to technology, there are many digital language learning programs available for businesses to help meet their training needs and that allow their employees to learn at home or on the go. Panda Restaurant Group, for example, offers Rosetta Stone's Catalyst program as an employee benefit to its workers, many of which are English Language Learners. The company has seen a tremendous interest from its workforce, with 275 workers signing up to take on the courses in an attempt to improve their English skills. As a result, Alvin Tang, coordinator of the learning and development department at Panda Restaurant Group, told PCMag.com that he saw those same employees begin "to provide better customer service, more natural casual customer interactions, and safer exchanges with co-workers."

Tang put it best, "there are so many barriers in careers as is. We don't believe language should be one of them." The company has also seen the added benefit

(Continued on p. 42)


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The Role of Antioxidants in Extending Shelf Life

Discussion on how antioxidants fight rancidity, comparing natural versus traditional shelf life solutions, and current trends in the marketplace | BY **JENNIFER IGOU**

Antioxidants play a vital role in extending the shelf life of food. Whether antioxidants are natural or traditional, their benefits are extremely valuable to the food industry.

The ability to extend shelf life is important for not only the consumer, but also food manufacturers, retailers, and restaurants.

The Oxidation Process

It takes only a small amount of oxygen to initiate oxidation of a food item. The overall mechanism of lipid oxidation consists of three phases:

1. Initiation: the formation of free radicals; and

2. Propagation: the free-radical chain reactions; and

3. Termination: the formation of non-radical products.

When auto-oxidation starts, free radicals or chemical by-products, such as peroxides, aldehydes, and ketones form. These by-products that are formed can cause off odors or alter flavors in a food product.

Oxidation can also negatively impact the appearance of food, resulting in browning or pigment loss. It also can cause the reduction of nutrients such as essential fatty acids and vitamins.

Combating oxidation is where antioxidants come into play. They help prolong the process before oxidation of food sets in. As hydrogen donors, antioxidants donate a hydrogen to quench the free radicals being formed and delay or slow down the next phase of the reaction, propagation. This ultimately can delay rancidity.

Fighting Rancidity

Several factors or catalysts can drive oxidation in a complex food matrix. They include the presence of oxygen, light, heat, metal ions (such as copper and iron), enzymes, water activity, chlorophyll, or simply time.

Different food products will vary in their susceptibility to oxidize, whether faster or slower. For example, baked goods that are high in polyunsaturated fatty acids are more susceptible to oxidation than baked goods that contain hydrogenated fats. Additionally, baked items that contain seeds and nuts, particularly if they have been chopped or sliced, would be more susceptible to oxidation. This is due to the increased surface area, which allows more opportunity for oxygen to propagate the harmful oxidation cycle.

Besides antioxidants, there are other mechanisms to help fight rancidity in food. These include novel packaging, processing, or changes in distribution conditions, like refrigeration. Additionally, minimizing light, heat, and exposure to air can aid in increasing the shelf life of a food product.

With that said, there are a few issues with these other methods: the alternatives are more expensive, can be difficult to implement, and may not provide the desired shelf life. Whereas, antioxidants can be added at very low concentration levels, are easy to incorporate into food, and can be better and more cost-efficient solutions.

Evolution of Shelf Life Extenders

Traditional antioxidants such as BHA, TBHQ, and BHT have been the antioxidants of choice for use in fats and oils for many years. They remain benchmarks for their ease of use, effectiveness, and acceptable cost. Vitamin-based antioxidants, such as ascorbyl palmitate, are generally perceived by the public as natural, but are actually synthetically produced.

Today's focus on clean label solutions have challenged the antioxidant industry to ideate new solutions such as extracts high in antioxidant activity, like rosemary, green tea, and the use of tocopherols.

The selection of an antioxidant must be considered carefully relative to the functionality of the lipid system as well as the desired attributes of the finished food product. The shelf life required for long distribution, storage conditions, and packaging could determine which antioxidant is recommended.

Natural vs. Traditional Shelf Life

The modern producer enjoys a wide range of ingredient and packaging solutions designed to help control oxidation. Antioxidants, both natural and traditional, are just one proven solution that can be used in conjunction with other shelf life solutions.

Natural. Natural shelf life solutions can be an advantage for food producers who are trying to market their products to a certain demographic or make certain label claims. While the FDA does not define the term "all natural," consumers have varying ideas on what a cleaner label means to them.

In addition, natural shelf life solutions can be used to produce a food product with ingredients consumers can recognize or that are less "chemical sounding." They can also be used in the case where "no artificial preservatives" is the label claim.

Traditional. Traditional shelf life solutions, such as TBHQ and BHA, have been used in the food industry for over 40 years. Both are safe to use according to the FDA, and are very effective at increasing the oxidative stability of food products even at low dosage rates.

These antioxidants offer longer carry-through in foods with challenging processing conditions. Examples of this are fried foods or foods baked at higher temperatures. Shelf life solutions like TBHQ and BHA do not impart a color, flavor, or odor to the finished food product. They are the most cost-efficient solutions for increasing the shelf life of food susceptible to oxidation.

Shelf life providers like Camlin Fine Sciences (CFS), a provider of high-quality shelf life extension solutions, produce a full line of both traditional and natural antioxidant blends in both liquid or powder forms. CFS also offers complimentary customer application testing to evaluate oxidation in a finished food product and to help mitigate the oxidation cycle.

Natural vs. Traditional Trends

The overall shelf life solutions market has grown significantly over the past few years, mainly driven by increasing demand for processed foods and widening distribution channels. There has also been more demand for natural and organic foods. This comes on the heels of increased awareness about food safety. It also has been in large part driven by social media, which has created a great deal of both awareness and discussion of the topic.

Affordable solutions to shelf life will continue to dominate the overall volume of antioxidants sold globally with a focus on synthetic ingredients.

Healthy eating trends and the preference for quality food today is fueling the demand for natural shelf life solutions. It is evident that natural antioxidants are growing at a faster rate as consumers clamor for food labels with mostly recognizable ingredients. Still, synthetic or traditional antioxidant solutions remain the largest growing segment of the global food antioxidant market.

Traditional antioxidants continue to grow in the U.S. as well as globally. However, the shift to natural is trending upward in the U.S., as it is in countries like the U.K., China, and Germany, which all have large markets for clean label.

With the rise of the middle class in Brazil, China, India, and Russia, longer shelf life is an increasing demand for food formulators. Affordable solutions to shelf life will continue to dominate the overall volume of antioxidants sold globally with a focus on synthetic ingredients.

Lastly, the other major current trend is the demand for longer shelf life, yet fewer preservatives. This has spurred food manufacturers to figure out new packaging solutions.

Rise of the Clean Label

Before making natural claims regarding specific ingredients or the overall product, food manufacturers need to clearly identify what the true needs are for the consumer, retailer, or restaurant they are developing for.

Some items food manufacturers typically have considered before moving to fully natural claims include the following.

- Do they want to keep away from a list of ingredients a retailer or restaurant chain has put together?
- Do they want to minimize the number of ingredients on an ingredient statement?
- What are the label goals regarding the "natural" claim?
- Do they want to use the word "natural" on the label, or simply be able to claim, "Made with natural ingredients"?

Going "all natural" depends greatly on the target demographic. Without a doubt, natural alternatives to traditional shelf life solutions are more expensive. Not only are the products more costly, but also an increased inclusion rate is frequently needed to achieve the same or similar shelf life.

Whether or not a food manufacturer can afford to go all natural depends wholly on for whom they are formulating. There is still a majority of the population that cannot afford the increase in their overall grocery budget that would result from the amplified costs.

Many companies, especially larger ones, have jumped on board in recent years to reformulate their products while continuing to keep costs reasonable. This is evident from the grocery aisles to restaurants with marketing at the forefront.

Count General Mills among the companies taking the clean label very seriously. Pick up a box of Honey Nut Cheerios at the store and two things become immediately evident: 1) The cereal's first ingredient is whole grain and it is naturally flavored. 2) A recent Cheerios commercial, "Good Goes Round," plays a catchy song about all the ingredients that go into their end product—from the farm to the "O."

The food industry continues to evolve to create a better and healthier end product for consumers, while helping to extend product shelf life for retailers, restaurants, and food manufacturers alike. It is an exciting, ever-changing venture in this industry and transparency is at an all-time high. ■

Igou is the general manager of Camlin Fine Sciences. Reach her at jennifer.igou@camlinfs.com.

Avoiding Stored Product Spoilage

Comparing benefits and costs of tank blanketing, air box systems, and air tank venting

BY **COLTER MARCKS**

Many food and beverage manufacturing processes require a product to be stored in a holding tank for a few hours, days, or weeks. The purpose may be temporary storage before packaging, or longer-term storage where a reaction, such as fermenting, needs to occur before processing continues.

While storage is an important step in food and beverage manufacturing, it can be prone to spoilage unless plant managers take precautions. Without protection, air that harbors bacteria, dust, pollen, water, oil aerosols, and vapors can enter the tank and spoil or contaminate a product.

There are three commonplace methods for avoiding product spoilage and contamination in holding tanks:

- Tank blanketing;
- Sterile air box systems; and
- Sterile air tank venting.

The costs and advantages of these solutions vary widely, so it's important to use them in appropriate circumstances. Let's compare their relative benefits and costs.

Tank Blanketing

The most familiar solution is tank blanketing, sometimes called "padding" or "buffering." In this method, an inert gas such as nitrogen is used to fill the empty volume of a tank, covering the product with a protective layer.

Tank blanketing is most appropriate in applications where exposure to oxygen can trigger chemical reactions that spoil products or turn them stale. A gas blanket between the product and tank ceiling maintains a stable chemical balance. Tank blanketing is often useful with combustible foods, protecting the product from oxygen, the element responsible for both spoilage and combustion reactions.

This is the most costly solution for storage protection. Producing nitrogen onsite requires a generation system—or the purchase and delivery of bottled nitrogen to your facility. In many cases, nitrogen flowing into a holding tank must also be filtered to ensure it's pure and dry, adding costs for a filtration system, housings, and elements.

The total cost for nitrogen blanketing can be tens of thousands of dollars. While it's a reliable option, it may not be warranted where simpler filtration is appropriate.

Sterile Air Box System

The second most common method for protecting food and beverage products in a tank is the sterile air box. This option works well in applications that require clean, bacteria-free air in and around their processes. It's also appropriate for processors of dairy, sour, brine, or alcoholic products because it filters out contaminants while preserving the aseptic conditions favorable to aerobic fermentation.

The sterile air box does not use a separate compressor or gas cylinder, as in tank blanketing. Instead, a low-pressure blower produces enough positive pressure to keep unfiltered air out of the tank. Sterile air boxes are a full air purification solution that come equipped with blowers, pre-filtration, and a sterile air final filter. They're available in both stationary and mobile models, which make plant modifications easier.

While less costly than most tank blanket systems, sterile air boxes are still a considerable investment. Depending on size of the application, the systems cost upward of $20,000.

Sterile Air Tank Venting

For many applications, the most cost-efficient solution for protecting storage tanks is the sterile air tank vent. Placed at the top of the tank, this vent allows air to flow in and out, compensating for changes in volume. Inside the housing is a sterile-grade hydrophobic filter element to screen out particulates and bacteria from inflowing air.

Why not just maintain a tightly sealed tank? Because tank pressure fluctuates when products are added or emptied, or when temperatures change. It's possible for the tank to bulge or collapse under these pressures. But if equalizing pressure is your main concern, a gas blanket or sterile air box may be overkill. A sterile air tank vent is a good alternative in plants where oxidation or fermentation are not concerns. Sterile air tank vents are especially effective where there is a high variability of inflow and outflow sterile air.

The initial purchase of a sterile air tank vent requires only the tank vent housing and a sterile-grade air filter. Costs vary depending on requirements, but the investment starts at approximately $1,000. Most sterile air tank vents are clean-in-place compatible.

If you're a fiscally minded manager in food processing, it pays to know the spoilage risks in your holding tanks and choose storage protection scaled to those risks. The range of options includes solutions that are appropriate for your needs and budget. ■

Marcks is lead development engineer in Donaldson Co.'s Process Filtration Division and an actively involved member of 3-A SSI and CAGI. Reach him at colter.marcks@donaldson.com.

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Utilizing Information Management to its Fullest Potential

The environmental monitoring built into leading LIMS solutions creates a defendable QA framework to keep food safe

BY **SAMUAL CLARK**

One of the fundamental requirements of the Food Safety Modernization Act (FSMA) is the establishment of an environmental monitoring program at each facility. This must define the tests, including the analytical methods, to be carried out for appropriate microorganisms that could be present in their facilities. Procedures are required to identify the locations from which samples will be collected and the number of sites to be sampled, since the number and location must be adequate to determine whether the preventive controls are effective. The timing and frequency for collecting and testing samples must be specified. There is a need to include corrective action procedures in the event that testing detects an environmental pathogen or an indicating organism. Actions might include changing sanitation methods, increasing test frequency or locations in areas of concern, segregating traffic patterns, re-training staff, and so forth. Just as importantly, all of the data associated with this testing program, including the results and corrective actions taken when microorganisms exceed safe levels, need to be recorded and accessible for audit purposes. All corrective actions should identify the root cause of the deviation, actions taken to prevent recurrence, and, if product safety is not affected, a written conclusion (supported by factual and scientific data) issued to say that the deviation "does not create an immediate food safety issue." The emphasis should always be on pre-emptive actions to remove potential points of failure before issues get into the final delivered products causing stock loss and costly recalls.

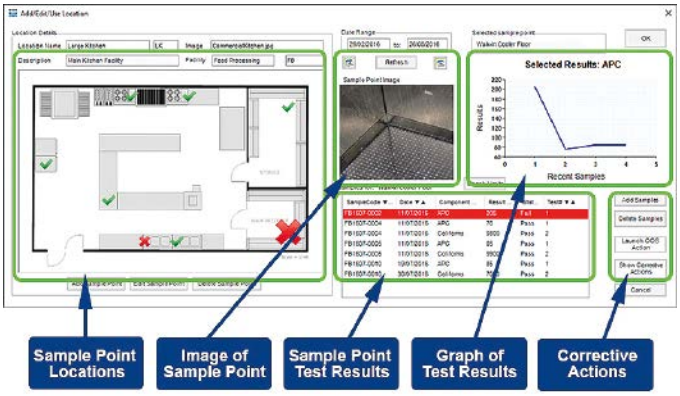
Challenges for Manufacturers and Processors

To help meet these challenges, specialist expertise is needed, which comes at a cost to the organization. Yet this should be seen as money well spent. A general guideline is that if the preventive controls are effective, every dollar spent in preventive measures is likely to save the company $10 in corrective controls where something needs to be fixed. Also, every dollar spent in prevention is likely to save over $100 if there was a failure of control such as a recall or an FDA mandated closure or the requirement to re-design their plant. Since the FSMA requirements are new and are not necessarily well understood by many companies, there are a lot of programs and consultants offering services to help companies set up their environmental monitoring programs. Clearly, specialist expertise is needed, but when building a program from scratch it can be extremely costly, mostly due to the fact that companies continue to rely on these experts when technicians don't know for sure what they are supposed to do. So they end up bringing in the expert person for more of the time. A lot of work or time is lost in uncertainty because they have to look at the guidelines, look up the requirements, and ask for help. The most cost-effective way of utilizing resources is to get the program itself set up by experts with clear instructions and processes so that much of the implementation can be carried out by lesser-qualified technicians.

Information Management

In addition to the challenges associated with designing and staffing a program, many organizations struggle with unwieldy information management. Important data can be scattered across the organization in spreadsheets and forms, etc. Any time the bigger picture needs to be examined, and while senior managers are trying to ascertain the status, there can be a lot of time spent in compiling and analyzing that data. If an auditor or inspector is expecting that

information quickly, it does not reflect well if it takes a long time to pull that information together. This is especially true if, for greater scrutiny of those details, it is necessary to sift through a patchwork of records and documentation. Of course, all the time spent on retrieving and analyzing data also takes away from productive management of the operations. This approach also keeps the awareness of the actual status of the facility to a very small group of people instead of enabling more people to devote their attention to making sure that quality processes are being followed. The use of an appropriate information management system can provide structure to ensure that technicians follow the program guidelines and make it much easier to keep track of and analyze all the data more effectively.



The LIMS Approach to Data Management

The use of a LIMS (laboratory information management system) is commonplace in QA labs to record and monitor laboratory samples, tests, and results in order to simplify and automate processes and procedures. LIMS can maintain a clear, audit-trailed, searchable record of all samples and test results, and reports issued. It can demonstrate the date/time of sampling, of results, and details regarding how/when they were reported, by whom, and to whom. In the event of a recall, it is possible to quickly retrieve test results for every lot analyzed. This makes it possible to query/analyze historical data to drive process improvement since all results can be documented and any trends identified. In this way, LIMS makes it possible to:

- Implement data management strategies that increase security and availability of data;
- Eliminate manual assembly of data for analysis and audit; and
- Make data more useful with easy retrieval/visibility.

Perhaps most importantly, a LIMS configured to automatically link test results to specific sampling points in the facility can provide a suitable framework for setup and adjustment by the environmental monitoring expert while reducing the expertise required to operate it on a daily basis. A standard operating procedure that can be developed which will increase testing and start "out-of-specification" actions if abnormal microbial contamination is detected. All actions must be clearly documented, which can be done by adding appropriate records directly into the LIMS. In the event of failures, investigators will want to focus on the particular sample points and the "out-of-specification" actions that were initiated to investigate and resolve these failures. Typically, three months of data are requested around these sample points, though up to two years' worth of data could be requested.

Getting the Most From LIMS

LIMS, in principle, provides the capability to handle the requirements of environmental monitoring. However, the system will need to be configured to do so and this may not be a trivial exercise. The software will need to be configured to represent user requirements in terms of workflows, screen designs, menu designs, terminology, numbering schemes, report designs, and much more. Full configuration for specific applications requires custom coding, which will require re-validation. However, LIMS that provides configuration tools using an interactive user interface where the core code remains unchanged removes the need for re-validation. This latter approach allows the implementation of an environmental monitoring program by non-specialist personnel and the configuration tools allow customization for any facility and monitoring program. Sampling point locations, test results, and corrective action plans can be linked in a single graphical environment. Trend analysis of the results can be made without needing to transfer the information to a separate, non-validated spreadsheet. This approach offers a way for food and drink companies to document their sanitation/safety programs and instantly show written evidence of both testing and corrective actions.

Using External Laboratory Resources

Not all food companies choose to have their own internal QA labs. This may be either because they are too small or because they choose to outsource this function. Such companies will use an external contract laboratory to ensure their environmental monitoring program is fit for purpose. In any inspection, the FDA (or equivalent authority) will want to see proof that preventive regimes are in place and corrective actions are proactively taken to ensure food safety.

Contract labs will usually have a LIMS solution and may have an environmental monitoring module in place. This LIMS extension will trace where samples are taken on each customer site along with the sampling frequency, report test results, and provide trend analysis at each sample point across each of the sites. If test results stray outside agreed limits then an "out-of-specification" action automatically starts a quality improvement cycle with the end customer. Importantly, historic data from the environmental monitoring is available allowing detailed examination, trend analysis graphs, and so forth to be created at the touch of the button should this be required by the QA teams, management, or FDA inspectors.

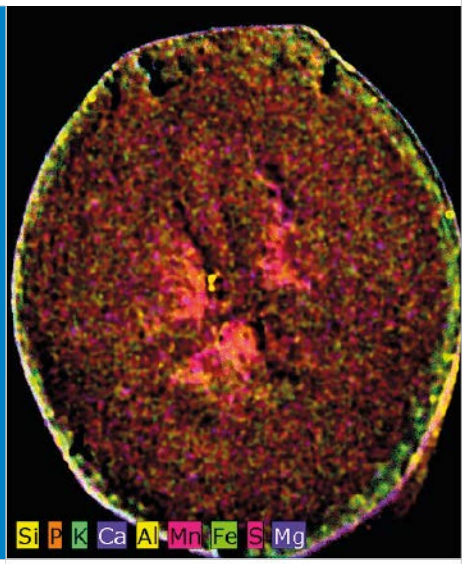
While the FSMA is U.S.-based legislation, its effects are being felt worldwide as suppliers throughout the supply chain drive preventive regimes to avoid food contamination. The environmental monitoring built into leading LIMS solutions form an important part of this food safety jigsaw puzzle, creating a defendable QA framework to keep food safe. ■

Clark is North American sales manager for Autoscribe Informatics Inc. Reach him at sclark@autoscribeinformatics.com.

Rapid Elemental Analysis Spectroscopy Methods

EDXRF spectroscopy helps food labs measure nutrients and fortificants, screen for contaminants and incidental adulterants, and identify foreign body contaminants

BY **KIMBERLEY RUSSELL, MS**



Elemental nutrient distribution analysis of banana slice with laboratory micro-XRF.

Energy dispersive X-ray fluorescence (EDXRF) spectroscopy is a rapid and non-destructive elemental analysis technique. It helps food labs optimize production processes and minimize downtime. EDXRF is used to measure nutrients and fortificants, screen for contaminants and incidental adulterants, and identify foreign body contaminants found during production or packaging.

EDXRF performs measurements on all kinds of samples including liquids, solids, or loose powders. It combines high accuracy and precision with minimal sample preparation. It provides simultaneous analysis of elements from carbon to americium and for elemental concentrations from ultra-trace levels up to 100 percent, depending on the specific instrument configuration.

EDXRF is a powerful, green alternative to traditional atomic spectroscopy methods. Sample preparation is rapid and non-destructive with no hazardous waste disposal regulations to be concerned with. Additionally, EDXRF has comparatively low operation or maintenance requirements and costs.

Options of this type of spectroscopy include the following.

- Benchtop EDXRF is the food lab method of choice for dedicated applications in quality and process control with its ease of use and compact size. It delivers speed and analytical flexibility for a multitude of research and monitoring tasks.
- Micro-XRF is the food lab method of choice for high-speed, two-dimensional elemental analysis of non-homogeneous or irregularly shaped samples as well as small samples or inclusions.
- Total reflection XRF (TXRF) spectrometry is the food lab method of choice for rapid ultra-trace elemental analysis, and low parts-per-million (ppm) and parts-per-billion (ppb) of multiple sample types.
- Handheld XRF (HHXRF) is the food lab method of choice when an analyzer needs to be brought to the sample for immediate analysis rather than transporting the sample to the lab.

Analysis of Elemental Nutrients and Fortificants

Benchtop EDXRF analyzers quickly measure elemental nutrient and fortificant content in food products at any stage of production, from incoming raw materials to end products. This includes elemental additives such as sodium and potassium or fortificants such as iron and calcium in milk products. EDXRF also measures elemental nutrient content such as selenium and molybdenum in dietary supplements or magnesium and iron in animal feed.

Micro-XRF goes one step further by providing visual images of the nutrient or fortificant distribution on or within the food product. A slice of produce is measured to determine elemental nutrient rich locations, such as in bananas and apples. Micro-XRF also provides elemental fortification distribution maps of crackers, chips, or cereal to help optimize food processing. Mapping images for the distribution of phosphorus, sulfur, and iron on cereal as well as salt distribution on snacks help determine effective fortification process steps.

Mapping images for the distribution of phosphorus, sulfur, and iron on cereal as well as salt distribution on snacks help determine effective fortification process steps.

Analysis of Incidental Adulterants and Contaminants

EDXRF is ideal for routine analysis of incidental adulterants and contaminants in foods at any stage of the product. These efficient analyzers quickly identify and quantify incidental adulterants such as lead or chromium from colorants, mercury or copper from fungicides, lead from water, or arsenic and bromine from pesticides. Minimal sample preparation is required to achieve high precision and accuracy of results.

TXRF is best suited for ultra-trace elemental analysis. While it is a powerful tool for food fraud prevention in globalized supply chains, it's particularly relevant for

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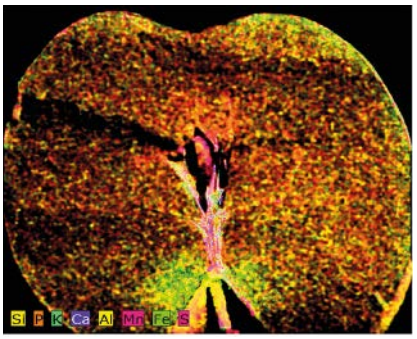
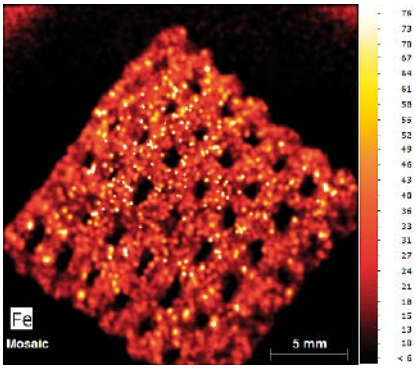


Elemental nutrient distribution analysis of apple slice with laboratory micro-XRF.



Elemental fortificant distribution analysis of cereal with laboratory micro-XRF.

food safety as outlined by the Food & Agriculture Organization/World Health Organization (FAO/WHO) standards, stating it can directly analyze low levels of arsenic in rice or lead in tea drinks. Its versatility for the analysis of multiple sample types as well as minimal sample preparation requirements for even complex samples makes it much faster than inductively coupled plasma emission spectroscopy, which requires fully dissolved liquid samples for analysis.

Identification of Foreign Body Contaminants Found

Contaminants are the last thing anyone wants in their final products, but with virtually non-stop use of production line equipment such as food augers, roller mills, air locks, and drying conveyors, it happens. When contaminants are found, the use of handheld XRF can help food labs quickly identify the foreign body and find its source to fix the problem before any more product is contaminated.

HHXRFs configured with internal libraries of standard alloy and metal grades and compositions identify the contaminants. However, to determine the source of foreign bodies, an XRF audit of all equipment on the production floor is performed first. Simple 30 second test results of all metal surfaces that come in contact with food, or have a potential for breaking, provide a production floor matching catalog. This contains the metal or alloy grade and elemental composition of each piece of equipment, component, piping, or part tested. When more than one source of an identified contaminant is possible from the matching catalog, spectral fingerprint matching is used to take a closer look. Advanced qualitative PC software for HHXRF is used to match the spectral fingerprint of the contaminant to that of its source.

How EDXRF Measures Elements Quickly

Atomic spectroscopy is the most commonly recommended technique for

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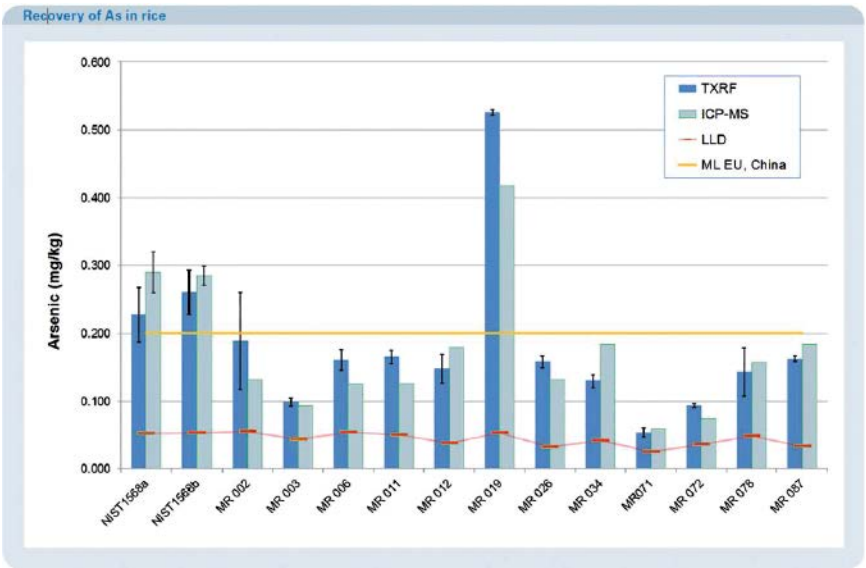
evaluating the elemental composition of samples. It analyzes the interaction between light (energy) and matter (samples). EDXRF is a non-destructive, versatile, and fast spectroscopy technique with minimal sample preparation requirements; and, it can be designed as a laboratory or portable analyzer.

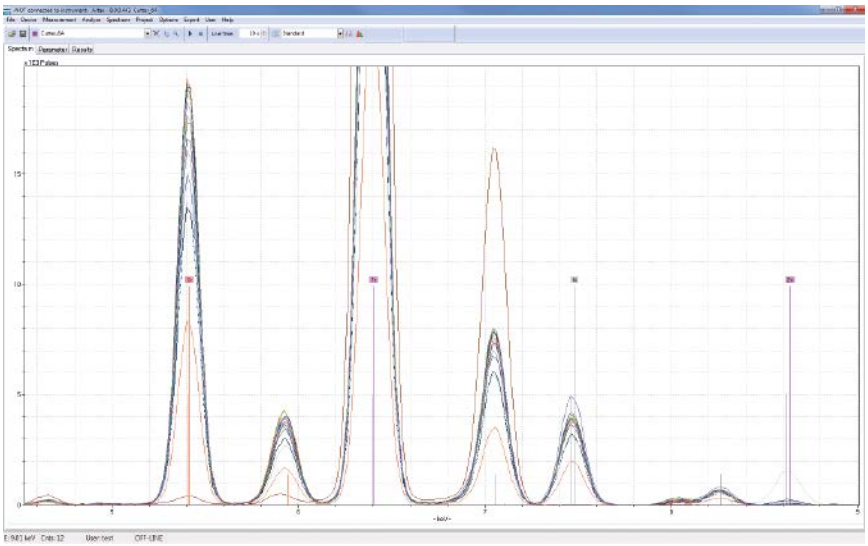
In a way, EDXRF is like a high-powered flashlight that sees beyond what humans can. When the light source is turned on to illuminate a sample, it "sees" the energy of any elements present. It also "senses" how much of those elements are present by their energy's magnitude. For example, when EDXRF illuminates a sterling silver coin, it detects silver at 22.163 keV and copper at 8.046 keV; and, it determines the coin's composition to be 92.5 percent silver and 7.5 percent copper.

The process of EDXRF elemental analysis of a sample is as follows:

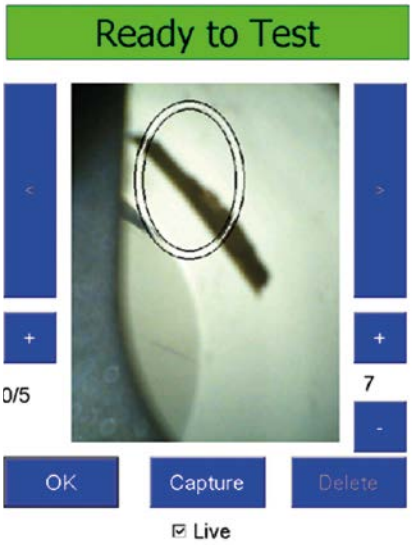
- Energy from an EDXRF source aimed at a sample can eject the sample's atoms' inner orbital electrons;
- Outer electrons move into those voids to regain stability;
- While moving in, the outer electrons generate energy characteristic of elements in the sample;
- Resultant energy is detected and processed to determine which elements are present in the sample;



Ultra-trace analysis capability of arsenic in rice with mobile TXRF.



Cataloged spectral fingerprints of relevant process equipment in production line folder for contaminant spectral fingerprint matching with handheld XRF analyzers.



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Internal camera view of metal fragment contaminant in analysis window of handheld XRF.

- EDXRF spectrometry results are represented as graphs or spectra showing intensity as a function of energy; and
- The intensity (number of photons) measured at a given element's energy determines its relative abundance or concentration.

Benchtop EDXRF. These analyzers have the widest range of elemental detection, from light elements such as carbon to heavy elements such as americium with short analysis times, high precision, and excellent detection limits. They are the most versatile in terms of setting up user specific calibrations for virtually any analysis scenario. And, they typically have the most advanced and comprehensive qualitative and quantitative data analysis software capabilities available.

Benchtop EDXRF analyzers are closed-beam systems that can be configured with air, helium, nitrogen, or vacuum atmospheres. Closely coupled thin window X-ray tubes with power up to 50 watts and 50 kV excitation voltage for direct excitation, automatic filter changer selection and high energy resolution silicon drift detectors (SDD) enable the wide elemental analysis and low detection limit range. They are self-contained with a touch screen for user-friendly routine analysis and a variety of connectivity ports. Options typically include internal cameras, automatic sample changers and spinners.

Micro-XRF. This elemental analysis technique with a spatial resolution signifi-

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In a way, EDXRF is like a high-powered flashlight that sees beyond what humans can.

cantly smaller than conventional EDXRF enables micron size sample analysis. It is especially helpful for analyzing small particle wear debris found during production or particle inclusions in plastic film found during packaging. When micro-XRF is combined with sophisticated elemental mapping software, it is ideal for studying the distribution of nutrients in foods, such as produce, and of fortificants on foods, such as cereal and snacks.

Micro-EDXRF is configured as a closed-beam benchtop two-dimensional micro-XRF spectrometer, typically with a 30W powered rhodium X-ray tube, SDD detector, programmable X-Y-Z stage, fisheye camera, optical video microscopes, polycapillary X-ray optics for spot sizes of 25 micrometers, and software designed for collecting large elemental data sets and mapping distribution via "stitching."

TXRF. These analyzers provide ultra-trace (PPB and PPM) quantitative and semi-quantitative multi-elemental microanalysis. This capability is especially critical for ultra-low, but dangerous levels of heavy metals like arsenic and lead. TXRF spectrometers provide fast quantitative and semi-quantitative multi-element analysis of liquids, suspensions, and contaminants. TXRF is optimally suited for trace elemental analysis reaching ppb and ppm detection limit ranges.

TXRF analyzers are configured with a 50W, 50 kV X-ray tube, multilayer monochromator optics and an SDD detector to provide fast and accurate measurement of ultra-trace elements as low as 0.1 ppb in liquids. They have a variety of sample chamber tray configurations; and, in contrast to most analytical methods, sample amounts in nanograms to micrograms are sufficient.

HHXRF. When you can't take samples to the analyzer, you can bring a portable XRF to them. HHXRF analyzers are the most agile XRF analyzers for the simultaneous measurement of elements anywhere they're needed. Although they are primarily used for in-situ measurements, such as alloy or metal identification of in-use equipment or incoming materials, they can also be set up in benchtop stands for use with prepared or small samples. They are ideal when immediate results are needed on the production floor.

HHXRF is an open-beam technology, typically with a 2-4W powered X-ray tube, silicon PiN or SDD detector, internal camera, variable spot sizes up to 8 mm, application-specific filters, and software capable of qualitative and quantitative analysis. Some HHXRF analyzers provide the ability to use customized filters and even vacuum or helium flush for light element analysis. ■

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Optimize Safety With Smart Manufacturing

Converging operations-technology and information-technology systems into a single network architecture

BY **JEAN-LUC BONNET** AND **DANIEL REINARTS**

Food and beverage manufacturers have always had to find a balance between maintaining food safety and maximizing productivity. Today, however, a combination of internal and external pressures can make that balance harder than ever to maintain.

First, driven by new regulations and a desire to improve competitiveness, food and beverage manufacturers must be able to gain insights from large quantities of data. Manual data collection and paper-based records are no longer feasible strategies. Instead, manufacturers need secure, connected and information-enabled operations.

Second, production has also become more complex. As producers have expanded their product and packaging varieties to satisfy more diverse consumer preferences, their operations have transitioned to shorter production runs and more frequent changeovers. Amid this greater complexity, producers must not lose their grip on food safety.

Third, as production complexity grows, the workforce is undergoing a dramatic demographic shift. Experienced workers are retiring, and a younger generation of workers are taking their place. These younger workers don't have the deep experience of their predecessors with the legacy plant technologies. As a result, they may not be able to identify potential food safety issues or achieve the same level of consistent quality.

Finally, recalls in the era of social media can hurt a company's bottom line and its long-term reputation. Today, food and beverage manufacturers must be fast and laser-focused when conducting recalls to limit costs and brand damage.

So, how can producers protect food safety amid all these challenges and still increase productivity? By tapping into the power of smart manufacturing.

Get Connected

Smart manufacturing presents an opportunity for food and beverage manufacturers to gain better insights into food production processes, and to resolve or help prevent food safety issues in new ways.

Real-time data can be collected from virtually any aspect of an operation and contextualized to provide actionable information when and where it's needed. That information can be seamlessly shared across all levels of an organization to improve quality- and safety-related decision-making. And the digitization of physical processes—such as data collection and reporting—can help improve both productivity and information accuracy.

For all this to happen, however, food and beverage manufacturers must first converge their operations-technology (OT) and information-technology (IT) systems into a single network architecture. They must also adopt the enabling technologies that thrive on this network architecture, like Ethernet, cloud computing, and mobile platforms.

Rockwell Automation refers to this connected, information-enabled operating environment as "The Connected Enterprise."

Food Safety in the Digital Age

By embracing smart manufacturing in a Connected Enterprise, food and beverage manufacturers can take command of food safety in new and better ways.

Rather than having isolated islands of data, manufacturers can collect from multiple sources and centrally store information to have an entire perspective of how their products are made. Most historian software solutions are well-adapted to collecting large quantities of data. However, enterprise manufacturing intelligence (EMI) software can also provide workers with data-rich dashboards, offering job-specific insights into food quality and safety processes.

For example, EMI software can use existing data on variables such as speed, current, and time, and aggregate them with data coming from other systems, including batch and recipe IDs. This can turn into actionable information related to critical control points and CIP data for regulatory compliance, continuous-improvement goals, and other purposes.

On the other hand, a scalable manufacturing execution system (MES) can help manufacturers reinforce quality rules based on specific recipes, customer demands, or market constraints while tracking quality in real time. Process data can also be fed into an MES to create consistent workflows and help ensure that each batch is the same, even as raw materials vary.

A production-management MES module can help workers make sure they download the correct recipe with equipment specifications for each production run, and print accurate labels from production to palletizing. Accurate labels can be especially critical for consumer protection—incorrect labeling is one of the core factors in food recalls as outlined by the U.S. FDA.

A quality-management MES module can help reinforce food quality. The software can alert workers when they should take samples or which specification they should be measuring against. It can also provide integrated video instruction, notify operators when there is a deviation (SPC function) from critical limits, and collect any required production data in real time.

Rather than having isolated islands of data, manufacturers can collect from multiple sources and centrally store information to have an entire perspective of how their products are made.

In addition, to meet new and emerging traceability requirements, food and beverage manufacturers can deploy a supply-chain, track-and-trace system. Beyond regulatory compliance, these systems can provide added business benefits, such as the ability to conduct more efficient product recalls and support customer-targeted marketing programs. They can also improve production costs through the mitigation of waste due to quality-related issues.

Mixing optimization solutions can help manage process changes and ingredient variability to improve product consistency. This can help in applications ranging from single repeatable processes to large processes that have complex sequencing requirements.

Rather than designing an in-house, track-and-trace system, which can be difficult to sustain over the long term, food producers should consider using an out-of-the-box system. Such systems can be easily integrated into a production line while providing buffering and translation to achieve interoperability all the way from the machine to the cloud. An MES system provides a reliable platform to maintain data integrity while being customizable for an application's specific requirements.

Model predictive control (MPC) software can help improve product quality caused by equipment and ingredient variability. MPC systems take multiple, variable material or system inputs that may not react linearly and provide one or more outputs.

The MPC software adjusts the system as the materials enter the conversion process instead of adjusting based on the measured values after conversion. The reduced variance in output often allows the system to adjust target values closer to formula limits, resulting in higher yields.

Finally, food and beverage manufacturers shouldn't underestimate the role that machine analytics can play in food safety. Scalable analytics software can be deployed as close to the source of data as needed, and track machine or device performance to see if it's operating within specification limits. Manufacturers can then use that information to take preventive actions and resolve machine-degradation issues before they start to impact product quality.

The Security Factor

As food and beverage manufacturers bring their food quality applications online, they must also have a robust industrial-security program in place.

A security-through-obscurity approach is not sufficient for today's vast and continually evolving threats. Instead, a multilayered, defense-in-depth security approach should be deployed as a natural extension of a producer's production processes.

Defense-in-depth security establishes several lines of defense against all types of threats by deploying security measures at six levels: physical, network, computer, application, device, and policy. Every organization's security strategy will be unique. However, key safeguards that every food and beverage manufacturer should consider include an industrial DMZ, data encryption, anomaly-detection software, and authentication, authorization, patch management, and accounting software.

Why Wait?

Food safety issues reverberate far and wide. Most importantly, they can affect the well-being of consumers. From a business standpoint, they can seriously disrupt operations, damage brand reputation, and have financial consequences ranging from lawsuits to lost sales.

Food and beverage manufacturers have a lot at stake. They should leverage the opportunities offered by a Connected Enterprise to better manage today's challenges and help protect the integrity of every product that rolls off the line. ■

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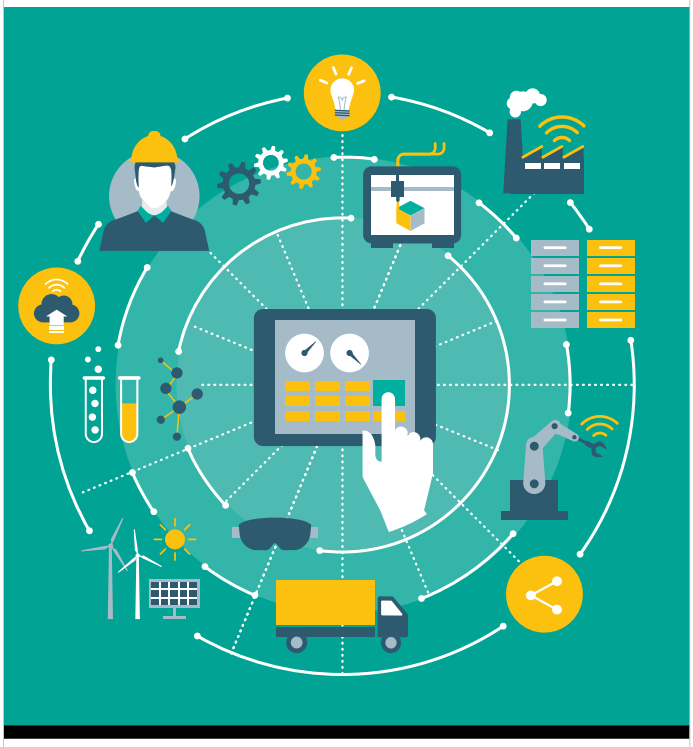
Reducing Risk and Limiting Recalls: How the IIoT Can Help

Factors to consider when adopting the Industrial Internet of Things into a manufacturing process | BY **JASON ANDERSEN**



By 2020, the Earth's population is expected to rise from 7 billion to 9 billion. The agricultural sector will need to find ways to produce more food in order to meet this increasing demand for supply. However, there is another way to help address this deficit—avoiding food waste by preventing or limiting recalls.

Across the industry, people are paying attention to this issue and are focusing on preventing it. But, oddly enough, the USDA states that the amount of food recalled nationally increased by 37 million pounds between 2015 and 2016. How can that be?

This uptick is likely caused by more diligence and sophisticated analysis tools on the part of food manufacturers, making them capable of finding more issues earlier and more completely. While increased vigilance for quality is good, the resulting increase in recalls can also result in significant costs to the manufacturer—the average being $10 million in direct costs according to a study by the Food Marketing Institute and the Grocery Manufacturers Association—and may tarnish the brand, leading to poor market performance against competitors.

In order to prevent recall risks, food manufacturers today are using a variety of techniques. One example, DNA analysis, can sense when ingredients are unsafe and could affect food quality or product safety. However, while manufacturers may have controls set up to monitor their own processes, they are missing specific, beginning-to-end monitoring of their entire supply chain, including raw materials through packaging and distribution, which will help them recalibrate and adjust to this new-found visibility. This need for beginning-to-end monitoring makes the food and beverage industry ripe for disruption with the Industrial Internet of Things (IIoT). Although it sounds like a large undertaking, food manufacturers looking to adopt the IIoT will only have a few main things to consider when first starting out.

Intelligent Tracking Technology

Digitization of the food supply, from farms to warehousing to food distribution and retailing, enables the IIoT to leverage technologies that monitor and analyze the entirety of the process. The IIoT has the potential to address many challenges, including food quality, timeliness of delivery, waste, spoilage, and recalls. Leveraging sensor technologies and real-time data analytics has allowed food manufacturers to precisely monitor incoming ingredients through the adoption of track and trace techniques.

This IIoT technology can gather specific details about crops, narrowing down to the exact row in a vegetable field where something was grown. Similarly, food manufacturers can now monitor finished products in real-time from the manufacturing facility to the consumer, presenting manufacturers with the opportunity to mitigate issues that could lead to a food safety issue or spoiled product before it happens.

For example, this can give manufacturers insights into temperature changes during transport. A real-time monitoring, IIoT-based sensor and analytics system could quickly and accurately identify if products are being exposed to dangerous temperature shifts and gain insights into which batch of products might be affected in order to limit the damage. In addition to limiting wastage, it will provide valuable insight to help avoid future issues and can provide peace of mind to manufacturers who will know their product is being taken care of even after it has left their hands.

Implementing the IIoT

The benefits IIoT technology can bring to the food and beverage industry are undeniable, especially to help reduce recalls. Yet, thin margins and high competition are things food manufacturers need to consider before making the investment, which can sometimes make them slow or hesitant to move forward.

However, by knowing where to focus these efforts first and how it will pay off in the long run, manufacturers can make smart decisions when implementing the IIoT into existing processes. Three main factors to consider include the following.

1. Expand on and prioritize existing critical control points. Revamping an entire food production process with IIoT-based monitoring can be overwhelming and seem cost-prohibitive for most manufacturers. Instead, begin with areas that are most essential to food safety and quality, like the Hazards Analysis and Critical Control Points (HACCP). Gathering and analyzing data in

real time from these critical supply, manufacturing, and distribution points will provide great returns in terms of mitigating recall risks by helping to find and avoid potential problems before they become costly issues. The long-term payoff of these investments can become instrumental to a plant's success.

2. Ensure compliance through the IIoT. Implementing IIoT technologies can help food manufacturers address some of the challenges brought about by the Food Safety Modernization Act (FSMA). Regulations from the FSMA increase individual food facilities' obligations to prevent threats to the supply—the impacts of which most food manufacturers are all too familiar. The IIoT can bring about improvements such as test results that are immediately available to centralized quality systems through automated, in-line quality analysis. Through real-time chemical and spectroscopic analysis data, manufacturers can identify potential problems early in production and respond proactively before the product has been produced and shipped. This can drastically reduce the risk of a recall, large fines, and brand damage.

Another example of IIoT technology applications for supply chain compliance include the data produced, as this demonstrates to regulators that a food manufacturer is properly monitoring food quality and safety.

3. Protect and leverage data to decrease risk. Without data, the IIoT could not function and protecting the data that keep everything running is essential. In order to do that, manufacturers need to invest in systems that ensure the continuous operation of critical production and monitoring equipment. This can be done through high-availability, fault-tolerant systems that prevent data loss—from the systems that gather information throughout the supply chain to in-flight data in the cloud to permanent repositories. High availability can also increase manufacturers' confidence in these systems.

IIoT Migration: The First Step

Forward-looking enterprises are viewing IIoT implementation as an opportunity to modernize automation systems and IT infrastructures. However, for most it is still a big undertaking. Fortunately, adopting the IIoT can be an evolutionary process. Most manufacturers will start with just a few implementations that target the most essential quality control points, as mentioned earlier. As the value from intelligent tracking, tracing and analysis of the food supply chain and production process is recognized, manufacturers can then extend IIoT infrastructure into new areas. To begin this journey, take a thorough look at your entire supply and demand chain and production process and identify which control points are most critical—and start there. ■

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FDA Slammed Over Lax ...

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Mike Taylor, Dr. Ostroff's predecessor under the Obama Administration, urged Agriculture Secretary Sonny Perdue to "withdraw and reconsider" the proposed transfer.

"There has been no dialog on this proposal with the broad food safety community and no explanation from USDA of the problem the proposed reorganization solves," Dr. Taylor wrote. "The credibility and effectiveness of Codex and its mission are too important to jeopardize through hasty action to fundamentally alter the program's management."

The outpouring of criticism caught the Administration's attention. In late October, Perdue notified Senate Agriculture Committee Chairman Pat Roberts (R-KS), that he was staying the planned Codex transfer pending "further discussion," the senator's communications director Sarah Little confirmed. But in a Nov. 14, 2017 agency memorandum, Perdue announced the transfer had occurred.

The U.S. now joins five other nations—Congo, Guinea, Lesotho, Madagascar, and Samoa—in having Codex oversight residing within their government's trade promotion agency. ■

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Water Usage and ...

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guidance as to how this should be accomplished. A best practices approach should address at least four types of variance including instrumental variance, process variance due to inhomogeneity in the processing system, process variance associated with product, product feed rate, and reference variance. This is a big task.

Our diligent processor has one more task to conform to FSMA. It is virtually certain that there will be some level of process non-conformity. Plans are needed to address these non-conformities. There needs to be a plan to use the data. This plan is the process to make data into information. It is very powerful to have automation handle routine matters of non-conformity. For example, if the antimicrobial level falls too low, the product feed can be halted. The logged data can provide the information to drive continuous improvement. Its value extends well beyond just insuring that the product produced at the time of collection was properly processed.

Making the assumption that everyone wants to be FSMA compliant in their water usage, it is important to understand the objectives of the water use, understand why the process is done in a particular way, and verify conformity. The water user should be able to articulate the answers to these questions before something unfortunate happens. ■

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How Language Learning ...

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of an increase of nearly 20 percent in employee retention at the locations with the highest usage of the Rosetta Stone language program. Tang can't directly tie this back to the language program but he believes providing employees with the tool "helped them feel a sense of belonging," which encouraged them to stay at the company.

As with any new initiative, comprehensive language training requires an upfront commitment of time and money on the part of the food service organization. There's no question that it will take time for workers to sharpen their language skills and additional funds to set up the program, but what you put in, you get out. If food service owners and managers provide their employees with the specific tools they need to succeed, there's a much higher chance they'll do just that.

Don't overlook a language strategy when looking at your overall business plans. It will likely save you in the long run. ■

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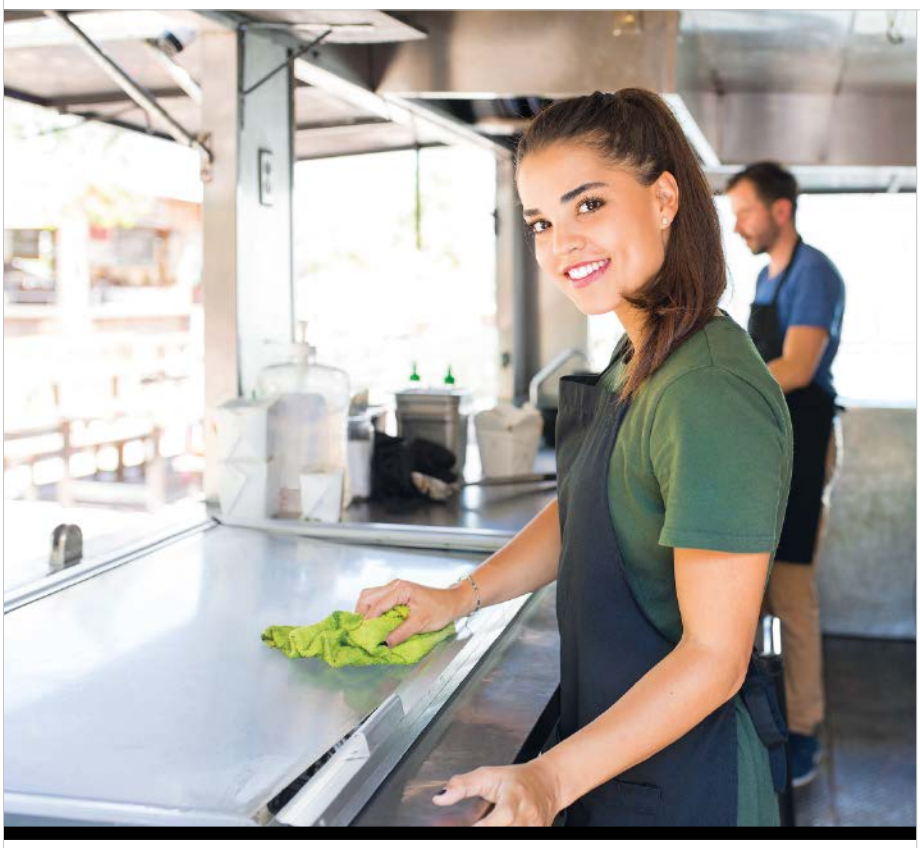

Employee Education Equals a Successful Cleaning Program

Recommendations for safety and sanitation training that keep businesses running smoothly

BY **JEFF ANDERSON, PHD,** AND **CHUCK PETTIGREW, PHD**

In the U.S., educational/training interventions have been widely used to decrease foodborne disease in food service operations with most interventions focusing on improving worker knowledge of safe food handling. The limitation of this approach is that knowledge alone does not influence the adoption of safe food handling practices.

And with the CDC estimating that 48 million people get sick from foodborne illness each year, it's important to understand the significance of a proper sanitation program and how to best develop and execute one in any food service operation.

Understanding the risk factors and levels of cleanliness needed to prevent contamination of food and kitchen equipment is the first step when implementing a thorough food safety program. Identify the types of soils and surfaces in your establishment to determine the proper cleaning and sanitation products to use, how often cleaning must be done to achieve the desired results, and the training needed for your staff from management on down.

Create a Proper Cleaning Plan

Working with your cleaning supplier is a great way to put a highly effective sanitation plan together. A cleaning supplier can help identify any contamination risks within your facility by conducting a cleanliness audit, inspecting everything from the floors and drains, to kitchen equipment and food contact surfaces, among other areas. They can also help ensure your cleaning program is working by measuring trace ATP and surface proteins through regular testing.

Once the risks have been identified, facility managers can create a Master Cleaning Plan, outlining what should be cleaned, how it should be cleaned, when to clean, and who should do the cleaning. This plan should also include details on which cleaning products to use to remove various soil types found on the different surfaces in any food service operation, as well as training procedures and schedules for staff at every level.

Common Cleaning Guidelines

Any sanitation program should include cleaning procedures for the common, and sometimes overlooked, areas found around any commercial kitchen.

Countertops. In a commercial kitchen, countertops are at the heart of the action. Protect against food cross-contamination with regular disinfection and maintenance that can help prevent foodborne illnesses.

Cutting boards. Cutting boards need to be cleaned frequently, including before use, before changing from one food type to another and after food handling is complete. Since these surfaces tend to be scored and scratched, they can harbor food that can lead to bacterial growth.

Dishes, pots, and pans. A main ingredient to a spotless kitchen is the right dish cleaning product. Get your dishes virtually spotless and remove stubborn grease by using a dependable product you can trust.

Floor drains. Bacteria can often be found feeding on food residues in floor

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drains. These food sources can also attract other unwanted pests. Regular drain cleaning can help keep this in check.

New equipment. Consider the ease of cleaning when purchasing new kitchen equipment, such as ice machines. The more difficult it is to clean, the less likely it will be cleaned consistently or correctly.

The Right Products and Tools

Using the right cleaning products and tools is also imperative when it comes to achieving food safety goals. Multipurpose products can clean a broad range of soils and surfaces, making cleaning easier by reducing the number of products needed and minimizing rework. Multipurpose products also help save time by reducing the complexity of the job, making staff training easier, and simplifying inventory management.

With employee labor accounting for up to 80 percent of cleaning costs, operators can reduce the amount of time and cost to clean a restaurant by using effective cleaning products and putting efficient cleaning processes into place.

Additionally, facility managers should have procedures in place to properly clean and sanitize cleaning tools regularly since scouring pads, brushes, and mops can be sources of cross-contamination.

Importance of Cleaning and Disinfecting

To fully understand why a proper cleaning program is important, employees need to recognize the difference between cleaning and disinfecting and why each step is essential to ensure guests (and employees) stay safe and healthy in your facility.

To start, employees need to be able to identify the difference between cleaning—the removal of soil or dirt from a surface—and disinfecting—the killing or reduction of microorganisms that cause disease, odors, and spoilage—and understand that both steps of the process are necessary.

Most disinfectants do not effectively remove soil, if at all, but cleaning well allows disinfecting agents to work more effectively because the soil is removed and cannot protect the germs. Multipurpose products that clean and disinfect in a single step are the best value for operators by limiting inventory needs, reducing rework, and simplifying training.

Incorrect cleaning methods can spread dirt and bacteria around instead of cleaning them, and not using cleaning products the way they're intended can reduce or eliminate their efficacy, putting guests and staff in harm's way.

The Value of Training

Employee education and training are the keys to success for any sanitation program. Incorrect cleaning methods can spread dirt and bacteria around instead of cleaning them, and not using cleaning products the way they're intended can reduce or eliminate their efficacy, putting guests and staff in harm's way. Training should be ongoing and provided to each new employee and each time there is a new piece of equipment or new cleaning supply introduced.

Properly training employees, at every level, can help eliminate these risks and give employees a clear understanding of why thorough cleaning is vital, and how to make sure their efforts meet the most rigorous of cleanliness standards. Proper training can also increase employee safety by ensuring that products are being used correctly and reducing rewash (exposure to chemicals) and miscalculation with mixing.

To achieve the highest levels of content retention, training programs should be developed with content that is highly visual, auditory, and tactile like videos that show and tell employees how to complete a task, including the opportunity to learn by doing. P&G Professional and Clemson University recently completed a study to determine the effect of a multi-phase, motivation-based educational intervention to improve the cleanliness of surfaces in a commercial kitchen. Validating that the trainees understood the content during the initial training sessions was one of the most important outcomes of the study, and this goal was achieved through use of multiple choice questions that were graded and documented in real time. Knowing they would be graded, trainees paid more attention to the content.

There are a variety of training tools that can be successful in reaching food service employees, including using Active Managerial Controls to help improve managers' ability to train and sustain a cleaning program and individual training for food safety/compliant cleaning. On-demand tools that offer written procedures or training videos are also ideal. For example, P&G Professional's online University site regularly monitors and records knowledge intake.

Self-Monitoring and Feedback

Implementation of routine and documented checks can help improve overall cleanliness and can be used for retraining, which is also an important step in ensuring information retention. The checks system should not be overwhelming to implement and should take no longer than 10 minutes of a manager's time. Measures can primarily be sensory (visual, touch, and smell) with established checkpoints such as tables and chairs (not sticky and visually clean). Additionally, when issues are noted, the manger should retrain employees on proper procedures using demonstrations, as well as visual and auditory training materials and techniques. Your cleaning supplier can help develop a self-monitoring program that makes sense for your business.

An End-to-End Approach

Food safety requires an end-to-end cleaning and sanitation regimen that is continually monitored, and where constant feedback is provided to achieve the overall goals of the program. By evaluating your facility and equipment needs, with an eye toward safety and ease of cleaning, and selecting the most effective sanitizing and disinfecting products, you can have a dramatic impact on food safety, as well as productivity. ■

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The Fresh Food Distribution Revolution

Eliminating potential breaks in cold chain to get fresh prepped foods to destinations faster, whether on store shelves or consumers' doorsteps | BY **MICHAEL LIPPOLD**

There's no denying that more and more Americans are adopting healthier eating habits. There's also no denying that they are still creatures of convenience. Not only do consumers want *real* food—nutritious, natural, fresh, unprocessed, and free of preservatives—but they also want it to be fast and easy.

However, making fresh, home cooked meals isn't something that everyone has the time, interest, or ability to do. While the healthier-eating trend is pushing us toward fresh ingredients, there's an equally powerful trend demanding convenience. Microwave meals are not the answer anymore, but study after study shows that Americans aren't willing to devote many hours to meal preparation in the kitchen or cruising aisles at the grocery store either. Society has learned to expect increasing convenience in every aspect of our lives, and getting dinner on the table quickly is no exception.

So how do we rethink the nationwide food industry infrastructure to get fresh, convenient food to consumers—whether onto store shelves or direct to doorstep—and do it safely?

The Enemy to Prepped Perishable Food

The current food distribution system struggles to meet these twin demands for freshness and convenience when it comes to short shelf life, prepped perishable products. Food is the third-largest expenditure in most Americans' monthly budgets, but surprisingly unlike the two other big-ticket categories—housing and transportation, which have seen major technology advancements—food distribution is still for the most part a very low-tech system. It's slow, it's inefficient, and it isn't built to move prepped perishable food quickly.

Too often prepped perishable foods (e.g. pre-chopped vegetables, pre-peeled and cut fruits, etc.) lose their luster because of breaks in the cold chain during fulfillment and delivery, and due to inefficiencies occurring at every stage of the production and distribution process. Although consumer demands are clearly changing, the distribution system remains stuck in the past, making it difficult to get the fresh, flavorful, prepped foods people want to where they are needed.

Awareness of the need to handle prepped perishable food more effectively and through differentiated, convenient solutions is growing. Supermarkets are feeling the pressure to meet the demand for fresher items and convenience packaging and services, and are now offering tools like online ordering and expanding their prepped perishable sections. Freshness and convenience are also being touted by new categories such as direct-to-home meal kits. However, this sector is experiencing challenges of its own. Many current meal kit solutions often include un-prepped ingredients, which require more time in the kitchen than would be considered turnkey by many consumers. Plus, the ingredients themselves are often below quality standards, or even unsafe, due to poor thermal packaging in transit.

A 'Break' in Safe, Fresh Delivery

With food delivery, whether to store shelves or direct-to-home, the cold chain is the number one, two, and three most important consideration in a good food safety program. Breaks in the cold chain are a critical issue when dealing with prepped perishable foods.

For direct-to-home, the primary challenge appears to be the gap between delivery and refrigeration—the last hours of the last mile. As one example, most meal kit vendors and delivery companies don't consider that many people work during the day and a delivery left on a doorstep may sit for hours before the items are unpacked and refrigerated. Additionally, they don't think about how the icepacks shift during shipping. Upon delivery, the protein may not even be next to the ice

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anymore. Not to mention, some packages sit in the cold, some in the heat, and some in the sun. All of this creates a difficult problem that takes deep thermal research and understanding to solve.

Stepping away from doorstep delivery specifically and exploring the cold chain on a more macro level, the prepped perishable food industry needs to ensure that from source to retailer shelf, there is no break in the cold chain (that is, until the product meets consumers' hands). Every break introduces some level of degradation, leaving the food much less fresh and safe.

Whether for meal kit delivery or prepped perishable options at the retail level, a food safety standard as stringent as the one that continues to work for mainstream retail industry must be adopted. But to get there, and address the growing consumer demand for freshness and convenience, the industry needs to be ignited with fresh thinking, fresh technology, and food safety accountability.

Keys to an Effective Solution

New delivery solutions are being developed, but change doesn't always come quickly, and there are still many details to work out before we'll see broad adoption of a different way to get fresh meals to consumers—conveniently and safely.

Ultimately, an effective distribution system for prepped perishable food needs to meet key criteria:

- It should connect existing industry infrastructure and allow each part of the perishable food ecosystem to function in its core competency and not seek to rebuild the fresh food industry, but connect it to work more efficiently; and
- It should adhere to the standards of the Global Food Safety Initiative and manage the cold chain along the entire delivery route, maintaining a safe temperature—not too cold and not too warm—for the entire journey, including the hours after the food has been delivered to the consumer's doorstep.

Different players in the fresh food category are taking individual approaches. FreshRealm, for example, is building a national infrastructure that enables companies to quickly and safely deliver fresh prepped meal kits, and prepped and prepared foods, to customers direct-to-doorstep or to retail store shelves. It allows the grocer to get meal kits from farm to store shelf or doorstep in 48 hours. This entails:

- Starting with high-quality ingredients sourced from the same producers that are featured in high-quality natural food supermarkets;
- Having meal kits made to order—first prepped in regional facilities, according to a standardized ingredient SKU set—and then sent to stores directly for retail sale or packed in the FreshPorter shipping container for safe delivery to doorsteps via FedEx or UPS; and
- The proprietary ice algorithm to mathematically calculate optimal quantities and locations where food and ice are to be placed inside the FreshPorter depending on the forecasted temperature range along the delivery route and at the delivery location.

The FreshPorter maintains an optimal temperature range of 32.5 degrees Fahrenheit to 41 degrees Fahrenheit with no electricity or consumables until 9 p.m. on delivery day, even when the outside temperature is high, low, or even both during the same delivery route. Once the FreshPorter is delivered and unpacked, the user peels off the original shipping label to reveal a prepaid return label underneath. The FreshPorter is left outside for automatic pickup and returned to FreshRealm, where it's sanitized and reused.

FRESHREALM

> ...the industry needs to be ignited with fresh thinking, fresh technology, and food safety accountability.

A Unified Focus

What needs to change to safely democratize fresh food? What's the solution?

Don't *only* invest money in marketing to the changing needs and tastes of today's consumer, which is the focus of many current meal kit companies, but also invest in developing infrastructure that allows the industry to be safe and more efficient. More innovative technology and solutions need to be developed and embraced to support the consumer demand for fresh, convenient foods, whether on store shelves or delivered directly to their homes. Collaboration is key to put these building blocks together.

The entire industry doesn't need to be rebuilt, but there does need to be a strong investment in technology that allows the current disparate pieces to integrate. When this happens, the industry can truly meet today's demand for fresh, convenient foods. ■

Lippold is the founder and CEO of FreshRealm. Reach him at michael@freshrealm.com.

NEW PRODUCTS

Engineless Refrigeration Unit

The 35X direct-drive unit provides refrigeration for perishable and frozen cargoes for small- to medium-sized box trucks and large delivery vans. It offers refrigeration capacity of 10,500 BTUs at 35 degrees F (100 F ambient). The 35X includes an exterior-mounted condenser unit, a compressor that mounts to the truck engine, and a narrow-profile Slim-Line evaporator that fits tightly to the ceiling of the cargo area, helping to maximize cargo space. As a split system, the 35X unit provides flexible mounting options for the condenser, either to the nose of a box truck or roof of a van. The unit's Cab Command 2 digital controller provides quick setpoint configuration and the ability to program the unit for automatic defrost cycles. It also offers diagnostic capabilities and hour-meters to track usage for service interval planning. **Carrier Transicold, 800-227-7437, www.transicold.carrier.com.**

Oxygen Absorbing Flexible Packaging

NutraSave, a resin technology, keeps foods fresher and enhances the consumer appeal of popular brands while minimizing food waste and costs. Embedded as a film layer within flexible packaging, it removes oxygen trapped within sealed packages to safely extend and protect original food flavors, aromas, and textures without the need for sachets or packets. Ideal for retort packaging applications, NutraSave protects products such as soups, sauces, processed fruit, protein bars, prepared meals, and wet pet foods, as well as natural and organic and gluten-free products that are particularly vulnerable to food spoilage. The preservative-free innovation, which prevents mold growth and color changes, is FDA compliant. **Mitsubishi Gas Chemical America, www.mgc-a.com.**

Condensation Management

Condensation Management Film is an adhesive film designed to manage intermittent condensation formed during the sanitation process in food processing environments. Its wicking technology minimizes the release and transfer of hanging water droplets. The adhesive increases the evaporation rate, with lab studies showing condensation drops evaporating on average 10 times faster than natural evaporation, says company. Unlike traditional methods, Condensation Management Film can minimize the release and transfer of condensation droplets, improving plant hygiene. The film can be applied to many metal and plastic surfaces including galvanized and stainless steel, PVC, aluminum, and copper at 5-10 ft./min. **3M, 800-362-3550, www.3M.com.**

Food Safety Spill Kits

The Premium Food Safety Spill Kit featuring GOJO Industries' PURELL Foodservice Surface Sanitizer ensures all biohazard cleanup materials for a single event can be accessed at once when needed. Each kit contains a bilingual training guide, protective equipment for employees, and disposal supplies for the safe removal of fluids. Kits are easy-to-access capsules—easy for staff to get to when accidents happen and easy for health department inspectors to see that an establishment is prepared. The kits contain everything an operator needs—and everything used in the kit is designed and portioned for immediate disposal upon completion of the cleanup, a critical final step. **OSHAKits.com, 800-270-0153, www.oshakits.com.**

UV Disinfection

S.A.G.E. UV is an antimicrobial line of germ-killing products that combines a broad spectrum of UV and violet blue light with motion sensor technology and artificial intelligence to automatically kill germs whenever a room is unoccupied. According to the company, it effectively kills up to 99.9% of the most common germs from as far as 3 meters away. By combining UV-C, UV-B, UV-A, and violet blue light, S.A.G.E. UV optimizes the amount of the germ-killing energy delivered through the air and onto any contact surface. This causes inactivation of microbes and inhibits reproduction, preventing the spread of harmful bacteria and viruses. **Violet Defense Technology, 407-433-1104, www.violetdefense.com.**

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Optical Sorter for Nut Processing

The SORTEX F optical sorter provides hygienic design and high capacity performance for the nut and dried fruit processing industry. Available with SORTEX BioVision technology, it provides 3-in-1 detection of color defects, shell, and foreign materials. Featuring a stainless steel, open design frame with sloped surfaces, hygienic conduits, and food-safe grade fixings, the SORTEX F helps to eliminate the risk of cross-contamination and product buildup, as well as preventing the growth of pathogenic bacteria that can induce foodborne diseases in low moisture foods. All polymer materials are resistant to high pressure washer jets or air and conform to FDA regulations. **Bühler Group, www.buhlergroup.com.**

Sterile Air Filters

The P-SRF filter line includes two variations: P-SRF V, a borosilicate depth media suitable for final filtration of processes and venting applications; and P-SRF X, a pleated PTFE final membrane filter in a strong stainless-steel housing designed for extreme conditions and temperatures. Both filters deliver a log reduction value of 7 or greater for bacteria, viruses, and particles (down to 3 nanometers) to improve product and process integrity. Mechanical stability and temperature resistance up to 392 degrees F. Superior de-wetting characteristics for faster filter drying times. **Donaldson Co., Inc., 800-543-3634, www.donaldson.com.**

Metal Detector/Magnetic Separator Systems

Metal Detector/Magnetic Separator "Double Team" Systems offer customers protection against ferrous and nonferrous metal contamination. The first new system is a Magnetic B Trap followed by an XtremeLiquid Line Metal Detector. The magnet removes the ferrous contamination from the pumped liquid product, improving product quality and minimizing rejected material from the downstream metal detector with automatic rejection. The metal detector is left to focus on detecting and rejecting non-magnetic tramp metals, such as aluminum and stainless steel. The other new system pairs a Magnetic Grate-in-Housing with an Xtreme Gravity Drop Vertical Metal Detector. The magnet removes the ferrous contamination from the gravity-dropped material to enhance product quality and reduce rejected material from the downstream metal detector with auto reject. Both systems ensure compliance with HACCP programs and regulations set forth by various federal agencies. **Eriez, 888-300-3743, www.eriez.com.**

PCR Enterobacteriaceae Kit

The iQ-Check Enterobacteriaceae PCR Detection Kit can provide results in as little as 3 hours following a single enrichment. Developed as an open and flexible system, the kit can be used for up to 94 samples on high- or low-throughput Bio-Rad instruments. According to company, it is designed as a multiplex reaction that includes an internal inhibition control that is amplified in parallel with the target DNA for a reliable result with negative result validation. **Bio-Rad Laboratories, Inc., 800-424-6723, www.bio-rad.com.**

In Other News

Alchemy Systems launches Alchemy Academy, a new online training resource for food industry supervisors, managers, and safety professionals.

AOAC International validates **Bio-Rad Laboratories'** iQ-Check *Salmonella* II Real-Time PCR Kit as a First Action Official Method of Analysis for the detection of *Salmonella* spp.

iGPS Logistics now offers the capability to deliver direct food contact level safety for its pallet customers by applying a food contact surface sanitizer to its plastic pallets.

Hygiena expands its testing portfolio with PCR-based systems.

Mission Data introduces OpSense, an IoT platform based on a temperature management solution created with **Kroger.**

Microbiologics expands its UV-BioTAG Brand of GFP-marked control strains with addition of *Listeria monocytogenes*.

FarmLead launches GrainTests.com to allow grain farmers to conveniently test their grain.

Biosan receives OLR-2114-N-B and OFLR-2115-N-B approval for the online and off-line reprocessing of poultry from the FSIS in order to expand its antimicrobial product.

Dynamic Systems updates the SIMBA Production and Inventory System that includes the ability to track lots to the specific case, including mixed and commingled product.

Advertiser Directory

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Best Sanitizers	19
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Diamond V	7
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Events

JANUARY

23-25
FSPCA Preventive Controls for Human Food Course
Boise, Idaho
Visit www.techhelp.org/events/385/fspcaboise2018/,
email jenniferbuel@techhelp.org,
or call 208-426-3767.

26
Preventive Controls for Human Food (Blended Course)
New Orleans
Visit www.fsqservices.com,
email lance@fsqservices.com,
or call 337-257-6936.

30-1
IPPE
Atlanta, Ga.
Visit http://ippexpo.com/.

31-2
Developing & Implementing HACCP Plans
New Orleans
Visit www.fsqservices.com,
email lance@fsqservices.com,
or call 337-257-6936.

FEBRUARY

26-1
Pittcon
Orlanda, Fl.
Visit https://pittcon.org/pittcon-2018/.

MARCH

5-8
Global Food Safety Conference
Tokyo, Japan
Visit http://www.tcgffoodsafety.com/.

6-8
Food Packaging Short Course
State College, Penn.
Visit http://agsci.psu.edu/food-packaging,
email CSCO@psu.edu,
or call 814-865-8301.

APRIL

3-5
Safe Food California
Indian Wells, Calif.
Visit https://safefoodcalifornia.com/.

16-20
Conference for Food Protection
Richmond, Va.
Visit http://www.foodprotect.org.

MAY

7-10
Food Safety Summit
Rosemont, Ill.
Visit http://www.foodsafetysummit.com/.

9-11
Global Food Contact 2018
Bethesda, Md.
Visit https://www.food-contact.com/global-food-contact,
email bnorton@smithers.com,
or call 330-762-7441.

22-24
Food Microbiology Short Course
State College, Penn.
Visit http://agsci.psu.edu/foodmicro,
email csco@psu.edu,
or call 877-778-2937.

JUNE

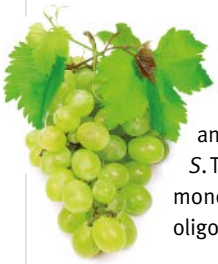
4-7
Fundamentals of Food Science
State College, Penn.
Visit http://extension.psu.edu/fundamentals,
email mmm354@psu.edu,
or call 814-865-0970.

Have an Upcoming Event to Promote?

If you have an upcoming industry event that you would like considered for inclusion in our online and print listings, go to www.foodqualityandsafety.com/events/ for info or contact Ken Potuznik at kpotuzni@wiley.com.

SCIENTIFIC FINDINGS

For access to complete journal articles mentioned below, go to "Food Science Research" located in December/November 2018 issue at www.FoodQualityandSafety.com or type the headline of requested article in search box.



ARTICLE: Evaluation of Peanut Skin and Grape Seed Extracts to Inhibit Growth of Foodborne Pathogens

This study evaluates the antimicrobial effects of peanut skin extract (PSE) containing A-type procyanidins and grape seed extract (GSE) containing B-type procyanidins against select foodborne pathogens (*Listeria monocytogenes*, *Escherichia coli* O157:H7, and *Salmonella Typhimurium*). GSE had a significantly lower minimum inhibitory concentration than PSE for *L. monocytogenes* and *S.* Typhimurium, but no difference in inhibition of *E. coli* O157:H7. Growth curves of all three pathogens in the presence of full extract, monomer, and oligomer fractions were compared separately. Results indicate that an extract with type B procyanidins higher in oligomers may have greater antimicrobial properties. **Food Science & Nutrition, Volume 5, Issue 6, November 2017, Pages 1130–1138.**

ARTICLE: Shiga-Toxin Producing E. coli: Pathogenicity, Supershedding, Diagnostic Methods, Occurrence, and Foodborne Outbreaks

The main challenge regarding the study of *E. coli* is the standardization of a high sensitivity method including all pathotypes that allows for enrichment of STEC cells and a decrease of background microbiota. The ability of some *E. coli* cells belonging to other pathogenic groups, such as O104:H4, to acquire genes unique to the STEC group, increases the pathogenic power and the risk of new outbreaks related to these bacteria. In addition, animals with a high concentration of pathogenic *E. coli* cells present in feces, designated as supershedding animals, may be the primary transmission factor among ruminants. Therefore, the purpose of this review is to address pathogenicity factors and the importance of supershedding animals in the transmission of this pathogen, discussing the main methods currently applied, to focus on the occurrence of STEC in beef. Comprehensive Reviews in Food Science and Food Safety, **Volume 16, Issue 6, November 2017, Pages 1269–1280.**

ARTICLE: Developments and Challenges in Online NIR Spectroscopy for Meat Processing

Meat and meat products are popular foods due to their balanced nutritional nature and their availability in a variety of forms. In recent years, due to an increase in the consumer awareness regarding product quality and authenticity of food, rapid and effective quality control systems have been sought by meat industries. Near-Infrared (NIR) spectroscopy has been identified as a fast and cost-effective tool for estimating various meat quality parameters as well as detecting adulteration. This review focuses on the on/inline application of single and multiprobe NIR spectroscopy for the analysis of meat and meat products starting from the year 1996 to 2017. The article gives a brief description about the theory of NIR spectroscopy followed by its application for meat and meat products analysis. A detailed discussion is provided on the various studies regarding applications of NIR spectroscopy and specifically for on/inline monitoring along with their advantages and disadvantages. Comprehensive Reviews in Food Science and Food Safety, **Volume 16, Issue 6, November 2017, Pages 1172–1187.**

ARTICLE: Oxidative Changes in Lipids, Proteins, and Antioxidants in Yogurt During the Shelf Life

This study evaluated the antioxidant properties of yogurt in standard conditions of preservation. Total phenols, free radical scavenger activity, degree of lipid peroxidation, and protein oxidation were determined in plain and skim yogurts with or without fruit puree. After production, plain, skim, plain berries, and skim berries yogurts were compared during the shelf life up to 9 weeks. All types of yogurts revealed a basal antioxidant activity that was higher when a fruit puree was present but gradually decreased during the shelf life. However, after 5-8 weeks, antioxidant activity increased again. Both in plain and berries yogurts lipid peroxidation increased until the seventh week of shelf life and after decreased, whereas protein oxidation of all yogurts was similar either in the absence or presence of berries and increased during shelf life. During the shelf life, a different behavior between lipid and protein oxidation takes place and the presence of berries determines a protection only against lipid peroxidation. Food Science & Nutrition, **Volume 5, Issue 6, November 2017, Pages 1079–1087.**

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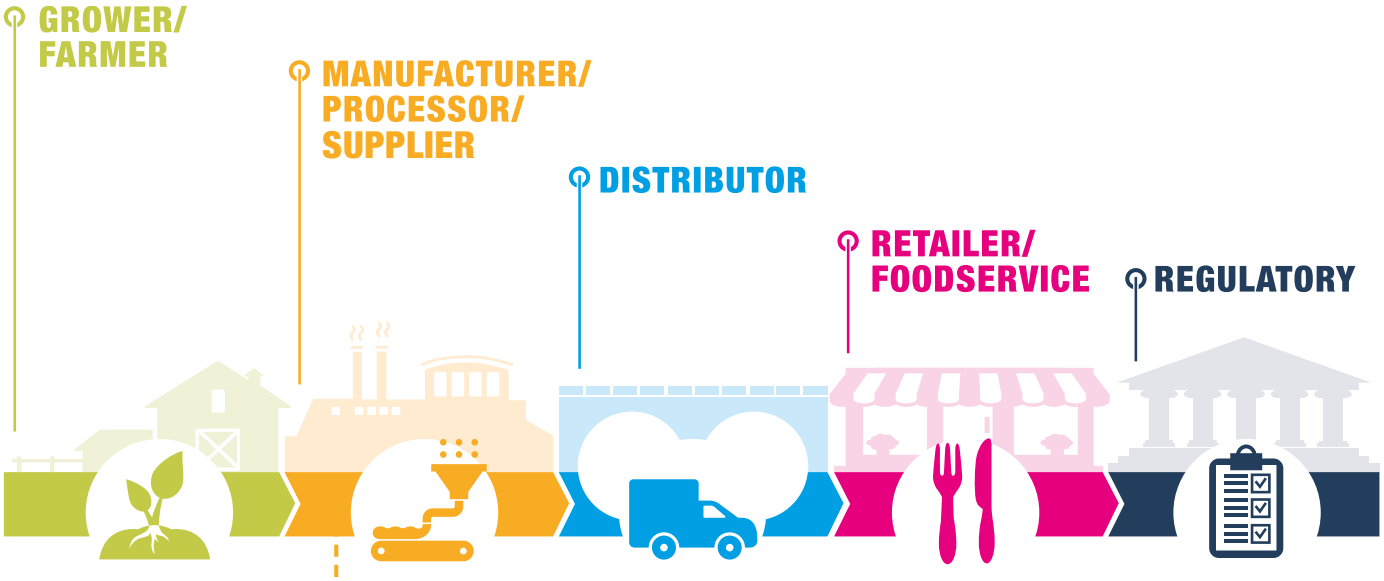

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