PLUS Rodent and Pest Exclusion Tactics ■ Cannabis as a Food Additive ■ Indecision Over Cultured Meat

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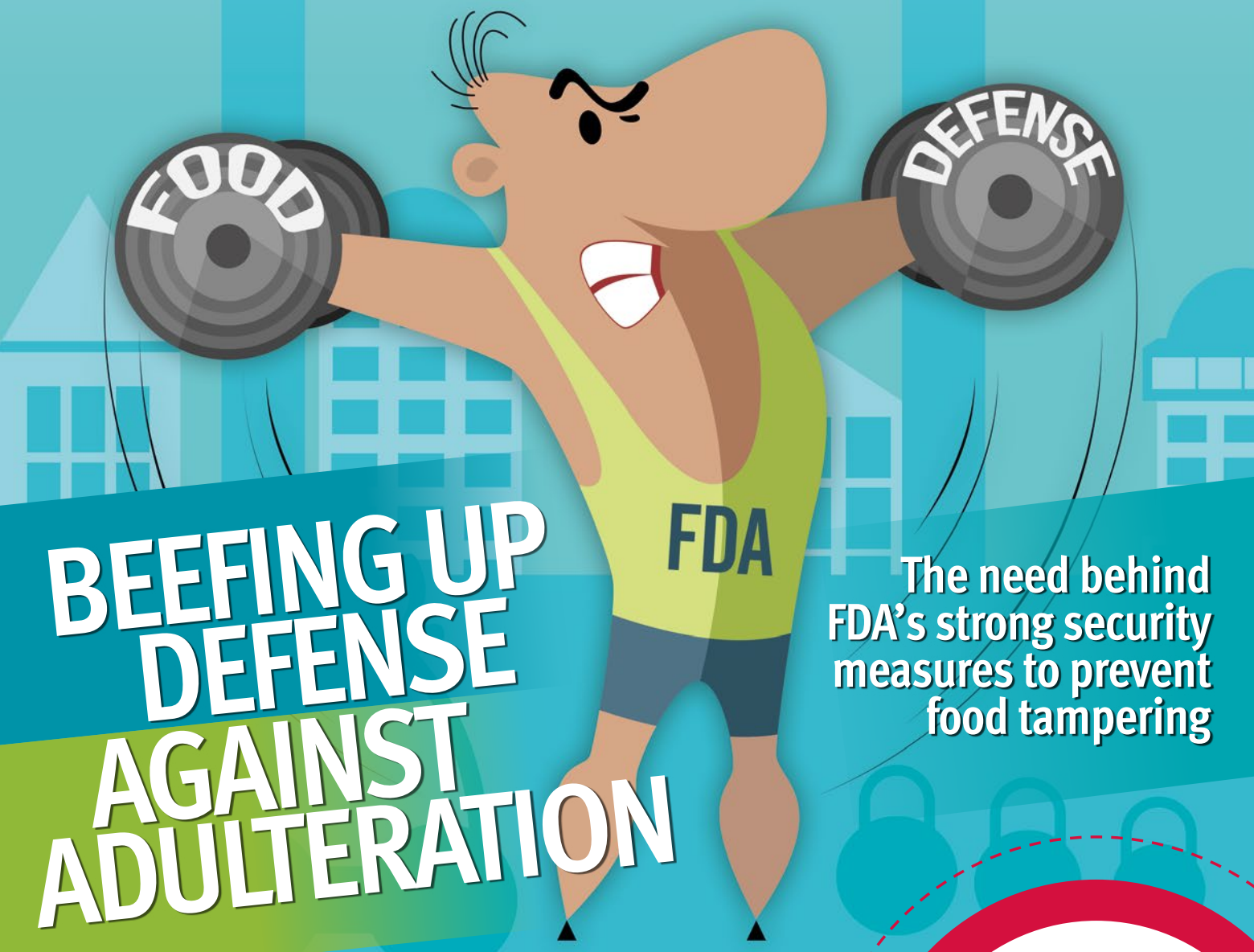
APRIL/MAY 2018

Food Quality & Safety

FARM TO FORK SAFETY



BEEFING UP DEFENSE AGAINST ADULTERATION

The need behind FDA's strong security measures to prevent food tampering

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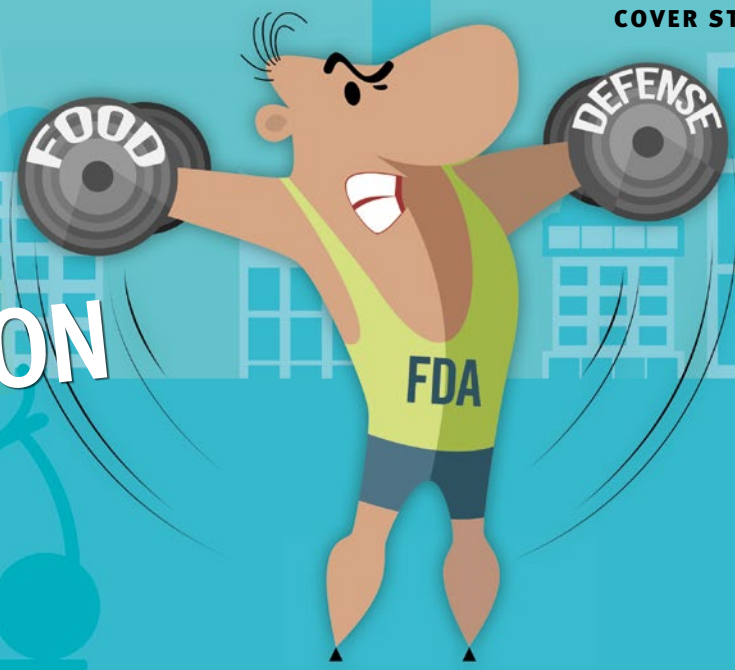

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From The Editors

R.I.P. HARPC. Food Quality & Safety magazine would like to belatedly report the demise of HARPC. HARPC, or Hazard Analysis Risk Based Preventive Controls, was conceived in the halls of Congress in response to national concerns regarding the safety of U.S. food supply. How long HARPC remained in the womb until his/her birth in December 2010 is unknown, but it apparently was a long gestation period. HARPC was officially acknowledged by President Obama in January 2011 when the he signed FSMA into law—one of the rare recent examples of our Congress working together on something.

The coming of HARPC into the world was met with great jubilation by some proclaiming that the child was "HACCP on steroids" and a vast improvement over traditional HACCP in that they felt HACCP was not a proactive means of ensuring food safety. The latter was sort of an odd take because the FDA as far back as 1990 was praising HACCP as being proactive. Former FDA Commissioner David Kessler referred to HACCP when he made the statement, "Our safety systems should be preventing problems rather than chasing the horses after they are out of the barn. HACCP is a system that will make that possible."

The coming of HARPC created great angst as it was presented as a brand-new food safety management system that would mandate the industry completely disassemble its current programs to implement the new systems. The angst was magnified since as soon as the law was passed, "experts" came out of the woodwork offering expensive workshops on how to comply with HARPC. The route that the food industry should have taken: look at the law, re-evaluate existing food safety management systems, and await passage of the regulations that the FDA was charged with developing to ensure enforcement of FSMA. When the draft regulations appeared, they did not include much that was new but did mandate the food safety management systems be more robust; something which all processors did not do, especially when it came to validation issues.

But we are here to note the passing of HARPC. As the draft regulations were issued and the mandated programs to train Preventive Controls Qualified Individuals (PCQI) were developed, HARPC disappeared. In fact, he/she is not even mentioned in the PCQI course. So HARPC is dead and buried and is really not being mourned. In fact, most food processors probably would say, "Good riddance."

Rick Stier
Co-Industry Editor

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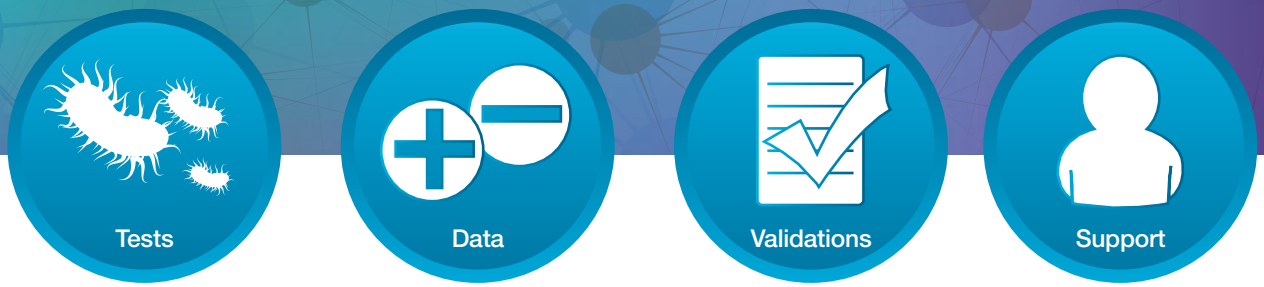

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NEWS & NOTES

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New Standard for Regenerative Agriculture

The Carbon Underground and Green America, in partnership with Ben & Jerry's (Unilever), DanoneWave, Annie's (General Mills), and MegaFood are developing a global verification standard for food grown in a regenerative manner. The standard seeks to encourage farmers to restore the carbon cycle and build soil health, crop resilience, and nutrient density. The core design team for the new standard includes farmers, ranchers, soil scientists, and certification experts and includes input and agreement from nearly 50 organizations on the goals of the new standard. Benefits include greater food security, more stable supply chains, greater viability of farmers, and drawdown of carbon from the atmosphere to mitigate climate change and rebalance the carbon cycle.

FDA Updates

FDA releases the 2017 edition of the FDA Food Code, a model regulation that provides all levels of government and retail industry with practical, science-based guidance and manageable provisions for reducing foodborne illness. Significant changes to the 2017 edition include a revised requirement for the person in charge to be a certified food protection manager; a new section that addresses the use of bandages, finger cots, or finger stalls; harmonized cooking time/temperature parameters for intact and non-intact meat and poultry in accordance with USDA's FSIS; and updated procedures to continue during an extended water or electrical outage. The 2017 FDA Food Code is available at http://www.fda.gov/FoodCode.

FDA's 2017 edition of the Voluntary National Retail Food Regulatory Program Standards provides recommendations for designing and managing regulatory programs. Updates were made to the Training Standard definition; clarification to the standardizing and re-standardizing criteria for food safety inspection officers; consolidation of the facility categories that can be used when conducting a risk factor study; and consolidation of reporting forms.

After leaving the agency five years ago to join the Produce Marketing Association, Jim Gorny, PhD, returns to FDA in newly created position as senior science advisor for produce safety at Center for Food Safety and Applied Nutrition. He will work on implementing new science and risk-based requirements to prevent illnesses from contaminated produce.

$6.5 M Verdict in Landmark Case

On March 1, 2018, an Arizona federal court jury returned a verdict in the amount of $6.5 million in favor of a 5-and-a-half-year-old child who suffered a brain injury as a result of a *Salmonella* Heidelberg infection from chicken produced by Foster Poultry Farms. The case established that chicken producers can be held responsible for *Salmonella* contamination on raw chicken product even though the USDA does not consider *Salmonella* an "adulterant" in raw chicken and the bacteria can be killed by cooking.

Deadly *Listeria* Could Herald Tighter Food Safety Rules in South Africa

According to Reuters, a huge and deadly outbreak of *Listeria* in South Africa could alter the country's approach to foodborne disease. The WHO's top specialist on global food safety likened the South African outbreak's potential impact to the "mad cow disease" BSE crisis in Europe that began in the 1980s and a vast *E. coli* outbreak traced to Jack in the Box burgers in the U.S. in 1993. Peter Ben Embarek, who manages the WHO International Food Safety Authorities Network, told Reuters, "this could be the crisis that will finally make at least South Africa, and possibly the whole of Africa, realize the importance of food safety and foodborne diseases and the need to invest in improving things." At least 180 people have been killed in South Africa since January last year and almost 1,000 infected in the world's worst recorded *Listeria* outbreak. Health officials linked outbreak to a type of processed sausage meat.

Reflections on Food Recalls

The recently released Q4 2017 Recall Index from Stericycle Expert Solutions reveals the food and beverage industry experienced the most dramatic spike in units recalled over the past five years. Products recalled by FDA skyrocketed 92.7% since 2012, and recalled pounds regulated by USDA jumped 83.4% in the same period. Improvements in food testing combined with factory farming and growing automation in food production were major drivers of the increases. Approximately 28% of FDA food recalls were due to bacterial contamination in 2012, with that number jumping to 31.3% by year-end 2017. pounds dropped 92% to the lowest since Q3 2013.

Business Briefs

Park City Group's ReposiTrak and **Recall InfoLink** form a new partnership to integrate their technologies and conduct joint business development activities.

SCS Global Services and **AgSafe Food & Farms** partner to expand agricultural training.

Hygiena opens a new facility in Canada called Hygiena Canada Ltd.

Hydrofresh HPP, an affiliate of Keller Logistics Group, is constructing a $10 million pasteurization plant in Delphos, Ohio, that uses high-pressure processing technology.

The Food Marketing Institute and **The Center for Food Integrity** partner to develop a transparency index that will provide retailers with an assessment tool.

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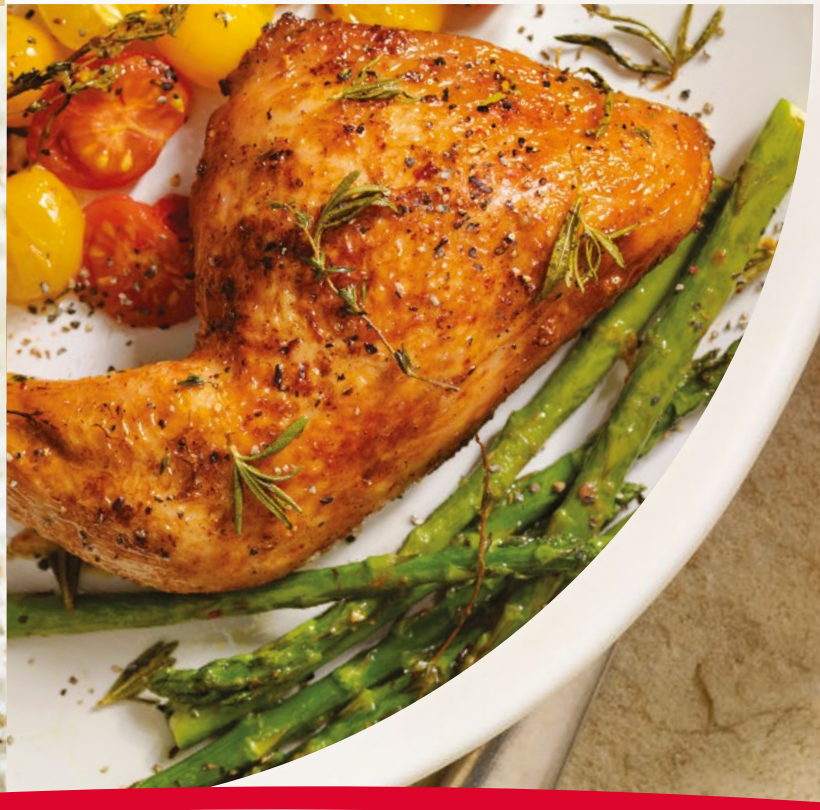

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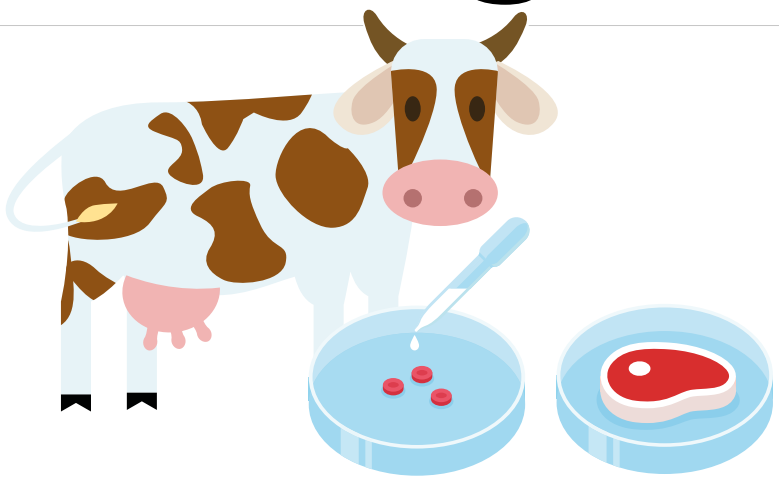

Battle Brewing Over 'Clean Meat' Labeling

USDA, FDA remain on sidelines over lab-grown or cultured meat—for now | BY **TED AGRES**

Major food producers and meatpackers Tyson Foods Inc. and Cargill, along with numerous investors including Richard Branson and Bill Gates, are throwing millions of dollars behind efforts to develop and commercialize alternative protein products, particularly "clean meat," also called lab-grown or cultured meat, and plant-based proteins.

The investments are fueled by the recognition of a growing worldwide demand for high-quality protein and increasing consumer preferences for environmentally friendly and sustainable food production. And while the market for clean meat and plant-based protein products is projected to remain small in comparison to traditional beef, pork, and poultry, the efforts clearly have the meat industry worried.

The U.S. Cattlemen's Association (USCA), a leading trade group, has filed a petition with USDA's Food Safety and Inspection Service (FSIS) requesting the agency officially limit the labeling of "beef" to "cattle born, raised, and harvested in the traditional manner...rather than coming from alternative sources such as a synthetic product from plant, insects, or other non-animal components and any product grown in labs from animal cells."

Similarly, "products that are labeled as 'meat' should be limited to those that are derived from the tissue or flesh of an animal harvested in the traditional manner," USCA said in its 15-page petition, submitted in February.

"Consumers depend upon the USDA FSIS to ensure that the products they purchase at the grocery store match their label descriptions," said Kenny Graner, president of USCA, who asked the agency "to rectify the misleading labeling of 'beef' products that are made with plant or insect protein or grown in a petri dish."

Similarly, the National Cattlemen's Beef Association, another major trade group, has made the issue a priority in 2018, with "a focus on protecting the industry and consumers from fake meat and misleading labels on products that do not contain real beef." The group is reportedly in discussions with USDA and FDA, as are representatives of companies developing these products.

The regulatory boundaries are somewhat vague. While FDA has purview over most food products, USDA has primary authority over meat, poultry, and most egg products. And FDA, not USDA, is typically involved in labeling disputes. While not commenting on the labeling issues, FDA said, "Given information we have at this time, it seems reasonable to think that cultured meat, if manufactured in accordance with appropriate safety standards and all relevant regulations, could be consumed safely."

An FDA spokesperson added the agency was "committed to supporting innovation in the food supply" and encouraged manufacturers to "engage with us to address any questions they may have." It isn't clear when, or if, FDA or USDA may weigh in on the controversy, but neither is likely to rule on clean meat terminology until the technology is more fully developed, concludes a recent whitepaper from CoBank, a national cooperative farm bank based in Colorado.

Major Investments

The beef industry's opposition to clean meat is "shortsighted" and "disappointing," says Emily Byrd, communications director for the Good Food Institute, a nonprofit that supports creation of "a healthy, humane, and sustainable food supply." Plant-based and clean meat "have the potential to fundamentally transform meat production for the better," she adds. "It's up to the industry whether they will align themselves with this change and share the benefits, or fight this change to their detriment."

Plant-based meat substitutes made from soy, nuts, and grains have been around for decades. Long a staple of vegetarians and the health-conscious, the segment is now becoming more mainstream, thanks to efforts by startup companies such as Los Angeles-based Beyond Meat,

whose plant-based burgers, sausages, and chicken strips are so meat-like they can often be found in the supermarket meat aisle. In 2016, Tyson Foods took a 5 percent ownership stake in the company, followed by an additional investment last year.

The capital infusions come from a $150-million venture capital fund Tyson launched in December 2016 to invest in companies "developing breakthrough technologies, business models, and products to sustainably feed a growing world population." Tom Hayes, Tyson president and CEO, admitted the company's decision to invest in cultured meats and plant-based proteins "seemed counterintuitive to some inside our company." But meeting the growing worldwide demand for protein, in ways that are sustainable, "will take a combination of innovative and traditional approaches," he explained.

Earlier this year, Tyson New Ventures LLC also invested in Memphis Meats, a San Francisco-based startup developing meat that is cultured from living animal cells without the need to breed or slaughter the animals. Last year Memphis Meats received $17 million in VC funding from a group of investors including Cargill, Virgin Group founder Richard Branson, and Microsoft founder Bill Gates. So far, the company has raised at least $22 million in funding.

"The world loves to eat meat, and it is core to many of our cultures and traditions," said Uma Valeti, MD, cofounder and CEO of Memphis Meats. "However, the way conventional meat is produced today creates challenges for the environment, animal welfare, and human health."

Supporters boast that clean meat production eliminates environmental contamination from animal waste runoff, requires no antibiotics or artificial hormones, produces no bacterial contamination, and doesn't harm animals. Clean meat could be produced with up to 96 percent lower greenhouse gas emissions, 45 percent less energy, 99 percent lower land use, and 96 percent lower water use than conventional meat, according to a study from the University of Oxford.

USDA has estimated that the average U.S. consumer will eat more than 222 pounds of red meat and poultry this year, surpassing a record set in 2004. Despite this, 60 percent of U.S. consumers say they are cutting back on meat, and 17 percent of those aged 15 to 70 claim to eat a predominantly plant-based diet, according to data from HealthFocus International. Worldwide, meat substitute sales could reach $5.2 billion by 2020, according to Allied Market Research, an 8.4 percent annual increase from 2015. While this is only a small fraction of the $750-billion market for conventional meat, projected supplies are likely to be insufficient as the world's population reaches 9.7 billion by 2050.

All this is good news for companies developing alternative protein food products, which, in addition to Beyond Meat and Memphis Meats include Amy's Kitchen, JUST, Inc. (formerly Hampton Creek), and Morningstar Farms in the U.S.; Cauldron Foods, Quorn Foods, and Vbites Food in the U.K.; Garden Protein International in Canada; and MosaMeat and Meatless B.V. in The Netherlands.

How to Grow Clean Meat

The idea of using tissue engineering to produce edible meat is far from new. In 1932, Winston Churchill predicted that within 50 years, "We shall escape the absurdity of growing a whole chicken in order to eat the breast or wing, by growing these parts separately under a suitable medium." His forecast wasn't far off. In-vitro cultivation of muscle fibers was first performed in 1971. In 2000, inventor Jon Vein received one of the first U.S. patents for the production of tissue engineered meat for human consumption.

Today, two main biotechnologies are used to produce cultured meat. The first, called the "self-organizing technique" uses muscle cells of donor animals to self-replicate in a nutrient medium containing salts, pH buffers, and other molecules. The technique can be used to create highly-structured meat, such as steak. But new animal cells are needed regularly and quantity production is limited.

The second or "scaffold-based technique," uses adult stem cells where embryonic myoblasts or adult skeletal muscle cells are attached to an edible or biodegradable scaffold or support structure and fed a culture medium in a stainless-steel bioreactor. This approach is used to produce ground meat products. Numerous technological issues remain to be solved and production costs, while falling, remain exorbitant.

Memphis Meat, for example, reported last year that a pound of clean meat costs $2,400 to produce. This, however, is compared to an estimated $18,000 in 2016 and $325,000 in 2013. As technology advances and production scales up, costs are expected to fall. Netherlands-based MosaMeat predicts its clean beef could eventually cost a competitive $3.60 per pound.

While the timeline for commercial viability of clean meat remains unknown, many estimates place market introduction to be within the next three to five years, with widespread supermarket adoption within the following two or three years.

Challenges to Clean Meat

In addition to cost, there remains the challenge of consumer perception. In 2014, 80 percent of Americans said they would not eat meat that was grown in a lab, according to a Pew Research Center survey. Sentiments are changing. A separate 2016 survey found only about 20 percent of Americans were unwilling to try cultured meat, with two-thirds willing to try it and one-third willing to consume it regularly. Potential barriers were identified as taste/product appeal (79 percent), ethical concerns (involving high-tech genetics, 24 percent), and price (20 percent).

Much of the perception issue involves marketing, namely what the product will be called. Supporters prefer positive-sounding terminology, such as "clean meat," while opponents tend to characterize it as "in-vitro meat," "lab-grown meat," or, as the Cattlemen's Association puts it, meat "grown in a petri dish."

Clean meat is similar to "clean energy" by communicating important aspects of the technology, "both the environmental benefits and the decrease in foodborne pathogens and drug residues," says Bruce Friedrich, cofounder and executive director of the Good Food Institute.

"It is no more accurate to say that clean meat is 'lab grown' than it is to say that Cheerios and commercial peanut butter are 'lab created,'" Friedrich says. "All processed foods start in a food laboratory, of course, but with clean meat, the end result is real, pure meat." ■

Agres is an award-winning writer based in Laurel, Md. Reach him at tedagres@yahoo.com.

Pathogen Patrol

Staving Off *Salmonella*

New tests, technologies, and ambitious research are combating the impacts of this master foodborne pathogen

BY **LINDA L. LEAKE, MS**

There's no need to send a sympathy card to *Salmonella*. Yes, this proud bug dropped into second place on the 2016 CDC list of organisms responsible for foodborne illness in the U.S., with 8,172 cases reported on CDC's Foodborne Diseases Active Surveillance Network (FoodNet), compared to 8,547 cases for *Campylobacter*. But *Salmonella* still took the lead among all foodborne bacterial pathogens for causing most hospitalizations, 2,255, and deaths, 40, as reported in FoodNet's April 21, 2017 issue of the Morbidity and Mortality Weekly Report.

According to the December 2017 report by the Interagency Food Safety Analytics Collaboration that addresses foodborne illness source attribution estimates for 2013, 75.4 percent of *Salmonella* illnesses were attributed to seven food categories: seeded vegetables (16 percent), eggs (11.5 percent), chicken (10.4 percent), other produce, such as nuts (9.8 percent), pork (9.3 percent), beef (9.1 percent), and fruits (8.9 percent).

Salmonella challenges abound, but fortunately, much tireless work is in progress to minimize the negative effects of this organism throughout the food chain.

Faster *Salmonella* Test

A new diagnostic procedure has been developed that provides accurate, rapid testing for *Salmonella*, including serotype Dublin, an emerging food animal and food safety concern.

Salmonella Dublin can be difficult or slow to grow in culture, typically making detection challenging, according to Laura Goodman, PhD, an assistant research professor in the Department of Population Medicine and Diagnostic Sciences at Cornell University, Ithaca, N.Y., and lead author of the study that resulted in this new rapid test.

"Tests for *Salmonella* environmental screening used to take days, now they take 24 hours," Dr. Goodman points out. "The new method can also detect one hundredfold fewer *Salmonella* Dublin bacteria."

To tackle *Salmonella* diagnosis, Dr. Goodman and her team developed a workflow for testing veterinary matrices, including enteric and cloacal tissues (mostly from cows, but also from other species), feces (from cows, dogs, and horses), and feed, plus environmental samples, by using real-time polymerase chain reaction after selective enrichment in Rappaport-Vassiliadis soya medium.

Dr. Goodman says that the new method to detect *Salmonella* is now available as an environmental testing program for animal facilities through Cornell's Animal Health Diagnostic Center. "The test covers all *S. enterica* subspecies and serotypes and offers next-day results," she relates.

Dry Surrogate Organisms

While Novolyze, based in Dijon, France, has developed a full range of surrogate microorganisms qualified for different kinds of food products, target pathogens, and kill steps, the firm's signature product is a patented dry *Salmonella* surrogate marketed under the trade name SurroNov.

The Novolyze dry, ready-to-use surrogate microorganisms mimic the behavior of foodborne pathogens, and thus make it possible for food companies to perform in-plant preventive control validations, according to Karim-Frank Khinouche, the firm's founder and CEO.

"Our surrogate products are non-pathogenic, so food manufacturers can

validate their processes right in their own production lines," Khinouche relates. "SurroNov surrogates validate such products as spices, nuts, cocoa, pet food, powders, cereals, pasta, flour, cookie dough, and baked goods; and they can be used in extruder, steam pasteurizer, oven, and dryer applications."

Khinouche says the dry nature of SurroNov reduces the impact on the physical-chemical properties of the food matrix. Additional benefits include that these surrogates can be directly incorporated into a food matrix without an enrichment step; there is a guaranteed inoculation concentration and more favorable heat resistance to the target pathogen compared with liquid surrogates; and there's also the ability to reach higher inoculation levels than methods using liquid surrogates, up to 10-log colony forming units per gram.

> Dr. Rajashekara's team also tested their novel small molecules in chickens and found that these small molecules are effective in reducing *Salmonella* in infected chickens.

La Tortilla Factory, Santa Rosa, Calif., manufacturer of 1.2 million tortillas per day, first used SurroNov dry *Salmonella* surrogate at its 75,000-square-foot plant in early September 2017. "We needed documentation of our thermal processing procedures in order to comply with Food Safety Modernization Act regulations," says Nathan Wilson, the company's quality assurance manager. "Since our products typically have water activity of .9 to .99, they are at high risk for bacterial spoilage. So, we needed solid data and validation.

"We ran validation tests two times in one week, using 45 grams of SuroNov each to inoculate tortilla dough samples on numerous production lines and in several ovens," Wilson relates. "We tested samples after the heated press step that precedes the oven, and then after cooling of the finished product coming from the oven."

Wilson reports that, at the end of this testing, there were no positive results for *Salmonella*. "SuroNov gave us a higher log reduction, as typical labs will inoculate at 5 log, whereas Novolyze offers 10 log," he notes. "And at the end, the water activity of the product from the dough samples tested was 9.2."

Focus on Tomatoes

Courtesy of a $500,000 grant provided by the USDA National Institute for Food and Agriculture (NIFA), Gireesh Rajashekara, DVM, PhD, a professor in the Food Animal Health Research Program at the Ohio State University's Agricultural Research and Development Center, Wooster, is in the final year of a research project focused on *Salmonella* contamination of tomatoes.

(Continued on p. 16)

(Continued from p. 15)

By growing *Salmonella*-contaminated tomato plants in green house conditions, Dr. Rajashekara and his colleagues observed that specific environmental temperature and relative humidity conditions have significant impact on *Salmonella* persistence in contaminated tomato plants.

"High environmental temperature, greater than 77 degrees Fahrenheit, significantly reduces *Salmonella* abundance and persistence over time on the surface of the tomato plants, however environmental temperatures did not affect internalized *Salmonella*," Dr. Rajashekara explains. "On the other hand, low relative humidity levels, less than 40 percent, increased the probability of dissemination of *Salmonella* in the plant. Similarly, when tomato plants were experimentally infected with plant pathogens, we observed that the plant pathogens could increase the abundance and persistence of *Salmonella* in tomato plant tissues, which is most likely due to competition for available nutrients in the plant tissues. *Salmonella* once infected seems to compete successfully with plant pathogens to survive in tomato plants."

Big Work with Small Molecules

Another goal in Dr. Rajashekara's lab is to develop novel antimicrobials to control *Salmonella* using new generation small molecules. "Previous studies have shown that new generation small molecules are effective even against multi-drug resistant pathogens," Dr. Rajashekara relates. "We identified several novel anti-*Salmonella* compounds that are effective against even the internalized *Salmonella* in tomato plants and fruits. These small molecules are compatible with the use of alternative control methods such as beneficial plant associated microorganisms, so thereby can be combined with bio-control approaches to enhance *Salmonella* control in production systems."

Dr. Rajashekara's team also tested their novel small molecules in chickens and found that these small molecules are effective in reducing *Salmonella* in infected chickens. "Small molecules are also compatible with the use of probiotics and they enhance the antimicrobial activity of certain antibiotics that are currently used to control *Salmonella* in poultry production systems," Dr. Rajashekara says.

Success with Steam Pasteurization

Vacuum steam pasteurization is proving to be effective for killing *Salmonella* on several low moisture foods, according to Teresa Bergholz, PhD, a food scientist with North Dakota State University (NDSU), Fargo.

In Dr. Bergholz's recent research, she and her colleagues applied steam at lower temperatures to several low moisture foods, including flaxseed, quinoa, and sunflower kernels. "The lower temperatures are relative to greater than 212 degrees Fahrenheit, which is the temperature that would be required to produce steam if not under a vacuum," she explains. "The results show that vacuum steam pasteurization for 2 to 5 minutes at temperatures ranging from 167 degrees Fahrenheit to 185 degrees Fahrenheit can effectively kill 5 logs of *Salmonella*.

"Using a USDA NIFA grant, we are currently evaluating if *Salmonella* serovars Agona, Enteriditis, Montevideo, and Tennessee differ in their susceptibility to vacuum steam pasteurization when inoculated onto whole flaxseeds," Dr. Bergholz continues. "Our initial results indicate that the serovars have similar levels of inactivation."

Another part of this project was to evaluate if vacuum steam pasteurization impacted the quality of the foods that were pasteurized, Dr. Bergholz adds. "In collaboration with food scientist Clifford Hall, PhD, who coordinates the NDSU pulse crops quality program, we measured chemical and microbial changes in whole and milled flaxseed over 28 to 36 weeks after pasteurization," she relates. "Overall, we saw a reduction in the number of aerobic microbes, yeasts, and molds, and negligible changes in chemical parameters."

Poultry Vaccine

Since poultry products have been frequently implicated in reported cases of salmonellosis, and since there has been little information available about the chicken's intestinal microbiota and its role in resistance to disease causing pathogens, especially *Salmonella*, Hosni Hassan, PhD, a professor of microbiology in the Prestage Department of Poultry Science at North Carolina State University (NCSU), Raleigh, spearheaded a research project to tackle these issues.

Funded by a $2.5 million USDA NIFA grant that runs through June 30, 2018, Dr. Hassan, his NSCU colleagues, and collaborators at the University of North Carolina-Chapel Hill, have used an attenuated strain of *Salmonella*, which was developed by his students during 2007 through 2010 and patented in 2012, as vaccine. "The strain is different than the current vaccines and its authenticity and efficacy were first tested in the mice model of salmonellosis," Dr. Hassan relates, noting that the mechanism of action hasn't been published, so is yet confidential. "We also sequenced the complete genome of this patented *Salmonella* vaccine strain."

The research team used the novel vaccine strain in its poultry studies alone, and in combinations with other reagents, such as prebiotic galacto-oligosaccharides (GOS), for modulating the gut microbiome of egg laying chickens.

"We isolated and characterized several poultry-specific probiotic organisms from the healthy experimental birds and selected three isolates for complete genome sequencing," Dr. Hassan points out.

The researchers identified the composition and the development of the chicken gut microbiome as a function of age, vaccination, adding prebiotic GOS to the diet, adding poultry-specific probiotic isolates to the diet, and combinations thereof.

Dr. Hassan says these efforts are based on the fact that the gut microbiota plays an important role in the digestion of complex plant fibers and polysaccharides; and the microflora also provides protection against colonization by invasive pathogenic organisms (colonization resistance).

"We also examined the effects of these treatments on the chicken's immune system," Dr. Hassan continues. "Based on our results, we conclude that vaccination and modulation of the gut microbiome enhanced the bird's ability to resist *Salmonella* infections." ■

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For extended online coverage of *Salmonella*, go to the April/May 2018 issue at www.FoodQualityandSafety.com.

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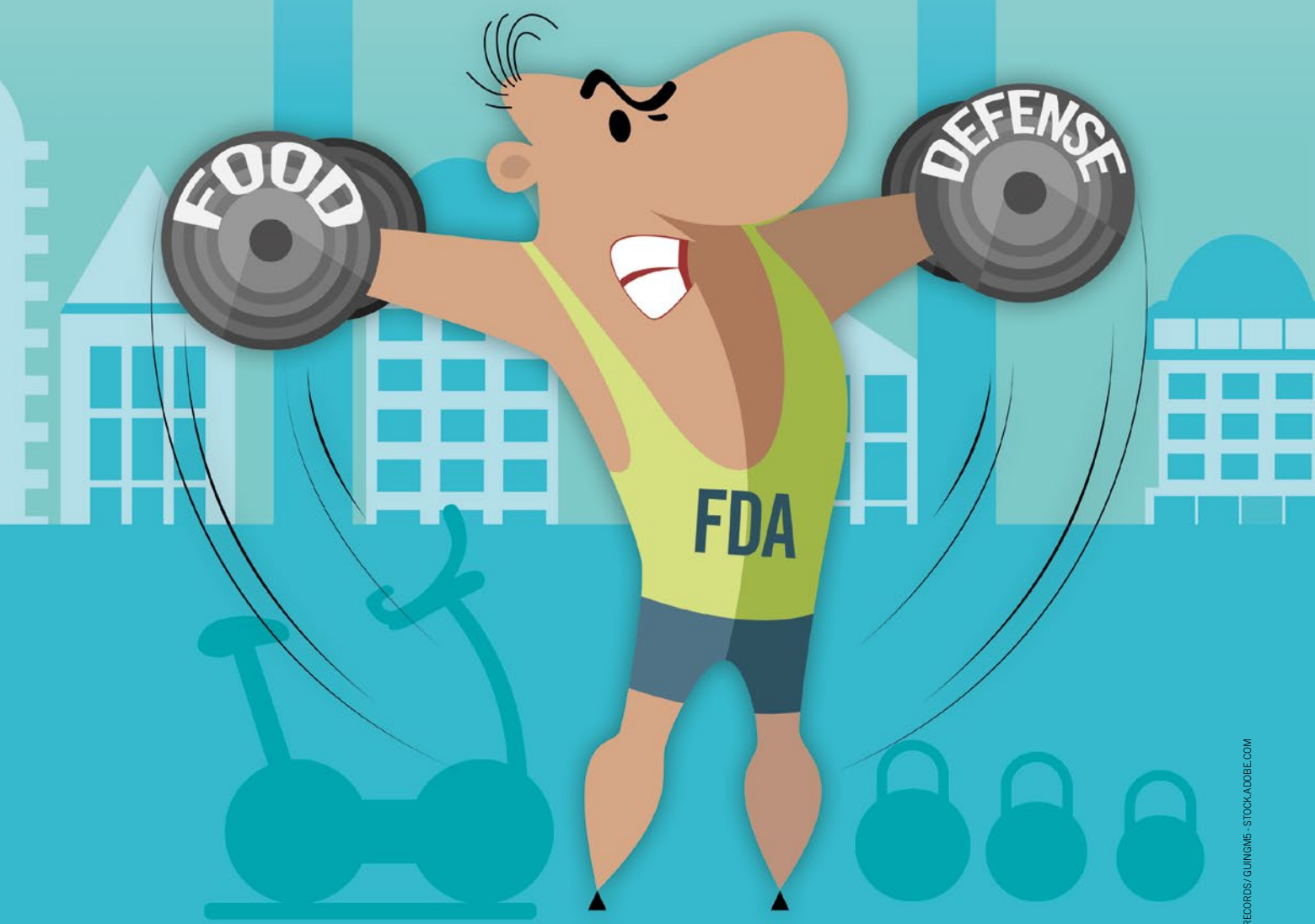
BEEFING UP DEFENSE AGAINST ADULTERATION

The need behind FDA's strong security measures to prevent food tampering

BY **JESSE STANIFORTH**



Criminal and terror attacks on food and drugs don't happen often, but when they do the public doesn't forget them. Most Americans born before the mid-1970s remember the Chicago Tylenol poisonings of 1982 and the terror that followed them. Two years later, in Oregon, followers of cult-leader Bhagwan Shree Rajneesh launched the largest bioterror attack seen to date on U.S. soil when they inoculated salad bars in 10 restaurants with *Salmonella* in an effort to prevent their political opponents from voting in large numbers, sickening over 700 people. Japanese consumers faced the same terror when, in late 2013, an employee at a Aqlifoods Co. manufacturing plant deliberately contaminated frozen food with the pesticide malathion, leading to as many as 2,800 cases of reported illness.

Such attacks can cast a shadow of anxiety on the everyday routine of buying and eating meals, and it's with the goal of reducing that anxiety that the Food Safety Modernization Act's (FSMA) Final Rule for Mitigation Strategies to Protect Food Against Intentional Adulteration will begin coming into effect next year.

This final rule is designed to deal specifically with the threat of malicious actors attempting to taint food with the goal of hurting consumers.

Rod Wheeler, founder and CEO of the Global Food Defense Institute, says that in most cases of tampering he encounters from year to year, the actor has been a disgruntled employee or other internal figure. However, he notes, groups like ISIS have encouraged their followers to kill Westerners by poisoning their food supplies.

"Obviously, [terrorists] are talking about this," he says. "Every year, you'll hear a little bit of something come through the wire, whether it's through the government agencies or through some other agency in another country."

An Old Problem with New Solutions

Earl Arnold, global manager for food defense and FSMA at AIB International, notes that intentional adulteration as a means of waging war on a civilian population has a long history.

"It was first recorded in the Roman times using deceased cattle to contaminate water supplies," he says.

With that history in mind—and with an eye toward future risks—the Intentional Adulteration rule demands production facilities conduct a vulnerability assessment that considers the public health impact of an adulterant being introduced at each process step, the extent to which the product is accessible at each step, and the ease by which the product could be deliberately contaminated.

"When evaluating all of this," Arnold says, "you must consider these things could be done by someone welcomed into the facility. If a processing step has a significant vulnerability identified—one that could cause wide scale public health impact—then a facility must develop mitigation to reduce the risk."

...Wheeler says, "you have open product and we have so many people coming and going out of our facilities each and every day that we, historically, have not vetted these people properly."

One noteworthy change in Intentional Adulteration rule is expansion of the idea of what constitutes production security. Arnold notes that until recently, production security has largely been centered around fences, CCTV cameras, and passkey doors—the goal to keep "bad people" from doing "bad things."

Amy Kircher, DrPH, director of the University of Minnesota's Food Protection and Defense Institute, says that FSMA will force a greater depth of understanding about what producers have to do to keep food safe.

"There is a significant culture change happening now," Dr. Kircher says, "where companies are now having to come into compliance in a way that will be enforced, and so many companies are starting to think about: How do we do vulnerability assessments for our entire company? How do we put mitigation steps in place that are beyond guns, gates, and guards?"

Novel Vulnerabilities

Wheeler notes that traditionally, production facilities have not paid much attention to security of shipping and receiving facilities, chemical laboratories, and chemical storage areas.

"But guess what? In 2018, now we do," he says, noting that the present-day adversary is likely an Internet-radicalized lone-wolf actor. He tries to imagine what the Boston-bomber Tsarnaev brothers would do if their goal was to attack the food supply, he says, because they are the model of the kind of adversary against which legislation is attempting to protect. "They're smart, Internet savvy, and they did their research before they set those bombs off," he says. As well, they had the appearance of law-abiding citizens—meaning they could easily find themselves employed in positions with access to food production facilities.

(Continued on p. 20)

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In food factories and packaging centers, Wheeler says, "you have open product and we have so many people coming and going out of our facilities each and every day that we, historically, have not vetted these people properly. You could gain access inside a facility as, let's say, an HVAC contractor or plumbing contractor. Really, you could be the bad guy in disguise. My philosophy has always been, which is right along with the FDA's, is just keep the bad guys out and those that we let in to these critical facilities, we vet them as best we can."

Fortunately, Dr. Kircher says that food producers have already been conscious and active in the preservation of food safety, so a move to adopting food defense measures is simply a matter of evolution. However, with each stage of evolution, the complexity of the process becomes more significant.

"We have to get beyond this sort of physical protection of our food," Dr. Kircher explains, "because very easily, we could have something come into an ingredient. We could have our cyber controls hacked. How else do we think about our food being intentionally adulterated beyond someone just trying to break into the manufacturing plant? If we're worried about cyberattacks, we should understand our technology and put safeguards in place so that nobody can, for example, hack the thermal processing controls that make sure pasteurization happens."

But the range of possible vulnerabilities extends well beyond any one company's production facility, as Dr. Kircher notes with reference to the problem of the ingredient supply chain.

But the range of possible vulnerabilities extends well beyond any one company's production facility, as Dr. Kircher notes with reference to the problem of the ingredient supply chain.

"With Worcestershire sauce, for instance, to get from spices or paprika to the actual sauce, that might be 11 steps, and companies don't always know the entire sequence of steps," she says. "They know who they bought from and who they sold to, but really to make these things, there are brokers and sellers and growers. When you get to a final product that we the consumer are buying on the shelf, it has taken many steps. If you think about a basic

recipe for a cheeseburger, that's 84 different components to make all the products that make up your cheeseburger. To me, that's 84 supply chains."

In conjunction with the Foreign Supplier Verification rule and the Transport rule, Dr. Kircher says, the Intentional Adulteration rule provides for robust preventive controls that create a more defensible food system even when it involves buying from vendors outside the U.S.

"This is not an overnight thing," she says. "It's a different philosophy. Companies focus on making good food that we want to buy. They don't think about somebody intentionally trying to harm their product, and so it is a mind shift, it is a culture shift, and we, I think, collectively recognize that we need to do it. But it will take time."

FDA's identification of four key vulnerable activities can be found in the sidebar on page 26.

Training Employees

At the plant level, meanwhile, Wheeler stresses that beyond all other measures, the most important factor in mitigation is well-trained employees. Cameras have no power to perceive potentially threatening behavior and stop it, while card-access systems may only serve to slow down potential threat-actors.

"If someone is going to harm the product, they have to come through the door in order to get to the products in our processing areas," he says. "It's going to be that frontline worker that sees something and says something about it to someone and then can maybe stop what could, potentially, be a huge event."

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The Intentional Adulteration rule mandates monitoring, corrective actions, and verification as components of a mitigation strategy. This is, Dr. Kircher notes, not necessarily an expensive process, however, it is a process that requires effort and organiza-

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She notes that FSMA requires companies to protect against "reasonably foreseeable threats," including weapons of mass destruction.

tion and a plan for deployment. At the same time, she agrees with Wheeler that employee training is essential.

"There are different levels of food defense training or awareness training that have to happen for employees that are what they call actionable process steps, or steps we know that could be a vulnerability in a system," Dr. Kircher says. "It might be an open vat. It might be bulk liquid receiving—those places that we think are at higher risk of adulteration than others. That means people working on the line, all the way up to your food defense program manager, have to have some level of training in food defense, and really, that is increasing the awareness of those that are working and making our food, which actually will create a lot of defense in and of itself, just to have more eyes and understanding of how to protect our food systems."

She notes that FSMA requires companies to protect against "reasonably foreseeable threats," including weapons of mass destruction. "Reasonably foreseeable" is a difficult phrase to define.

"The way it was defined in FDA rules was, if it's happened in the past, you have to show that you can mitigate against it," Dr. Kircher explains. "If there's been some adulteration in the past in this particular product, or for this particular method, or this particular agent, that's something that is a foreseeable risk."

She offers the example of a bunch of bananas versus a can of chicken noodle soup: While the products are each sold in the same stores, their producers and supply chains chart wildly different courses—one of which offers far more opportunity for intentional adulteration. Accordingly, threats that may be "reasonably foreseeable" for one producer are not at all applicable to the other, and vice versa. For that reason, food defense must take into account the peculiarities of each individual mode of production. Preparing to do that, Dr. Kircher says, is going to involve the food production industries acting together as a business community with a shared interest in customers' health and well-being.

"To do this comprehensively, we have to figure out a way to share information between companies and between governments, so there can't just be a single company that leads it," she says. "No one will be successful, so we have to figure out how to be more transparent about our global supply chain in a way that we've never been before. I would argue we can do it and still maintain those proprietary aspects that have to be maintained."

A Brighter Future

Among all parties, there is an air of confidence that FSMA's Intentional Adulteration rule will contribute to an increase in safety and trust in food-production processes, which will hopefully translate into an increase in consumer confidence.

"Since this is a preventive measure-driven program which allows facilities to identify their significant vulnerabilities and develop mitigation strategies that they know will work for their facility, I feel the food industry in the U.S. and globally will vastly improve," says Arnold.

Wheeler agrees, saying that while there's still a good stretch of road ahead, it's nothing compared with how far we've come on food defense.

"I'm very proud of the food industry and the leadership at a lot of these companies," he says. "Not just the major companies, but the midsize to small companies too because they're doing the best they can. As long as we can train frontline workers as to what to do, and get them involved, that's half the battle."

Over his 15 years in food defense, Wheeler says the change has been dramatic, in part because the most successful companies have been adopting goal-based defense: Rather than simply meeting the demands of regulation, they are envisioning the security of their product and facilities and implementing programs to serve that need.

"Companies need to understand why FSMA exists and not place so much emphasis on complying with the law," he says. "You're going to have to comply with the regulation anyway but place your emphasis on what is it that we're trying to achieve." ■

Reading Material on Authentication

Published by Wiley, the Food Authentication: Management, Analysis, and Regulation book covers the most advanced analytical techniques used for authenticating a vast number of products around the world. An introductory section presents the concepts of food authentication while the second examines the analytical techniques for the detection of fraud relating to geographical, botanical, species, and processing origin and production methods of food materials and ingredients. Finally, the third section looks at consumer attitudes towards food authenticity, applying bioinformatics, and future outlook. For more information, go to https://bit.ly/2IMi7oT.—*FQ&S*

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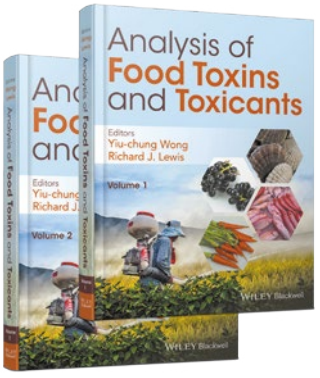

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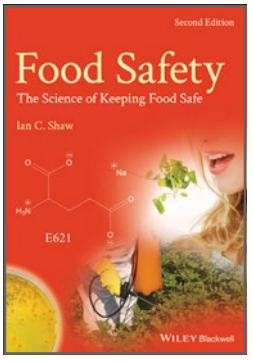

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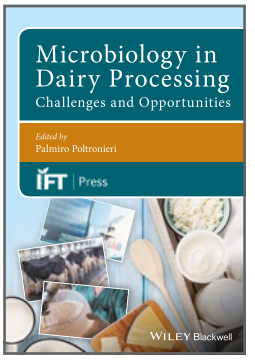

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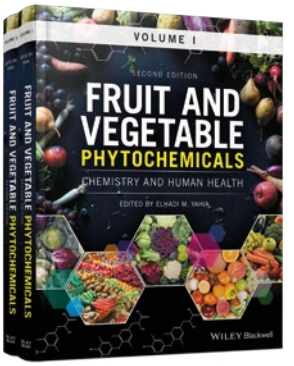

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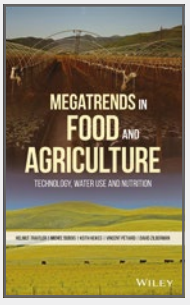

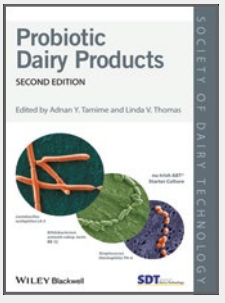

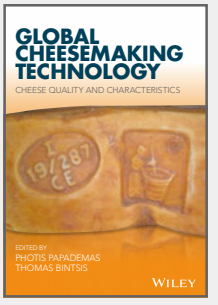

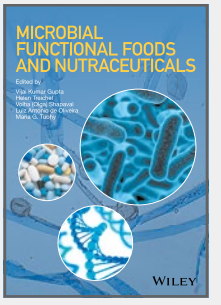

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Food Defense: It's Everyone's Job

Identifying common gaps in current food defense plans and the key components that can strengthen compliance for the Intentional Adulteration rule

BY **KIM ONETT**

Whether for political gain, revenge, or plain old vandalism, there are many opportunities in the global food supply chain for the intentional contamination of food. Motives and the methods may differ, but no one in our industry is exempt from the threat.

Food Defense in a Global Supply Chain

We live in a country where food from everywhere in the world enters our food supply chain every day. We are truly fortunate to have such choice. But we must also ask ourselves how many steps are in place to protect those products on their journey?

A classic illustration is milk. It is stored at individual dairy farms, transported from farm to farm via tanker truck, moved to a co-op, transferred to a dairy milk processor and moved through storage tanks, mix tanks, homogenizers, and fillers, and finally into a carton destined for a state-wide school system. The possible points of entry for an attack are numerous, and the impact both emotional and physical in loss of life and suffering would be devastating.

These very real threats have been recognized by the U.S. government and the voluntary Global Food Safety Initiative (GFSI) benchmarked standards, which contain criteria for food defense. With the passage of the Food Safety Modernization Act (FSMA), the Intentional Adulteration rules and regulations have been put in place. These state that you must develop and implement a food defense plan that includes: a vulnerability assessment; mitigation strategies; monitoring, corrective actions, and verification procedures; and training and recordkeeping.

At a minimum, the food defense plan must be reanalyzed every three years. Records of all activities must be maintained for two years.

If a vulnerability assessment is an evaluation of each point, step, or procedure in your food operation to identify significant vulnerabilities and actionable process steps, the parallels to Hazard Analysis and Critical Control Points (HACCP) are unmistakable. Any company that has a food safety management system in place understands the framework within which the food defense plan must be developed.

But it would be wrong to simply add food defense to your HACCP team's list of duties. Food defense requires a different mindset and a different set of skills. And just as you train your workforce in food safety best practice, you must train them in food defense awareness and mitigation strategies.

Building Your Food Defense Training Plan

What to train and how much to train will depend on the specific responsibilities of your workers. The baseline is awareness training: What is intentional adulteration? How does it differ from food safety and food fraud? And what can each individual do to protect the company?

The FDA has developed resources to help you build awareness in your workforce, and I encourage you to take advantage of them.

A series of webinars on the Intentional Adulteration rule can be found on the Food Safety Preventive Controls Alliance (FSPCA) website at https://www.ifsh.iit.edu/fspca/courses/intentional-adulteration. In these webinars FDA presents expectations and methods for achieving compliance to the rule. Present them to your food defense team and employees, customize the message to your situation, and, above all, get the conversation started.

A tool for identifying appropriate mitigation strategies can be found at https://www.accessdata.fda.gov/scripts/fooddefensemitigationstrategies/. This tool is built on a mitigation strategies database, which is broad reaching and practical.

The FDA also provides helpful posters, called Employees First. These can be printed off and used to educate frontline food employees as to what they can do to promote food defense.

Beyond awareness training, the topics and level of complexity in your education programs will be dictated by the responsibilities of the individual. Table 1 on page 26 provides a breakdown of topic categories based on job role.

The Qualified Individual

The Intentional Adulteration rule clearly states that the food defense plan must be prepared by a qualified individual. The plan must also include a written explanation stating how each strategy significantly minimizes or prevents the vulnerability at the actionable process step.

One of the ways to gain this expertise is by taking the FSPCA intentional adulteration training that will be available in both a face-to-face version and an online option.

The qualified individual, with support from senior management, will be best positioned to determine a training plan that will address all individuals in the facility, including seasonal and temporary employees.

The Food Defense Team

The food defense team is at the heart of your defense plan. Who is on that team and how they are trained is critical. Most will never have been involved in a food defense event, and this will be new territory for them.

Following best practices for risk assessment and building a multi-disciplinary team will be particularly helpful in this situation. In addition to a trained and knowledgeable team leader, consider other plant roles, such as human resources, health and safety, security, and IT, as team members. They can bring insight into potential vulnerabilities that need to be understood and addressed.

The risk assessment team must think outside the box and challenge themselves to consider vulnerabilities that are unique to the process and the particular facility. For example, have they considered the threat of a cyberattack? How easy would it be for the refrigeration systems to be hacked? Could hackers break into your PLC or refrigeration systems, bypass the alarm, and turn a cooler up for five hours and then back down on a weekend?

If some of your team members are new to risk assessment in general, they will require training on the topic. The same is true for procedure writing skills, conducting a gap analysis, understanding cybersecurity threats, and recognizing signs of employee dissatisfaction.

The type of vulnerability assessment training that you select will depend on the two methodologies outlined by the FDA: the three elements from Carver + Shock or the four key activity areas. It is up to you to select the one that you feel your team can best manage.

The results of the vulnerability assessment will highlight the food defense practices required to maintain the production processes and environment, and these may function much like food safety prerequisite programs. Once again, training will help focus efforts and prioritize implementation of prevention strategies. Most of us understand the need to keep doors closed and locked, but how significant is that threat when compared to protecting an isolated area of the facility where product is exposed and multiple ingredients are blended?

Here again, the FDA has provided a useful tool in its Food Defense Plan Builder. This user-friendly software program helps you tailor a food defense plan to your facility. It harnesses existing FDA tools, guidance, and resources into a sin-

(Continued on p. 26)

More on the Intentional Adulteration Rule

The purpose of the Intentional Adulteration rule is to prevent intentional acts of adulteration of the food supply that would cause wide-scale harm to the public. Since 2004, the FDA has been conducting vulnerability assessments on a wide range of products and processes as per the Homeland Security Presidential Directive #9.

Using the Carver + Shock prioritization tool, it identified three of the seven elements that contributed most consistently and significantly to the threat of intentional adulteration of food:

*1. **Criticality***—measure of public health and economic impact;

*2. **Accessibility***—degree of physical access to the facility and the product; and

*3. **Vulnerability***—ease of accomplishing the attack (including the possibility of an inside attacker).

These form the basis for the step-by-step vulnerability assessment of the process and contributed to the FDA's identification of four key activity types: 1) bulk liquid receiving and loading; 2) liquid storage and handling; 3) secondary ingredient handling; and 4) mixing and similar activities.

A food defense vulnerability assessment must at a minimum assess the process against the key activity types. This assessment must also include the possibility of an inside attacker.

The guidance document released by FDA in August 2017 describes the rule in detail and includes the following training requirements.

- The vulnerability assessment and the resulting food defense plan must be conducted by a qualified individual, with the education, training, and experience to conduct the assessment and the reanalysis. This includes the written explanation of the chosen mitigation strategies.
- The individuals responsible for implementing the mitigation strategy at the actionable process steps must be trained in those activities and must receive food defense training.
- Supervisors of those responsible for implementing the mitigation strategy at actionable process steps must receive training to ensure they can carry out supervisory activities and receive food defense training. Records of training must include the type of training, date, and names of the persons trained and must be maintained for two years.—*K.O.*

Table 1. Topic Categories Based on Job Role.

Frontline Workers	Food Defense Team	Senior Management	Facility Leadership Team
Awareness training: • What food defense is • What to look out for • Who to talk to if you see something Food defense plan overview: • What it is • Why the procedures have been put in place • How you contribute to a safe facility • How it intersects with existing prerequisite programs Task-specific training: • Monitoring control or mitigation strategies • Completing required documentation	Awareness training (as with frontline workers) The Intentional Adulteration rule: • What is required • How to comply How to: • Conduct a vulnerability assessment • Determine appropriate mitigation strategies • Implement, monitor, and verify those strategies • Document activities Additional topics: • How to conduct a risk assessment • How to gap your current practices to the new rule • Industry examples and best practices • How to recognize threats: What causes someone to want to intentionally adulterate food? • How to use tools such as FDA's Food Defense Plan Builder	Awareness training (as with frontline workers) Overview of Intentional Adulteration rule: • How lack of compliance can affect the business • Expectations around managing threats Understanding of the resources required by the food defense team and senior management's responsibility to ensure they are available Note: It is recommended that someone from senior management be on that food defense team Note: Senior management must be able to speak to their company's plan and its mitigation strategies	Awareness training (as with frontline workers) Overview of the Intentional Adulteration rule Understanding of the threats and mitigation strategies, so that they can ensure that they are in place within the facility How to enforce and monitor the rules of food defense Monitoring and verification procedures—need to be able to fill out or assess completed records

gle application. By asking you a series of questions about your production process, it calculates a vulnerability score for each step in the process that will help you prioritize your efforts.

Training to Support a Food Defense Culture

The ultimate goal of any training program is behavior change. You want people to do things differently. In this case, you want them to understand how intentional adulteration can occur, recognize threats to your food products, and take ownership of the part they play in preventing threats from becoming realities.

There are three key areas in training:

1. Knowledge—how well your employees know the topic, both the fundamentals of food defense and the requirements of your plan;

2. Skill—how well they can perform specific tasks as itemized in your food defense plan; and

3. Attitude—how they approach their role in food defense.

Once you have classified these areas, you can customize your training program to address specific gaps. Assessing attitude is by far the most difficult task, as is training for attitude change. And yet, it is the most important. Just because someone has been trained on a topic, or has passed an exam, it's no guarantee of success.

When people choose to do something because they believe it is the right thing to do—even though it might take longer and even though it might interfere with their other duties—then you know you are building a strong food defense culture. ■

Onett is the technical manager for training and education services at NSF International. Reach her at konett@nsf.org.

Terrorism's Growing Appetite for America's Food Supply

ISIS hasn't gone away—should agribusiness and the food industry still be concerned over possible threats?

BY **ROBERT A. NORTON, PHD**

Agribusiness and the food supply are vulnerable to terrorist activity. Although militants are being hunted down and much of their time is now spent in survival mode, it doesn't mean all will be neutralized. Some "squirters" will make it into countries undetected. They mean to do harm, and having survived the battlefield, are well equipped to do so. Multinational agribusiness and food corporations remain within reach of militant fighters. This will not change for a long time.

Governments are watching for incoming ISIS fighters. The U.S. continues to coordinate military operations with a large number of nations, many very quietly. However, ISIS fighters are using smuggling routes in cooperation with criminal organizations to move themselves wherever they want to go. The linkage of criminal organizations to terrorist organizations is an alarming trend not likely to subside anytime soon.

Will ISIS target agriculture and food? Of the two, an attack on food is more likely. ISIS currently has neither the delivery capability nor access to the agents necessary to enable an agro-terrorism attack. That doesn't mean the group doesn't dream about attacking a nation's critical infrastructure. They just don't have the needed "chops," so for the foreseeable future such an attack is a remote possibility.

The food supply is another matter. A terrorist group might not have the ability to attack an entire food supply, but might have access to food industry facilities and have the capability to stage a successful local attack. The food industry has four vulnerabilities that terrorists could target: 1) food products, 2) industrial chemicals and systems, 3) personnel and trucking, and 4) rolling stock.

ISIS is quite familiar with the chaos and suffering that poisoning food can cause. Ironically, in 2015 a successful poisoning attack on ISIS' own food supply killed at least 45 militants. Documents recovered from Mosul, Iraq, show the group used prisoners as guinea pigs for experiments using thallium sulfate, nicotine, and other toxic chemicals and has openly indicated a desire to poison the food supply. The toxic substances tested are possibilities, but using industrial chemicals and cleaners already present in the food industry is a more likely scenario. In addition, making threats without actual contamination could also cause major public relations problems for food corporations. And remember, ammonia refrigeration plants and chlorine tanks remain desired targets. ISIS has experience with both.

As far as personnel vulnerabilities, the food service industry has the same vulnerability as any other facility employing large numbers of people because large groups of people are a preferred target. A well-placed improvised explosive device, or IED, in a break area, cafeteria, or ingress/egress corridor would cause chaos. In fact, a phoned-in bomb threat recently disrupted operations at one U.S. food company. Fortunately, the call was a hoax, but that might not be the case in the future. Frankly, law enforcement and the Intelligence Community have been expecting more successful bombings. In terms of firearms, the Las Vegas sniper event last year proved how tragically successful a determined killer possessing lots of firearms and ammunition can be. In many ways, that event was a game changer, and rest assured ISIS noticed and would like to repeat such an event.

All in all, 2018 is likely to be an active year for ISIS and related terrorist groups. Europe and the U.S. will remain preferred targets, and agriculture and the food industry will need to continue to be vigilant.

The most important goal for 2018 should be to know exactly who is working inside the corporate wire. People with access to corporate personnel, processes, and systems can do considerable damage to both people and to the corporate brand, which will have lasting effects. People, of course, are the first consideration, but corporations are made up of people. The most important defensive strategy is to develop and maintain robust situational awareness. Vigilance is the thing that prevents or contains the damage. Stay vigilant to stay safe. ■

Dr. Norton, chair of the Auburn University Food System Institute's Food and Water Defense Working Group, is a long-time consultant to the U.S. military, federal, and state law enforcement agencies and is editor of Bob Norton's Food Defense Blog. Reach him at nortora@auburn.edu or by 334-844-7562.

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Safety & Sanitation

PEST CONTROL

Ten Ways to Prevent Pest Headaches

Avoid costly problems and meet requirements of pest management audits by following these proactive sanitation and maintenance strategies

BY **JERRY HEATH**

Pests and the contaminants they transmit pose a threat to every food operation and a facility can face enormous losses from recalls or bad publicity associated with a product's quality or a safety issue. Keeping your plant and products free of pests and contaminants is critical to the success of your organization. When a pest problem occurs, most businesses implement reactionary measures immediately to ensure the infestation is managed and ends quickly. However, food processing, storage, and handling sites must also place emphasis on pest management prevention and have an existing plan in place in case an infestation occurs.

To avoid costly problems and meet or exceed the requirements of internal and external pest management audits, it is important to employ proactive sanitation and maintenance strategies.

Top 10 Strategies

Here are the top 10 strategies your food processing plant should already be implementing.

1. Make sure the master sanitation schedule is adequate and up to date. Food processing facilities are continually remodeling and changing equipment and processes, which can make it challenging to keep the master sanitation schedule up to date and followed. However, master sanitation schedules are fundamental components of sanitation programs and chronic pest infestations can often be linked to sanitation deficiencies.

Having a schedule in place helps eliminate pest food and harborages, while cleaning schedules disrupt pest developmental cycles. Sanitation schedules also address microbiological risks and general housekeeping. Create and follow an updated ideal master sanitation schedule and be prepared to explain the potential risks if it cannot be followed. Pest management barcode software, periodic dashboard reports, and corporate sanitarians can successfully push critical communications up the management ladder. Also, capital funding can be made available for facility improvements when the need and risks are clearly communicated to the right people.

2. Make the business case for sanitation and pest management. Sanitation touches every department in a plant—invite managers from each department to participate in periodic inspections to show and share their needs. When making the business case, it is important to highlight that some operator cleanup or disassembly is more efficient than sanitation staff doing the work and creates less delays in startup. Also, emergency shutdowns with lines full of product are costlier than planned shutdowns, which can be managed more efficiently and can assure more sustainable product safety and quality.

3. Avoid product spillage and storing dead equipment and hardware supplies. Equipment "bone yards," litter, vegetation, waste management, and production spillage are great harborages for insects and rodents. Store hardware and equipment in an orderly manner and off the floor or ground. Reducing and managing product spillage improves pest management and operational efficiencies.

And remember the roof. Product leaks on the roof become attractive to many insect, rodent, and bird pests. Also consider methods that may be available to reduce bird harborages and roosting opportunities on rooftops.

4. Manage waste. Processing is often well-designed, but livestock feed byproduct (waste) sits in open bins or accumulates in waste load-out areas that are pest

hotspots. Lingering waste residue, leakage, and waste collection sites outdoors can quickly become problematic if not managed properly.

5. Close the door and fix the gaps. A tremendous number of insect and rodent issues can be traced to simple outdoor openings. Indoor rodent activity or trapping history often points to doors that stand open, leave gaps, or do not close properly. Correct exclusion issues, including door thresholds and side gaps, fans, air intakes, and other openings.

6. Seal cracks. Pests can spend their lives in cracks and crevices. These may be expansion joints in concrete floors, floor-wall junction cracks, or cracks at the edges of various panels or sheeting materials. Clean cracks out as good as possible, treat them with residual insecticide and fill them with sealant.

7. Inspect. Strive to improve access to equipment that is difficult to reach for regular inspection, opening, and cleaning.

8. Manage landscaping. Landscaping has definite negative impacts. Lush vegetation, ground covers, fruiting or nut trees, vegetation too close to buildings (actual contact equals ant bridges), and bark mulch on ornamental planting beds near entrances are common issues. Ideally a plant site should be "attractively barren" with well-maintained grounds, a gravel sanitation border surrounding the buildings, and gravel mulch if there must be bushes near an office entrance. Bark mulch is a perfect rodent harborage, and harborage for a number of insect invaders. The only place for a rodent to hide around the exterior of a food plant should be a bait box or trap.

9. Work closely with the maintenance department. Some of the greatest pest management success stories hinge on the involvement of maintenance departments understanding the value of exclusion and harborage elimination. The backdoor to maintenance shops is often the worst offender for letting pests in due to being propped open. Maintenance storage areas are often hotspots for rodents because they are cluttered, dimly lit, and quiet. Avoid pests by keeping the maintenance storage areas neat and well lit, keeping materials and hardware off the floor and capping pipes and wrap items so openings do not become dirty harborages.

Training and explanations of the process for identifying deficiencies and tracking corrective actions are very helpful. Working with a maintenance person to fix miscellaneous gaps, leaks, and entries into harborages could have a much better return on investment than many pesticide applications. Prioritize the corrective actions where maintenance needs to be involved.

10. Do the right thing. Food safety is deadly serious, and a company can face enormous losses from recalls or bad publicity associated with a product quality or safety issue. Sanitarians have the insight to recognize conditions and practices that cannot be tolerated, or products that may not be fit to be shipped. Be brave and do the right thing. It may not be popular to

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squelch production or somebody's shortcut, but report potential food safety problems to higher management and do your part to protect the brand.

The Outside Influences

In addition to these tactics, the following are other outside influences that can increase your chances of experiencing a pest infestation.

- Avoid standing water. It provides essential needs for mosquitoes, rats, flying insects, and moisture conditions favorable to pests.
- Waste containers and handling systems near doors often present irresistible attractions to many pest species, and it is no wonder a certain number gain entry, even if only by accident. Wastes need to be adequately contained away from buildings, and waste receptacles should be closed tightly and/or cleaned of waste and spillage.
- Outdoor storage areas need to be managed properly. Store dead equipment in sanitary conditions—off the ground, cleaned, capped pipes, etc. Make sure that contractors' supplies are stored in a manner they will not be vehicles for pest introduction. Also, avoid trash or junk directly outside your facility.
- Neighboring facilities and environments contribute to pest pressure too. Junkyards can harbor rodents; farms and livestock facilities can be the source of fly pressure; various pests might be associated with neighboring woodlands, wetlands, and aquatic habitats; several neighbors could contribute to roach pressure; and grain elevators, railroad facilities, and other food processors could contribute their own pest complexes.

Another proactive approach to preventative and pest management is to work with a pest management professional (PMP) who is knowledgeable about food processing. A PMP can identify the most critical risks to a particular facility and the most feasible management approach. Working with a skilled PMP is a key asset in today's audit-rich environment—they can easily provide the necessary documentation and communications to help you meet or exceed standards. Having a trained set of eyes will be valuable for ongoing inspections, monitoring for conducive conditions, and developing pest situations.

Implementing these strategies and tactics, working with a skilled PMP, and solving pest problems as early as possible will make pest management easier and less expensive. Be continuously on the lookout for conducive conditions that attract pests and make corrections immediately. It's also important to be prepared with plans for inevitable occurrences. For example, have a protocol in place for when a bird gets into the building, or a mouse is sighted. Having materials and plans for your own immediate response can save the organization lots of time and money and may even save your brand's reputation. ■

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XCLUDER RODENT AND PEST DEFENSE

Exclusion: Most Powerful Weapon in Fight Against Rodents

Eliminating all cracks, crevices, and other spaces to prevent pests from entering a building | BY **DREW MCFADDEN**

From production to processing, distribution to preparation, each step of the food production chain presents a unique set of food safety challenges. One challenge, however, is universal across all facets of the food industry—pest control. Technologies may advance, supply chains shrink, and food trends evolve, but the pest control battle wages on, with rodents often leading the charge for the opposition.

Rodents eat or contaminate at least 20 percent of the world's food each year. Their ability to contaminate on such a large scale is due in part to their "nibbling" habits, wherein they come into contact with far more than they actually consume. In addition, in just one year a rat can shed more than half a million body hairs, and a mouse can produce up to 18,000 fecal droppings. In that same year, a pair of rats can produce over 1,200 descendants. Within three years, that can grow to half a billion descendants! Rodents have been linked to asthma and transport fleas, lice, and ticks. The CDC also points out that they carry diseases including rat bite fever, hantavirus, leptospirosis, salmonellosis, murine typhus, and even the bubonic plague.

These are just a few of the disturbing statistics that highlight the importance of preventing infestations before they occur. Once rodents are inside, it is already too late. USDA Sanitation Performance Standards require that "establishments must have in place a pest management program to prevent the harborage and breeding of pests on the grounds and within establishment facilities. Pest control substances used must be safe and effective under the conditions of use and not be applied or stored in a manner that will result in the adulteration of product or the creation of insanitary conditions."

The use of chemical rodenticides in the food industry is impractical, ineffective, and often highly dangerous. Exclusion—the method of creating physical barriers against rodents and pests to prevent them from entering a building in the first place—is preferred among industry professionals as the safest and most effective pest management strategy available. Fundamentally, it involves the elimination of cracks, crevices, and other spaces that allow rodents to gain entry. The CDC lists "sealing up holes inside and outside the home to prevent entry by rodents" as its number one suggestion in preventing rodent infestations. The New York City Department of Health and Mental Hygiene recommends "sealing all cracks, crevices, and holes in walls, cabinets, and doors" as its top guideline for controlling conditions that promote pests.

Rodent exclusion is fundamental to food safety. Keep the rodents out—plain and simple. Or is it? These tenacious pests are relentless in their pursuit of food and shelter. A mouse can squeeze through an opening the size of a dime, and a rat through an opening the size of a quarter. Rats have the ability to gnaw through plastic, wood, aluminum, brick, cement, and even lead. They can climb wires and rough surfaces, swim considerable distances and tread water for several days, making them a worthy opponent to say the least. But with a comprehensive exclusion plan and employee diligence, it is entirely possible to keep rodents at bay.

Safeguarding Your Building

Building access points are not difficult for rodents to find. The most obvious, and

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therefore the most critical to protect, are exterior doors. Without proper exclusion, rodents will literally walk through the door and compromise food safety. Personnel doors, garage doors, and loading dock doors are all at risk. Exterior doors should remain closed whenever possible, and sheet iron flashing should be installed at the base of wooden doors, which are susceptible to rodent gnawing.

The gap beneath exterior doors is a very common access point. Any clearance below the door must be smaller than 1/4 inch. It is a common misperception that standard rubber or bristle door sweeps are sufficient to protect this area. While rubber sweeps may help keep out the elements, they provide little to no protection against rodents. Even the smallest of rodents can gnaw through a bristle or rubber door sweep in the course of a single night. Metal brush seals pose a larger obstacle for rodents, but overtime they dent and deform leaving gaps that rodents can exploit to gain entry.

Specialized, rodent-proof door sweeps are perhaps the single most important exclusion tool available. Xcluder Rodent-Proof Door Sweeps, for example, feature reinforced rubber gaskets lined with Xcluder fill fabric—a blend of stainless steel and poly-fiber that has been tested and proven effective against rodents by USDA/APHIS. The reinforced edge prevents rodents from gnawing on the sides of door sweeps, and the fill fabric's sharp, coarse fibers cannot be gnawed through by rodents. This type of specialized, rodent-proof product is fundamental to proper exclusion. Rodent-proof seals should be installed on all dock levelers, garage doors, and overhead doors. Vertical side seals are also important for dock doors because rodents will not stop at ground level attacks.

A simple method for testing door frame vulnerability is at night. Turn on the brightest light in the room or warehouse and step outside to see if any light is escaping around the door frame. If light can get out, pests can get in.

Additional rodent entry points that need protection include places where electrical, water, gas, sewer, and HVAC lines enter the building, beneath roofing tiles, and through small cracks in the foundation. The Mallis Handbook of Pest Control offers a practical set of exclusion guidelines for those tasked with protecting a building against rodents. Here are a few tips.

- Protect ventilator grills and windows with proper exclusion materials, ensuring any voids or cracks are filled.
- Defective drain pipes provide a transportation pipeline for rodents. A perforated metal cover should be cemented over the drain pipe. Patch or fill any small openings surrounding the drain where it enters the building with proven exclusion materials.
- Seal large sidewalk cracks, as these crevices allow rodents to access a restaurant's foundation and search for entry points. Foundation walls can be protected with barriers of metal, concrete, or brick around and below the foundation.
- Place circular rat guards around all vertical wires and pipes.
- Ensure that cracked or broken roofing tiles are replaced as needed and utilize exclusion material to fill any voids.

Specialized, rodent-proof products, like Xcluder fill fabric, are fundamental to proper exclusion.

The Right Tools for the Job

A comprehensive exclusion plan—one that identifies potential access points with a fine-tooth comb and constantly monitors for changes and weaknesses—is the most effective approach to protecting a building from invading rodents. A diligent plan, however, is only as effective as the barrier products installed. Caulk, mortar, and spray foam are occasionally recommended as exclusion tools. While appealing, given they are inexpensive and easy to install, these products offer little to no protection against rodents. A creature that can gnaw through lead pipes will certainly not be deterred by spray foam. Steel wool is another popular exclusion material. Though stronger than caulk and foam, steel wool faces rusting and decomposition over time and therefore requires regular replacement. Copper mesh, a more expensive solution, is effective against rodents when properly installed. However, this is not an easy task as a tight seal is difficult to secure, and the mesh often becomes loose over time. It is also a softer metal, lacking the sharp texture that discourages rodent gnawing.

Consider specialty exclusion products as a solution. Xcluder fill fabric compresses during installation to "spring back" once in place and creates a permanent seal, and the stainless-steel poly-fiber combination won't rust or degrade over time. This type of proven, specialty product offers permanent protection against rodents, and the peace-of-mind that goes along with it.

Repellents and sonic devices should not be considered viable pest control solutions. Chemical repellents, designed to discourage rodent presence without harming them, are both unsafe for use in the food industry and ineffective overall. Repellents cannot be used near food products, and though the chemicals may cause rodents some amount of discomfort, the resulting distress is not nearly strong enough to deter them from their pursuit of food and shelter. Sonic devices producing ultrahigh or ultralow frequency sounds to deter rodents have been deemed ineffective by the scientific community.

The Importance of Sanitation

A discussion of exclusion best practices would be incomplete without mentioning the wider tenets of integrated pest management, including monitoring and sanitation. The following are a few suggestions from The Mallis Handbook of Pest Control.

- Gutters should be free of debris and channel water away from the building. Repair or replace leaky faucets, pipes, and air-conditioning units. Do not leave water standing in sinks overnight. Storage rooms and basements should be dry and well-ventilated.

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XCLUDER RODENT AND PEST DEFENSE

Pest Management: Following in FSMA's Footsteps

Integrated pest management should be a targeted plan to not only deal with pests, but to prevent them and minimize their impact before they become a problem

BY **CHELLE HARTZER, BCE**

Your facility most likely already implemented changes to abide with the Food Safety and Modernization Act (FSMA), so now is a great time to check on how things are going as it relates to your pest management program.

FSMA regulations mandate a shift from a reactive to preventative approach with a heavy emphasis on documentation. A pest management program should mirror this preventative aspect of FSMA. An integrated pest management (IPM) program will look at all factors that may affect a facility. It should be a targeted plan to not only deal with pests, but to prevent them and minimize their impact before they become a problem. The Preventative Controls for Human Food Regulation within FSMA requires that food plants have a written preventive pest management plan. Think about the last time you reviewed your overall IPM plan for your facility. Whether you have a pest management provider or perform your own in-house pest management, a review should be done on a yearly basis or when conditions significantly change.

Chances are that this IPM plan has been given a cursory glance at the end or beginning of the year, the date changed, and the program has continued similar to previous years. Take some time to really go through the plan, check the data and trend reports from the last 12-24 months, and see what's working and what's NOT working. Look for ways to make the entire program more effective and as preventive as possible. FSMA aims to prevent issues in the food system and the IPM program uses an entire toolbox of methods to do just that with pest issues.

In order to prevent, facility managers must do their best to predict where future infestations might occur. In other words, a program needs to stay one step ahead of the pests trying to invade your facility.

Specifically, be prepared to answer anything that could be considered a "reasonably foreseeable biological, chemical, and physical hazard." If something is contaminated, it no longer matters if it occurred naturally or intentionally. You must have documentation of your efforts. This doesn't mean you need to scrap the food safety plan developed to meet Hazard Analysis and Critical Control Point (HACCP) standards, but you'll need to make modifications with the help of a Preventive Controls Qualified Individual (another new requirement).

To ensure a food processing facility is meeting all of the requirements necessary, there are a few crucial steps.

Path to Compliance

Most pest management companies offer a free initial inspection, so take advantage of it! A full inspection of the facility should be done at least annually, even if you haven't dealt with an infestation in the past year. You never know what pests could be lurking behind the scenes, especially if a lot of product is stored in the facility. Be sure that pests haven't compromised the packaging, or an infestation could spread quickly.

Specifically, be prepared to answer anything that could be considered a "reasonably foreseeable biological, chemical, and physical hazard."

After the initial inspection, staff training is a must. A few employees cannot be expected to monitor an entire facility, but assigning all employees a specific role (based on their job function) can lead to quicker discovery of pest problems. Many pest management providers offer complimentary employee training programs to teach facility staff the signs of pest infestations. By doing so, individu-

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als feel empowered to call out the danger signs, which will enable you to get ahead of pest issues faster. Think of it like this: If you're coaching a soccer team, you wouldn't send six players out at the start of a game when you're allowed 11. All your employees are key players when it comes to detecting pests.

From there, remember that proactively preventing pests is a team effort between company leadership, employees, and the pest management professional. Throughout this process, it's important to be on the same page, so communicate frequently. And don't forget to record your efforts every step of the way—hard work won't matter unless you can prove it.

Of course, in order to determine what the pest issues are and if they are close to or at the threshold, you need to monitor. Monitoring and constant improvement will help a company remain compliant with FSMA guidelines. When doing so, careful documentation is key. While it can seem tedious, one shouldn't overlook the value of monitoring and analysis as a management tool. Collecting data and putting it in context can be an effective way to prioritize pest control efforts.

A detailed analysis will account for normal seasonal cycles, deficiencies in maintenance, exclusion, sanitation, and harborages, just to name a few. This analysis can also help improve pest control efforts by prioritizing areas needing attention, especially when staff is limited by time or resources.

That's why careful documentation is critical, as it will help demonstrate compliance with FSMA standards. It can also help you stay audit-ready at a moment's notice.

The Paperwork

There are six key documents to keep on hand.

1. Food safety plan. The most important piece of documentation, the overarching food safety plan should be updated regularly. The plan should be a comprehensive document detailing all activities to ensure the safety of food during manufacturing, processing, packing and holding—and now—shipping as well. It needs to include a list of your facility-specific potential hazards, preventative controls, and corrective actions taken to mitigate those risks, along with monitoring and verification procedures.

2. List of service changes. A food safety plan needs to be dynamic. But when modifications are made to meet the ever-changing needs of a facility, keep careful records of how and why the plans have changed. As you work to stay one step ahead of changing pest pressure, you'll need to be agile and adapt your plan quickly. Document all changes made.

3. List of monitoring devices/traps. A food safety plan should include a map documenting all monitoring equipment, traps, and other devices used in the facility to reduce the likelihood of pests. Note the locations and activity levels of pests around each. A trend report from the collected data can help advise changes to the food safety plan. A pest management professional can help with this, as they should be noting activity each time they inspect the property. The historical data from pest monitoring devices and the corrective actions associated with any issues will show any third party that pest issues are taken seriously, which puts you in a great situation from the start. Monitoring devices also work as a warning system for developing pest issues, which is key to a proactive approach.

While it can seem tedious, one shouldn't overlook the value of monitoring and analysis as a management tool.

4. Annual assessments. Each year, review the food safety plan and current food safety program. Annual assessments note problem areas and help set goals for the coming year. It will help to demonstrate year-over-year improvement and show a long-term commitment to pest management. It'll also demonstrate that pest issues in a facility aren't lingering over time.

5. Sighting reports. Anytime a pest is spotted within the facility, it should be documented in a pest sighting log. The report should include information about the location of pests within the facility, who found them, and the number of pests spotted. Photo evidence helps with identification, so obtain a close-up picture of the pest(s) if possible. Ensure the pest is correctly identified by a professional and any corrective actions (if necessary) are documented. Record activity levels in the area over time to ensure the problem has been resolved.

6. Proof of training/certification. You know that your pest management professional is trained and certified, but a third party doesn't. To demonstrate a provider's expertise, keep on hand a valid license or certification document, written evidence of the pest management professional's training, and documentation of internal training on IPM and Good Manufacturing Practices.

Case Study

Let's bring all of this together with a case I dealt with recently. There was a large commercial bakery that started having a German cockroach issue. This was not one of the identified potential risks because it had not come up in the past. After thorough inspections, the problem was found mostly within a wall void. The employee breakroom was located on the other side of that wall. Once the cockroaches were treated, the food safety plan was updated to reflect the newly identified risk: employees bringing in cockroaches on personal items. Corrective actions were implemented: training of employees, better sanitation in the breakroom, and door seals from the breakroom to the processing areas were sealed. New thresholds were set and monitoring devices were put in strategic areas to monitor the area and verify that the corrective actions were working. The written IPM plan was also updated and everything was documented.

Your site has probably been in compliance with FSMA for a while, but now is a great time to review to ensure the plans are still accurate and working. An IPM plan should be in line with all of FSMA's requirements and ensure your facility is preventing foreseeable pest issues. ■

Hartzer, the technical services manager for Orkin, is a board-certified entomologist and provides technical support and guidance across all Rollins brands in the areas of operations, marketing, and training. Reach her at mhartzer@rollins.com.

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Testing

BEVERAGES

Nuclear Screening at Heart of Hungarian Wine Profiling

Hungary joins other European countries to create a wine map of origin, using nuclear magnetic resonance to detect wine fraud

BY **IRIS MANGELSCHOTS, PHD**

Hungary—a country with a growing wine export market—is composed of 22 wine regions. Despite winemaking playing an important role in Hungarian culture for hundreds of years, the country has not been as well-renowned globally as countries like France, Italy, and Germany. Tokaji—a sweet wine from the northeast region of Tokaj—is perhaps the most well-known Hungarian wine, but other wines of great value are produced in the country. For this reason, protection of Hungarian wine from wine fraud and forgery through the generation of a wine map of origin is of great importance.

Novel Tools and Partnerships

New, innovative tools are being developed to advance wine authenticity and identification methods. Nuclear magnetic resonance (NMR) is a powerful technique capable of making precise measurements of thousands of different wines, and its recent adoption in Hungary is providing wine customers and producers with confidence and trust in the content and origin of their wine. NMR has been used in western Europe for a number of years, but Hungary is the first eastern European country to adopt it.

The Hungarian Ministry of Agriculture and Diagnosticum Zrt., a Hungarian diagnostics company, have been working together in recent years to achieve two goals: 1) to develop a wine map of origin and 2) to contribute data on Hungarian wines to the existing international database. The recognition of a need of alliance between the Ministry and Hungarian wine associations led to the signing of a contract in July 2017, propelling the Hungarian wine authentication and identification program through the use of innovative technology.

The Ministry has now acknowledged the importance of an inclusive Hungarian wine map—the first in Eastern Europe—to extend the existing European Union (EU) map consisting of French, Italian, Spanish, and German wines. The addition of Hungary to the map will positively impact international business, wine producers, and dealers.

Ensuring Wine Authenticity

Wine fraud encompasses intellectual property infringement, wine adulteration, and counterfeiting, which can be done by misrepresentation and mislabeling of grape variety, blend origin, or vintage. The Hungarian Ministry of Agriculture is looking to tackle this problem using NMR screening technology.

The Hungarian Ministry of Agriculture and the EU commissions and funds the Hungarian wine identification and authentication program. Diagnosticum carries out screening of wine samples sent to its laboratory by wine producers who are keen to reinforce their customers' trust by authenticating their product. When wine producers from across Hungary send their samples in, Diagnosticum uses Bruker's NMR FoodScreener to screen for 52 different measurement parameters and produce a report. Each individual wine sample is then compared to a broad authentic database of reference samples and a detailed certificate is produced. The parameters include tests for decomposition, markers of fermentation, amino acids, phenol derivatives, and stabilizing agents.

"At the moment, we can produce a measurement report from sample receipt to report delivery within one month," says Sándor Fazekas, Minister of Agriculture, who signed the agreement between the Hungarian Ministry of Agriculture and Diagnosticum. "In the next year,

we're hoping to bring this time down further. The testing itself is very speedy—we can measure 120 samples per day across the two instruments we own, and only need a small sample to get an accurate measurement."

Wine Screening with NMR

Using NMR allows Diagnosticum to acquire spectroscopic profiles, or fingerprints, from wine samples that are specific to individual samples, and compare these to a large database of authentic wine samples using a multivariate statistical approach. This high-throughput technique provides a wide range of targeted and non-targeted information, such as the detailed chemical composition of the wines, the geographical origin (including influence of soil), identification of wine variety, vintage year, any form of adulteration, and aging of the wine. The resulting test certificate provides foreign and Hungarian traders with a greater guarantee of the origin and quality of the wines than previously available.

"The importance of wine goes beyond its pure market value—it empowers the whole economy," says Fazekas. "It is therefore imperative that the wine is of excellent and authentic origin for domestic and overseas customers. In order to implement the program, the Ministry will enter into a strategic agreement with Diagnosticum where they will provide the technical background needed to draw the map of origin of Hungarian wines, creating a database based on an internationally authentic mathematical model. In return for submitting their samples, Hungarian wineries will be given a year's free access to provide their wines for analytical studies, which has not been available to them until now. We see great potential in the innovative work that Diagnosticum are undertaking, which will unquestionably make the self-identification of Hungarian wine possible."

The parameters include tests for decomposition, markers of fermentation, amino acids, phenol derivatives, and stabilizing agents.

The wine analysis certificate gives both foreign and Hungarian traders a greater guarantee of the origin and quality of the wines, significantly improving the market position of Hungarian wines and strengthening consumer confidence. The "fingerprint" of the individual wines are visualized and verified in the database, and the technology used demonstrates the chemical characteristics of the wine, as well as information on the soil in which the grapes were grown. Consumers are increasingly wary of wine fraud, so validating authenticity will increase consumer trust on a global basis.

"NMR is the most reactive high-resolution spectrum technology, which is uniquely placed for generating unique wine identifiers (fingerprints)," says Ferenc Péterfy, PhD, chairman of Diagnosticum. "The NMR spectrum can be used to identify the wine's region, vintage, and variety, using a database based on authentic patterns. This is incredibly valuable to us and is the driving force of the Hungarian wine authentication and identification program."

International Support

Diagnosticum and the Ministry are in direct contact with Italian and French wine laboratories, which have been using NMR technologies for wine screening for some time. As part of the wine map of origin project, Diagnosticum has open access to these NMR facilities and the countries are able to discuss the latest advances in techniques.

"The same sample can be measured in different countries, but with NMR we should all get the same results," says Péter Szaszák, project director of the program at Diagnosticum, who is leading the partnership with the Ministry to develop the Hungarian wine map of origin and the international database. "We can directly ask other countries' wine laboratories how they are using these new technologies and what their workflow is. We're still learning, and we still have a lot of questions which, with the help of other countries, we will gain more answers to."

Looking Forward

Wine fraud and forgery is an industry-wide global issue, where significant investments are being made to bring new sophisticated solutions to market to improve authentication and identification methods. Mathematical modeling of wine analyses to create the wine map of origin is a work-in-progress, where professionals must be trained to interpret the data output from NMR screens. It is thought that in the next two years, a robust mathematical model will be available to wine producers, and the turnaround time for analysis and reporting will be cut in half. The advances in NMR technology could mean that countries not using this technique will be left behind. ■

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Map of Origin FAQs

What is the wine map of origin? The Hungarian wine map of origin will show the place of origin of each individual wine sample, as well as the wine composition. The Hungarian Ministry of Agriculture will help provide the technical background necessary to compose the map.

What is the international wine database? The metabolic profiles of wines from across the globe are compared to a large database of authentic wine samples using high-throughput NMR. This forms the international database, to which Hungary will begin to contribute.

Who participates? The Hungarian map will contribute to the existent EU wine map of origin, in which France, Italy, Spain, Austria, Germany, and Chile already participate.—*I.M.*

Is Automated Media Preparation a Good Fit for Your Lab?

Automating media preparation for pathogen testing can improve operational efficiencies for certain food laboratories

BY **HEATHER GARCIA** AND **HECTOR CASTANEDA**

As readers of Food Quality & Safety know, there has been an ever-increasing interest in recent years regarding testing for common food pathogens such as *E. coli*, *Listeria*, and *Salmonella* in commercial foods. Publicity around food disease outbreaks has increased in the media, which in turn has sparked more attention on food safety issues. As a result, more testing is required for food pathogens.

Traditional Pathogen Testing

Testing for pathogens in a food testing lab is a multi-step process and preparing the enrichment media constitutes much of the activity. Figure 1 on page 39 illustrates the typical process flow in the test cycle. After a food sample is received for testing, it is documented for recordkeeping purposes and weighed. Prior to use, enrichment media is prepared and autoclaved for sterilization purposes, and must pass QC checks, which can take several days. The test sample is added to the QC approved enrichment media, and incubated for a period of time, depending on the test method. Finally, the test sample is analyzed, and the test results are recorded and released to the customer. The test method used determines how the sample is analyzed. For example, testing for common food pathogens is typically not a quantitative (or numeric) test, but rather a simple qualitative (i.e., pass/fail) test.

Testing for food pathogens using this traditional method is highly manual and time-consuming, and fraught with problems in the testing process. First, there are numerous opportunities for human error that can affect test results. For instance, incorrect data may be recorded about the test sample, both pre- and post-test. There may also be inconsistencies in the volumes of media prepared for testing, which can have an impact on test results. Evaporation during the sterilization (autoclave) step is a very common problem and can cause measurement uncertainties in the test results. Next, there are a number of safety concerns in the testing process, particularly around enrichment media preparation as it is traditionally done. Autoclaves are used repeatedly, both to heat the enrichment media and to sterilize test containers, leaving various opportunities for contact burns from the autoclave itself or from glassware/containers. Large volumes of heated enrichment media, and the transport of same, also brings the potential for burns caused by contact with hot fluids. Finally, the post-enrichment incubation times may be long due to the time required to bring samples up to test temperature. With many standard testing methods, the enrichment media needs to be at the target test temperature, and using standard media preparation practices, each media container of approximately 3375 milliliter (mL) will need to be pre-warmed prior to use. These media containers are typically placed in an incubator or other heating source in order to do this. Heating large volumes of enrichment media takes time and failing to have the enrichment media at the proper test temperature will obviously influence the test results.

Heateflex's Demeter is an example of an automated media preparator.

HEATEFLEX

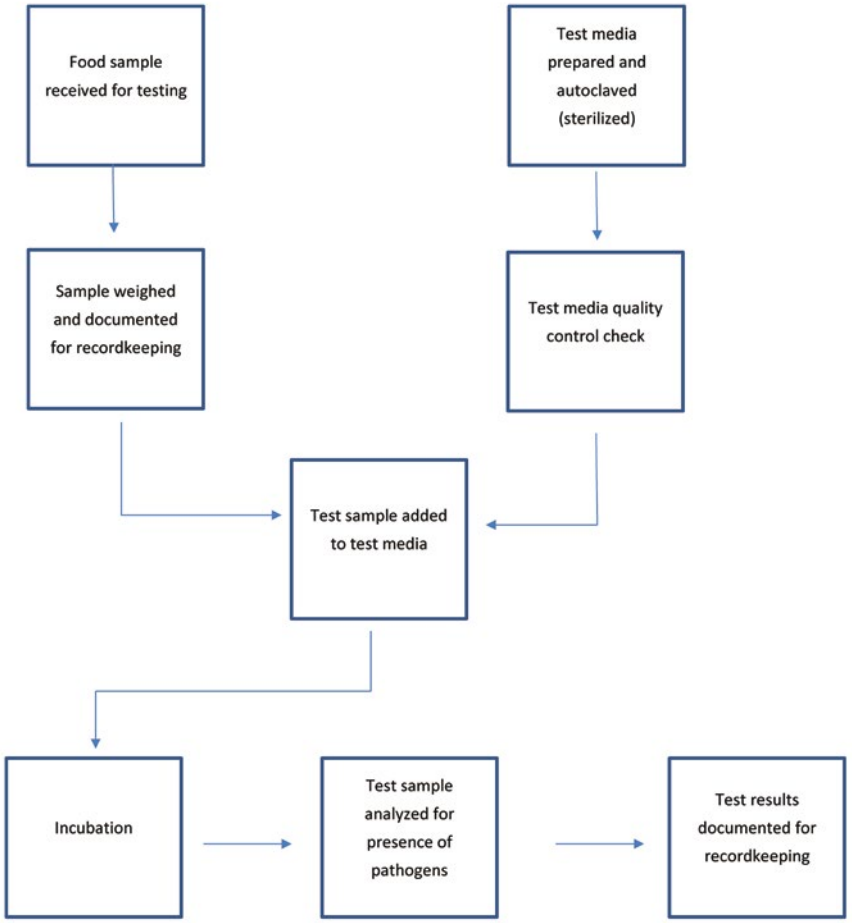
Heating large volumes of enrichment media takes time and failing to have the enrichment media at the proper test temperature will obviously influence the test results.

Increasing Efficiency of Media Preparation

Automating the media preparation process in foods pathogen testing can alleviate many of the problems previously described. Most notably, the throughput of test volume may be dramatically increased if QC-approved concentrated sterile enrichment media is added to test containers holding pre-heated and sterilized water prepared by an automated media preparator, which brings the enrichment media up to the final test volume. Tables 1 and 2 on page 40 show an example of how the use of concentrated enrichment media in this manner can allow for up to an 85 percent reduction in the amount of enrichment media that would need to be autoclaved, allowing for far greater throughputs. Dramatically decreased labor and energy costs result from processes that are more efficient, and which require significantly less autoclave time.

Automated media preparators may be valuable in both large and small food testing labs. In using a media preparator for a large lab, with an incubator room, the lab manager first determines the approximate daily sample volume and the amount of enrichment media that would be required in total using traditional testing methods. Sterilized water is then pre-dispensed into test containers to which the concentrated enrichment media will later be added. These sterilized water containers are placed into the incubator room to maintain the proper test temperature prior to testing. When using the system in a smaller lab, without an incubator room, the media preparator is adjusted to dispense directly into the test container, just above the target test temperature, and concentrated QC approved enrichment media is added to the sterile heated water containers. This allows the enrichment media and the sample to maintain the proper temperature prior to and during incubation.

Figure 1. Typical food testing lab process flow.



An Example in Cost Savings

Using traditional media preparation methods, a lab receiving 40 test samples per day at 375-gram sample size each would require 3375 mL of heated enrichment media per sample, or 135 liters of enrichment media per day. By using an automated media preparation system, only 20 liters of concentrated media would be required each day, nearly an 85 percent reduction in volume. This concentrated enrichment media is then added to the remaining volume of sterile water—dispensed at predetermined temperature by the media preparator.

The reduction in costs associated with autoclave use to heat enrichment media in this manner is dramatic, as outlined in Table 1 on page 40. In the standard procedure, 14 hours of autoclave time is required each day to heat the 135 liters of enrichment media, at a cost of about $245 in labor (14 hours x $17.50-hour labor cost). Using concentrated media and a media preparator, only four hours of labor would be required each day: two hours to make the 20 liters of concentrated sterilized enrichment media, and two hours to dispense 115 liters of pre-heated and sterilized test water. The daily cost savings would be $175; 10 fewer hours of labor; and 12 fewer loads in the autoclave.

The savings add up. In the example described above, the weekly labor cost savings comes to $1,225, or over $63k a year. Obviously, the larger the volume of media required each day for testing, the greater the cost savings, and the faster the automated media preparator will pay for

(Continued on p. 40)

H. GARCIA, DIAMOND PET FOOD

(Continued from p. 39)

Table 1. Daily Cost Savings: $175, or 10 hours in labor and 12 fewer loads in the autoclave.

	Standard Practice	Hours Required	Cost ($17.50/ hr.)	With Automated Media Preparator	Hours Required	Cost ($17.50/ hr.)
Number of Samples Per Day*	40			40		
Autoclaved media (liters)**	135	14	$245	20	2	$35
Sterilized water w/o autoclaving (liters)				115	2	$35
Total cost			$245			$70

*375 gram sample, 3375 mL of liquid media
**Market Forge Sterilizer Model STM-ED-95-6300

Table 2. Weekly and Yearly Cost Savings.

Weekly Cost Savings			
Standard Practice	945L	98 Hours	$1,715
W/Auto. Media Prep.			
Concentrated Media	140L	14 Hours	$245
Sterilized Water	805L	14 Hours	$245
Cost Savings			$1,225

Yearly Cost Savings			
Standard Practice	49.275L	5110 Hours	$89,425
W/Auto. Media Prep.			
Concentrated Media	7280L	730 Hours	$12,775
Sterilized Water	41995L	730 Hours	$12,775
Cost Savings			$63,875

itself. In addition to the number of hours required to prepare 135 liters of enriched media per day, the autoclaves in themselves are huge limiting factors in terms of production throughput in the testing lab. Smaller autoclaves aren't capable of keeping up with the large volumes of enrichment media that may be required, and large autoclaves can easily cost more than the media preparation system itself and can require additional staff to keep up with the sample volume.

As an example of a media preparatory, the Demeter, manufactured by Heateflex Corp., automatically heats and dispenses sterile water at a pre-determined temperature into a test container, to which sterile concentrated enrichment media and the test sample is then added. The dispense is highly precise and accurate for each test, eliminating human error. Onboard electronics provide traceability for test temperature and volume, and up to 16 pre-programmed test recipes/dispenses are available for various volumes (225 mL to 5,000 mL) and test temperatures (0 to 50 degrees Celsius). A UV light filtration system ensures that the test water is sterilized prior to the dispense. For recordkeeping, the system includes a scanner to record sample and batch data, and a barcode label printer for affixing test information to the sample container.

Don't Forget Other Possible Benefits

Economic arguments aside, there are other reasons for considering the use of an automated media preparation system in the food lab testing process. First, they're easy to use, and sample accuracy is ensured due to the precise dispense capabilities (both volume and temperature) afforded by these types of systems. Lab recordkeeping can also be automated to a certain extent, as the data collected by these products can often be uploaded to a lab information management system if one is available. And finally, lab operational safety can be significantly improved. There are fewer autoclaves involved in the testing process, and both the heating and transport of large volumes of heated enrichment media may be eliminated.

> Dramatically decreased labor and energy costs result from processes that are more efficient, and which require significantly less autoclave time.

In closing, using automated media preparation systems in the food testing process flow may make a great deal of sense in the operation of many food testing laboratories, but these products aren't for everyone. They're not ideally suited for labs where testing for food pathogens is minimal; e.g., in labs that are primarily focused on quantitative testing. And, in smaller labs, the traditional use of autoclaves and sterilizers may be adequate for test volumes, and there may not be a strong economic argument justifying the productivity advantages of these systems. However, in most other situations, automated media preparation systems are worth a look by laboratory managers who are seeking to improve operational efficiencies. ■

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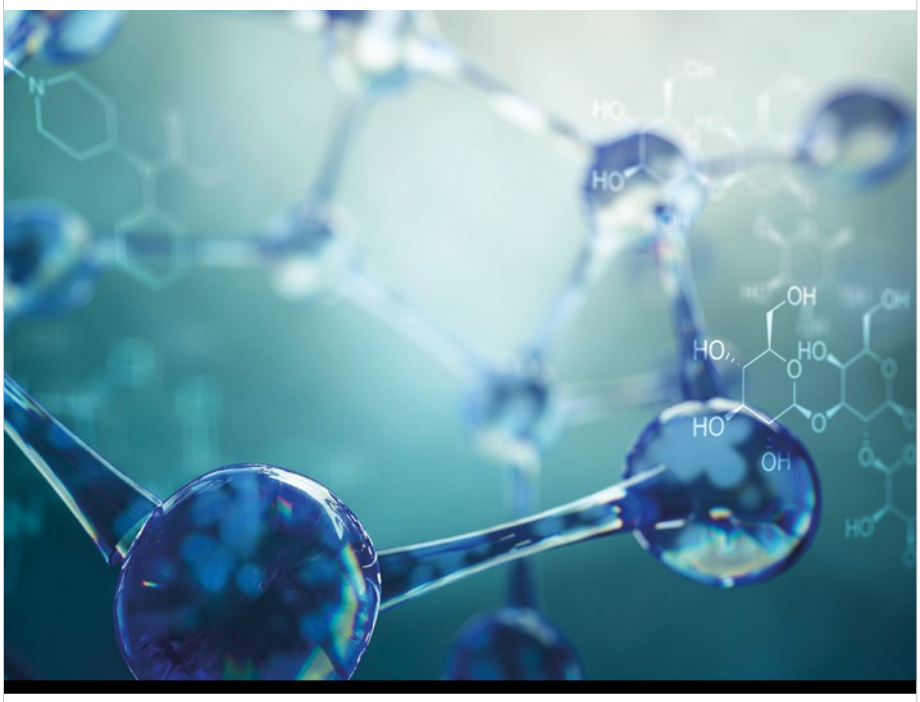
It won't be long until we name the 2018 Food Quality & Safety Award winner. Watch this space and learn more online at foodqualityandsafety.com/award.
This prestigious award honors the dedication and achievement of a food quality and safety assurance team that has made exceptional contributions to their company's commitment in supplying safe food products.



Food Safety Testing at the 'Molecular' Level

Automated molecular analysis tools are needed to simplify pathogen testing and reduce costs

BY **JACK REGAN, PHD**

As is often the case in business, it is always about the bottom line.

In the food industry, producers continually evaluate their processes to ensure the highest level of profitability, and a significant portion of the equation focuses on risk management. Risks like drought, flood, and pest infestation are considered acts of nature to which consumers are forgiving; however, other risks, such as releasing contaminated food items to consumers, is viewed by the public as preventable and less forgivable.

According to a study commissioned by the Grocery Manufacturers Association, 77 percent of respondents estimated the financial impact of a Class I recall to be up to $30 million dollars; 23 percent reported even higher costs. The prospect of these types of losses frighten large companies and can bankrupt small companies.

The Food Safety Modernization Act rules and regulations now require food producers to perform pathogen testing to minimize the probability of recalls. Although there is a willingness to perform pathogen testing, food producers don't want to excessively pay for testing, as it bites into their bottom line. Hence, food safety testing programs are all about sufficiently managing risk, while preserving the bottom line.

Over the past few decades, the incidence of food recalls has not declined, which is troubling. However, there is a reason for optimism as new technologies are under development that may provide better tools for food safety officers to carry out their jobs, presuming that they are more sensitive than current methods and can detect problems in a timelier manner.

Problems with Culture

The practice of growing pathogens (i.e. culture) has long been used in the industry since it is relatively affordable, simple to perform, and confirms viability, but it does have two major drawbacks. First, it is slow and takes several days to return a result. For perishable products, every day that's lost waiting for results impacts the product's value since there is less time for those products to be sold. The delay in getting test results is responsible for additional incurred expenses for transporting the food products to a storage facility and then paying for refrigerated storage, if needed. Although indirect, these costs need to be factored into the cost per sample tested.

The second drawback is that no single medium and growth condition works for all pathogens. This is problematic since splitting a sample across two or more growth strategies can double or triple the cost, which forces a decision as to whether or not to screen for certain pathogens. This is not a decision that's taken lightly, considering that foodborne illnesses are not only caused by bacteria but can also be caused by viruses and fungi. The failure to screen for pathogens like norovirus, hepatitis A, and mycotoxin-producing fungi leaves many companies exposed to more risk than is desirable, but the added cost of screening for these pathogens is often prohibitive with the current methods.

Pros and Cons of Molecular Testing

Antibody/immunoassay methods are inexpensive, generally look for just one pathogen at a time, and are easy to perform. Although these tests take just a few minutes to perform, their overall time-to-result is relatively poor because culture is first required to overcome their poor sensitivity. In contrast, molecular DNA-based methods are so sensitive that skipping culture can be entertained in some cases. Some have even argued that polymerase chain reaction (PCR)-based testing is too sensitive and would cause a dilemma in deciding how to handle samples since many would come up as positive, where previously they were thought to be nega-

tive. This is where quantitative PCR (qPCR) may have utility since a threshold in quantity for a positive sample can be set. Another benefit of molecular testing is that it is more amendable to multiplex analysis, allowing for samples to be screened for multiple pathogens at a time.

Molecular analysis also has drawbacks. Namely, it requires a skilled molecular biologist, is more expensive, and it cannot confirm viability. As such, it is not expected to entirely replace culture. Yet, PCR, if properly implemented, should allow food safety officers to rapidly assess the risk of some food items, thereby allowing them to quickly decide how to handle food lots of varying risk levels.

For example, samples that are found to not have DNA from pathogenic organisms would be deemed as low-risk items that could be shipped directly to customers, whereas samples that are found to contain DNA from pathogenic organisms would be deemed higher risk and slated to be either processed differently (i.e. heated to kill the pathogens) or tested by culture to confirm whether the positive genetic test could be attributed to residual dead pathogens or if the signal was due to viable pathogens that could cause disease.

Another drawback to PCR is that major sample types cannot easily be processed for PCR because some matrices are just too challenging. For instance, it is hard to envision genetic analysis being performed directly on a 25-gram beef sample, as the technology is just not designed to handle the volume or type of matrix. Likewise, it is very difficult to process viscous food items like peanut butter. For these types of matrices, upfront culture will be required to achieve the desired sensitivity, which eliminates the speed advantage of molecular analysis.

In contrast, it is easy to envision genetic analysis being performed on liquid samples that don't have too much particulate matter and are not too viscous (i.e. the media from swabs, fruit and vegetable wash, and the water that's used to rinse grains). Companies that are interested in exploring the advantages of genomics must first realize that the initial scope of use for genetic analysis within the food safety sector is limited. Nonetheless, sufficient testing happens on these types of matrices to warrant serious attention.

The incredible sensitivity of PCR makes it the most attractive molecular technology for detecting pathogenic organisms in food processing plants. However, although it is sensitive, it doesn't currently fully address the desire for a shortened time-to-result since the work must be done by trained molecular biologists who typically do not work night shifts, which is problematic for companies that operate 24/7. The better solution is to take the "skilled" human entirely out of the equation and have a fully automated instrument perform PCR analysis on the samples. Therefore, sample testing can happen around the clock.

The same factory workers who now package up samples to be sent to a food contract lab for testing would instead load samples directly onto an instrument in their facility for automated onsite testing.

Multiple companies are working hard to simplify the complexity of PCR into an automated solution. Successes have already been realized in other industries, namely human clinical diagnostics. But these same successes have not yet filtered down to the food safety industry, where the acceptable price point for each sample that's tested is substantially lower. Nonetheless, advances are being made on reducing the cost per sample down to a price point that potentially will spur widespread adoption in the food industry. This advancement will likely become commercially available in the next year or two.

The Ideal Solution

For many in the food safety industry, the ideal solution would be to have an instrument that is easy enough to be used by factory workers who have no training in microbiology or molecular biology and, as such, could be placed inside of the factory close to where the final products are packaged. The same factory workers who now package up samples to be sent to a food contract lab for testing would instead load samples directly onto an instrument in their facility for automated onsite testing.

Ideally, the instrument will be able to process large volumes of fluid to minimize the chances of a false negative result. The automated instrument will need to have the capability to concentrate the particulates in liquid samples, purify the genetic material from these particulates, and then assemble, perform, and analyze the results of multiplex qPCR tests that are designed to detect the most common pathogens that cause foodborne illness.

An added benefit would be to simultaneously quantify the level of indicator species so that the cleanliness of the product and cleaning processes in the facility could be monitored. To not hold up the packaging and shipping processes, the instrument will need to return results in about an hour. This will allow food safety officers to quickly make decisions as to whether or not food items should be loaded onto trucks that are destined for the consumer or onto trucks destined for a test-and-hold warehouse (while they await results from samples that are pulled for traditional culture analysis).

The bottom line is that the food safety industry is in need of better tools to prevent foodborne illnesses. The industry has a willingness to pay for more expensive methods if the new methods translate into operational efficiencies and lower risk. Advancements in the industry are moving quickly, and prices are coming down. Expectations are that the wait for new technologies isn't far away.

These new technologies are expected to empower food safety officers to change business practices where most food lots can be shipped directly to the customer, reserving only those that are found to be at a higher risk to be tested via culture. The hope is new technologies will allow food producers to deliver fresher and safer foods to consumers, while also allowing them to maintain economic efficiencies. ■

Dr. Regan is the CEO and founder of LexaGene, a biotechnology company that develops automated and sensitive instrumentation for rapid pathogen detection. Reach him at info@lexagene.com.

Cannabis as a Food Additive: The Farm-to-Fork Journey

Explosive growth is likely for marijuana production, but there are unique challenges to consider, from growing and harvesting to processing, packaging, and distribution

BY **PHIL KAFARAKIS**

As more states legalize recreational use of cannabis or marijuana—California being the most recent—questions about its harvesting, processing, and use as a food additive, against the backdrop of a complex legislative environment, come to the fore. In what is projected to be a $10 billion industry in 2018—as a point of comparison, note that ice cream is a $5 billion sector—the growth of cannabis as a food additive should therefore be of considerable interest to food manufacturers and processors.

As of January 2018, cannabis is legal for recreational use in eight states, in addition to the District of Columbia—Alaska, Washington, Oregon, California, Nevada, Colorado, Massachusetts, and Maine. An additional 22 states have approved it for medicinal use, meaning that the majority of the country now has some type of legal access to marijuana. With widespread legitimacy comes the need to plan for scaled production—a new opportunity that holds unique challenges but also great economic promise.

In Canada, where marijuana has been legal for medical use since 2001 and where recreational use as a food additive is expected to pass by 2019, early stage rumblings include an M&A deal between beverage giant Constellation Brands and Canopy Growth Corp., the largest publicly traded cannabis company in the world. Constellation wants to extract liquid from cannabis and put it into beverages, getting in on the ground floor of a new industry of nonalcoholic, marijuana-infused drinks.

From growing and harvesting to processing, packaging, and distribution, as more states legalize cannabis use, the legislative environment will need to keep up with establishing what regulations need to be in place as food verification and worker safety issues emerge.

The Start of the Cycle: Growing and Harvesting

What is known about growing and harvesting cannabis is largely because the experiment in Colorado has lasted as long as it has—more than five years have passed since Colorado Amendment 64 was signed into law, legalizing marijuana for recreational use a year later in January 2014. Since that time, the industry has found a market for medical as well as entertainment purposes. The main focus right now is to credentialize the production of cannabis as a legitimate business.

Environmentally, cannabis requires a dry climate. Towns that have suffered se-

vere ground water depletion could see a real resurgence, a kind of modern day gold rush. One desert community in California, where there was once a thriving community of floral, spice, and herb farms, has dried up—but now people are moving back to grow cannabis because of its ideal harvesting properties.

When cannabis comes out of the field in a growing operation, it must be tagged and marked, documenting where and when it was grown and processed. In the same vein, there will be a need for its purity to be checked once inside a processing plant, as part of a closely watched quality assurance cycle. When cannabis buds are harvested, they need to be processed in much the same way as small vegetables, though there will be refinements to accommodate the physical properties of the plant. As with specialty nuts, spices, and herbs currently, laws and regulations must be followed before it can reach consumers. Therefore, this ingredient will have to be added to the current guidelines.

Because of the changing regulatory environment, I believe cannabis processing plants will initially be attached to growing areas, rather than shipping the product across state lines. Unlike Florida orange growers shipping their fruit across the country to juice plants, the cannabis processing operation will be located close to the harvesting area. It won't require a lot of additives, such as water for wash down; from an operating standpoint, it's a dry harvest situation.

The Plant of the Future: Processing Cannabis

Consumption of marijuana is moving rapidly from simply smoking and inhaling it to polyphasic use as a food additive. Viewed for use in food, cannabis is just another dry, plant-based ingredient that can be added for its effect, much like Asian herbs for their digestive properties. Alternatively, though, cannabis can be extracted, worked, and created in liquid format for its own unique properties.

As these subcategories take off, how do we process this product? What will the cannabis processing plant of the future look like? In order to scale, marijuana needs to move from being hand-picked or farmed in a small agricultural manner, to the plant environment. Down one

stream, it will be pressed, heated, and rendered into a liquid format; down another, it will be chopped or dried and added to other products. As it reaches the level of manufacturing, production will have to scale up to supply the cookie or cereal manufacturer, for example, their key additive. There will be plant and processing implications.

In addition to increased levels of plant security around authentication, an important new challenge for producers will be handling the product itself. In its dry state as well as liquid reductions, workers could get "high" as a result of the dust and fumes. Sterilization methods, cleanrooms. and air quality will be extremely important in these plants—so added layers of air conditioning, dehumidifying, and dusting equipment must be planned for and built in. In a current plant environment where spices, herbs, seasonings, peanuts, and other allergens are processed, cleanrooms are created to separate these ingredients out from the others. When cannabis is prepared so it could be mixed in with cookie dough or another product, it's handled differently in that environment.

The ideal facility for the future of this industry is, first, a dedicated cannabis facility. In regards to location, I recommend a growing new boom town so manufacturers could set up dedicated processing plants close to where the farms are located. The ideal structure would be a co-op, where farmers bring in their prod-

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uct to be processed. The plant would be dedicated to the special processing needs of the different farms, packaging the product for them, and sending it out. Specialized equipment, a sterile environment, cleanrooms, and as much automation as possible would minimize the number of people working there—because of the possible aftereffects. How the farmers want it packaged would determine the predisposition of the product before it reaches the facility.

Packaging Safely for the Next User

This brings up the question, when the product comes out, how should it be packaged? In bags, in small-dosage packaging? When flavors are processed in a flavor facility, they're packaged in small vials. Will it be the same with cannabis? A conversation in the industry is needed to discuss how to best package cannabis to keep its properties so the next person in the chain can be assured of its purity in their process.

If cannabis follows the path of other highly regulated herbs and spices, it will be packaged in a way that the next manufacturer down the line wants to use it, and when it gets to that plant, there will be a separate area where it is strictly accounted for. At this point, it takes on the guise of a precious metal. It's not only regulated, but its cost will impact how the ingredient is managed. One similar example of a rare and expensive herb is saffron—processing saffron is a delicate, hands-on job, and it's put together in highly regulated doses to be handed off to the customer.

Uses and Implications of Marijuana in Specialty Foods

On a final note, there are implications of the new cannabis industry on two other growing businesses—specialty foods and the vitamins and supplements sector. At a recent Fancy Food Show, the Specialty Food Association turned down several products containing marijuana that were submitted, not because of their lack of quality, but simply because of the lack of consistent national legality. This is expected to change in coming years.

Another obvious outlet for cannabis is the vitamins and supplements business, considering the debate around weight lifting drugs and their effects on the chemical makeup of the body. There will be a whole stream to market, not just in wellness, but in a GNC-type store format.

It won't take long for cannabis processors to jump into the marketplace once the back-end functions are refined. With the enormous manufacturing and retail implications and economic opportunity marijuana presents, it seems inevitable that this is going be a part of many business plans going forward. Cookies and beverages containing cannabis are just the beginning—because consumers want to experiment with it, it's going to be a smoking hot commodity. And it's up to everyone in the value chain to keep it safe. ■

Kafarakis, food industry veteran and advocate, is president of the Specialty Food Association, an umbrella organization representing entrepreneurial member companies in the food and beverage industry. Reach him at pkafarakis@specialtyfood.com or @PresidentSFA.

HACCP

Digitizing is NOT an Option

Digital HACCP systems help food service operations maintain controls, increase staff productivity, safety, and overall customer experience

BY **ROBERT SPROULE**

The food industry is heading for a labor shortage crisis that could have disastrous consequences for consumers and some of the leading food brands. With turnover rates higher than ever and restaurant brands struggling to keep up with food sales in other sections of industry, the challenges facing operators are difficult. The impact is not only felt on the frontline where hourly workers are leaving the food service industry for jobs in other industries, it is also impacting general management and supervisorial roles, where brands have concerns about turnover and filling open positions with qualified staff. Without the right level of training, operators are putting their customers at food safety risk. Chipotle is an example of how insufficient training can result in a major food safety incident, as was seen when an ill employee came to work and didn't report their symptoms. The question for consumers is whether their favorite brands and restaurants have sufficient controls in place to serve food safely, especially with such high levels of turnover.

Adding to this are the sales growth in non-traditional food service locations; growing grocery, convenience stores, and home delivery services that are putting more pressure on food service operators. With new and innovative products, modern food service establishments are frequently updating their menus, putting even more strain on already complex operational processes. The question remains if leading restaurant brands can run safer, more efficient, and effective operations so they can reclaim their market share and provide customers with a great experience.

There is a way for operators to improve their food safety systems while increasing staff productivity and better managing their systems for training compared to the manual (paper, pencil) systems currently utilized in the vast majority of food service operations. Digital Hazard Analysis and Critical Control Points (HACCP) and operations systems are effective for helping large multi-location brands, franchisees, and single location operators manage food safety and restaurant operations with real-time data capture. The significant digital evolution over the last two years means these systems are now more affordable and capable than ever before. Simple task management and checklist software has been replaced with multifunctional comprehensive systems.

Benefits of Going Digital

The following five main benefits of implementing digital systems should be considered by food service operators to improve operations.

1. Increased efficiency and food safety by replacing tasks with alerts. Managing restaurant operations requires a high level of discipline, training, and monitoring to ensure employees are completing important daily checks, such as temperature monitoring at the required frequency, usually every four hours, to ensure they are operating effectively. It's commonplace to see paper temperature logs reading 41 degrees Fahrenheit written with the same pen in the same handwriting for every single shift. A better way is to install a cold chain temperature monitoring system that alerts users when temperatures are out of compliance. Employees are then trained on what to do when they receive an alert. Instructions contained within the alerts will help remind them of the corrective action or escalation that needs to take place. This also solves the issue of what happens when employees are not at work and a refrigerator breaks down. Consider the food loss from a walk-in cooler that breaks down during the early hours of the morning. If this defect is not discovered until six to eight hours later, the food within the unit will need to be discarded having a both a significant financial and operational knock on affect impacting customers.

2. Consistency in training. With high turnover rates continuing to be a significant issue for restaurant operators, the use of a digital platform can help make the process better, easier, and more consistent from restaurant to restaurant. Whether it's dealing with an employee that hasn't arrived for his shift, a security issue from the

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night shift, or a large influx of customers, restaurant managers can be pulled in every direction at a moment's notice. Add to that turnover at the management level and this makes it extremely difficult to track the quality of training that's occurring simply because there is too much to do. Using a digital solution can change the way training is completed by providing instructions to employees as they are completing tasks. Consider chicken that isn't cooked all the way through to a high enough temperature. Using pen and paper methods, there is a risk that staff will serve the undercooked chicken to customers because there is nothing to tell them to do otherwise. A digital system, such as Bureau Veritas' SafeOps application, can alert team members that the correct temperature hasn't been reached and what corrective action is required. This will help brands and operators ensure the consistency and safety of the food they are serving. At the same time, it will allow managers to focus on the day-to-day operations or priority items that unexpectedly need their attention. A new employee put to work without knowing what to do could have serious consequences for any restaurant operation.

3. Improved performance by targeting specific opportunities. Over the last two decades, second- and third-party audits have gained popularity for measuring food safety and customer experience. Audits typically occur three to four times per year and while extremely useful for providing a snapshot of standards, they don't solve the issue of what's happening when an auditor is not there. Most audits occur when the restaurant's general manager is present and when the restaurant is performing at its best. The better question to ask is how the operation is performing when the restaurant's general manager is not present (social media videos of employees acting inappropriately at work usually aren't occurring when the general manager is around). Using a digital system helps to identify the issues that are most prevalent not just at the location level but even down to individual shifts. This additional data can help with follow-up, improvement plans, and determining priorities to ensure the right action is taken to avoid a serious issue and improve overall system performance. Technology can also be used to identify system gaps where improvements can be made.

4. A focus on corrective actions. It's unrealistic to expect food service operations to run perfectly at all times. Instead of paying bonuses based on good scores on food safety audits, operators should be focused on taking the right corrective actions, improving performance across all shifts, and avoiding the critical items that increase the risk of significant incidents. The two advantages of a digital system are being able to monitor operators' inputs and activities. Additionally, the data collected every single day during every single shift allows operators to pinpoint where their biggest opportunities are.

5. New trend management. One of the most recent food trends involves the emergence of food delivery services, which are posing serious risks to operators in terms of both quality and safety. When the food goes out on delivery, operators no longer have control over its temperature and how quickly it will be delivered. The consumer will still have the same high expectation of the food operator and if something goes wrong, this could negatively impact them. A digital solution can help as operators can record the temperature of the food before it is picked up and take a photograph before it leaves, thereby demonstrating that it is properly protected. Operators can also record the temperature of when the food is delivered if available from the delivery service, ensuring it is within acceptable time limits, and have the opportunity to run metrics on the speed of delivery and customer satisfaction.

Food safety must remain a priority for food service brands in order to avoid serious incidences to ensure guests' satisfaction and to avoid regulatory and legal issues. The transient nature of the workforce has made it more difficult for conscientious operators to run a safe and efficient operation. It has also become very difficult for leading brands to attract, hire, and motivate managers. There is a better way. Utilizing a digital HACCP and operations system puts more reliance on the system and provides support for both managers and team members. Additionally, it better allows operators to monitor and improve their operations by identifying low performers, holding them accountable. These systems also help operators with new trends, such as food delivery services.

Now is the time for food service operators to replace pen and paper systems with a digital application that can better manage their food safety and operations. ■

Sproule is director of food and customized audits at Bureau Veritas, which provides services for the testing, inspection, and certification industry. Reach him at robert.sproule@us.bureauveritas.com.

NEW PRODUCTS

Moisture Determination

The TGM800 thermogravimetric moisture determinator features the ability to measure up to 16 samples at a time with drying time end-point recognition and intuitive software. It provides the user with flexible method settings, automation, and hardware capabilities that maximizes moisture determination's efficiency, productivity, and analytical performance, while offering the ability to meet the primary loss-on-drying method requirements for sample mass, oven temperature, and ventilation. The TGM800 is applicable to a wide variety of sample matrices including food, feeds, milled products, and agricultural materials. **LECO Corp., 800-292-6141, www.leco.com.**

Automated UV-Visible Spectrophotometers

QA/QC technicians, instructors, and university researchers seeking a robust spectrophotometer can choose from a range of options in the newly designed GENESYS UV-Vis spectrophotometer family. GENESYS spectrophotometers are accessible, automated, and network-ready. With a modern design and compact footprint, the new instruments take maximum advantage of limited bench space. Other features include onboard controls and a touchscreen interface, eliminating the need for an external computer. Additionally, users can create a printed record of their data via an optional snap-on thermal printer or a network printer using Ethernet or optional Wi-Fi. **Thermo Scientific, 866-356-0354, www.thermofisher.com.**

Pest Control with Internet of Things

The PestConnect system utilizes infrared sensors on rodent traps to monitor mouse activity on premise 24/7/365. It also allows for the immediate capture, containment, and notification of mice incidents as they arise. The goal of PestConnect is to monitor and log issues in real time, resulting in shortened response time to activity and enhancing compliance with regulations and standards. It also helps mitigate potential issues before they have an impact on the bottom line by preventing contamination of food products. **Rentokil Steritech, 888-258-6604, www.rentokil-steritech.com.**

Blockchain Quality Management

RizePoint Quality Management powered by blockchain allows QA managers to connect all supplier data—from onboarding information to supplier inspection results to industry certifications to corrective action—in a single source. Data collected by the RizePoint solution provides insights into all touch points in the supply chain. As products move through the supply chain, they must pass internal standards and correct any non-compliance immediately. RizePoint helps users identify problems faster in the supply chain. **RizePoint, 888-313-7095, www.rizepoint.com.**

Listeria Testing System

The RapidChek *Listeria monocytogenes* is certified by AOAC in its Performance Tested Methods program for detecting the pathogen on environmental surfaces and ready-to-eat foods, including hot dogs, frozen breaded chicken, frozen cooked shrimp, cured ham, and ice cream. It combines a sensitive immuno-detection strip with a single proprietary enrichment media. After enrichment, highly sensitive and specific strips indicate the presence of *L. monocytogenes* in 10 minutes. **Romer Labs, 302-781-6400, www.romerlabs.com.**

X-ray Product Line

According to company, its high-level X-ray inspection product line for small to large manufacturers of packaged food products features a greener/more sustainable solution and easier maintenance and operation, including a new user interface. Users can get quick access to operational components while providing contaminant detection. **Eagle Product Inspection, 877-379-1670, www.eaglepi.com.**

Farm Food Safety Management

CompWALK.farm, a food safety management software for the agriculture industry, helps farms manage regulations. Growers can conduct farm food safety mock inspections, download food safety templates, track corrective actions, and store documents in a single location. The software also provides a searchable file repository to save time maintaining regulatory documents. **NextLOGiK, 877-399-8086, www.nextlogik.com.**

In Other News

3M Food Safety's new Petrifilm Rapid *E. coli*/Coliform Count Plate is a two-in-one indicator test that provides both an *E. coli* and total coliform count in 18-24 hours.

AOAC International approves **Bruker's** MALDI Biotyper solution for two new Official Methods of Analysis for the confirmation and identification of pathogenic and non-pathogenic bacteria.

Hygiena receives AOAC certification for the BAX System Real-Time PCR Assay Suite for STEC for detection of non-O157:H7 STEC in 25g flour and ground beef.

Birko receives ISO 9001:2015 certification for adhering to stringent and consistent standards when designing, developing, manufacturing, and delivering general and food-grade chemicals and microbial intervention products.

Exclusion: Most Powerful Weapon ...

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- Storage areas containing bagged or powdered food should be monitored consistently with stock rotated frequently. Whenever possible, store food products away from the walls to reduce the risk of contamination.
- Store food properly in sealed, rodent-proof containers made of metal or hard plastic.
- Regularly clean and sanitize appliances, equipment, food contact surfaces, and all floors to eliminate any food sources for rodents. Frequently clean high volume areas where crumbs and trash are likely to accumulate.

The battle against rodents is not easily won. But a thorough, well-supported exclusion plan is the most effective tool in keeping rodents out, and absolutely critical in upholding food safety standards. Seek out pest management professionals who understand and support exclusion methods, and work with them to carefully identify and protect all building weaknesses. Do not underestimate the strength and resilience of these tenacious pests; take every precaution necessary and insist upon specialized, rodent-proof product solutions. Encourage all employees to report signs of rodent activity and remember that constant upkeep and monitoring are critical to long-term protection against rodents. ■

McFadden, the director of research and marketing for Xcluder Pest Control Products, has been serving the commercial and residential pest exclusion industry for many years, touching all levels of the food supply chain from production to retail. Reach him at drewf@gmt-inc.com.

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Visit https://academy.alchemysystems.com/basic-haccp-course/, email contactus@alchemysystems.com, or call 888-336-7224.

MAY

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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
University Park, Pa.
Visit http://agsci.psu.edu/foodmicro, email csco@psu.edu, or call 877-778-2937.

22-25
Creating A Food Safety Culture Executive Education
East Lansing, Mich.
Visit http://foodsafety.msu.edu/news/register-now-creating-food-safety-culture-executive-education-2018, email estherh@msu.edu, or call 517-884-2078.

22-23
Dairy Plant Food Safety Workshop–Dry Powder
Denver, Colo.
Visit http://www.usdairy.com/events or call 847-627-3249.

22-23
Food Safety Americas 2018
Nashville, Tenn.
Visit https://www.brcglobalstandards.com/events/food-safety-americas-2018/.

24
Food Processing Equipment Lubrication: Best Practices for Safety & Compliance
Louisville, Ky.
Visit http://bit.ly/2FOisWg, email nblythe@noria.com, or call 918-749-1400.

29-31
Food Labeling Compliance and Nutrition Facts Panel Regulatory Update
Alexandria, Va.
Visit https://easconsultinggroup.com/eas_events/food-labeling-compliance-seminar-may-2018/, email ascanlin@easconsultinggroup.com, or call 571-447-5508.

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JUNE

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University Park, Pa.
Visit http://extension.psu.edu/fundamentals, email mmm354@psu.edu, or call 814-865-0970.

12-13
Dairy Plant Food Safety Workshops
Twin Falls, Idaho
Visit http://www.usdairy.com/events or call 847-627-3249.

25-27
United Fresh 2018
Chicago
Visit http://www.unitedfreshshow.org/.

26-28
The 52nd Annual Microwave Power Symposium (IMPI 52)
Long Beach, Calif.
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