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Volume 21 Number 1
FEBRUARY / MARCH 2014

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FEBRUARY/MARCH 2014 • VOLUME 21 NUMBER 1 • www.foodquality.com

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*Food Quality & Safety* (ISSN 1092-7514) is published 6 times a year in Feb/Mar, Apr/May, Jun/July, Aug/Sept, Oct/Nov, Dec/Jan by Wiley Subscription Services, Inc., a Wiley Company, 111 River St., Hoboken, NJ 07030-5774. Periodical postage paid at Hoboken, NJ, and additional mailing offices. Subscription for U.S. is $126 per year. International subscription is $160.

*Food Quality & Safety* is a proud member of: United Fresh Produce Association
Folio Ozzie and ASBPE award winner for editorial and graphics excellence.

**POSTMASTER: Returns and address changes to *Food Quality & Safety* magazine, PO Box 9051 Maple Shade, NJ 08052-9651**

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**CORRECTION**

The "Making Food Safer Through Law and Technology" article in the December/January 2014 issue mistakenly stated on page 18 that BioControl Systems' LIGHTNING MVP ICON tests for pathogens and conditions that promote their growth. The text was intended to indicate that the system could validate cleaning effectiveness and manage HACCP parameters. A corrected version of the article is available at www.foodquality.com.

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# From The Editor

Social Media: Whether you're addicted to it, don't understand the point of it, or are just plain sick of it, there's no denying it has become a powerful tool in today's food industry. In some cases, it's even changing the way food is being produced.

Case in point, Green America's GMO Inside campaign brought it to the public's attention last year that General Mills was offering non-GMO Cheerios to consumers in Europe and elsewhere but had failed in making the same product available to U.S. families. The GMO Inside campaign relied heavily on social media, Facebook specifically, to inform and involve consumers in demanding that General Mills phase out GM ingredients in its products. Shortly after being bombarded with over 50,000 online postings, the major food producer announced its plan to make original Cheerios GMO-free for the American public.

On the flip side, social media can also be used *by* the food industry to improve food safety. For example, last December, experts from the CDC, USDA, FDA, and the International Food Information Council Foundation conducted a special Holiday Food Safety Twitter Chat with tips/tweets for a safer holiday season. Besides educating consumers, there's also the advantage of learning from your peers—LinkedIn has become a great professional gathering place for experts to discuss common industry issues and new methodologies to protect the food supply.

Undoubtedly there are plenty of companies still discounting the importance of social media. Therefore in this issue, we provide some background into what's brewing between social media and food safety as well as guidance on how to incorporate a social media plan as part of an overall food defense strategy. From ConAgra Foods to Chobani, there are those who are already learning their lessons the hard way when it comes to the power of social media, so make sure your company knows how to wield this power properly.

**Marian Zboraj**
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Food Quality & Safety
FARM TO FORK SAFETY

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Printed in the United States by Dartmouth Printing, Hanover, NH.



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# NEWS & NOTES

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### Pilot Testing Program for Raw Milk Cheese

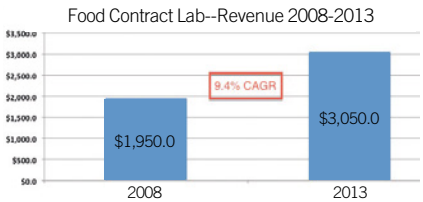
Launched in January, the FDA's pilot program is sampling and testing domestic and imported raw milk cheese aged at least 60 days for *Salmonella, L. monocytogenes*, and *E. coli* O157:H7. The program is using a new microbiological sampling surveillance model, which is aimed at increasing FDA's understanding of risks, contamination rates, and mitigation strategies. Sampling will last for approximately 12 months. It can take place at any point in the supply chain for domestic cheeses, including at cheese-making plants. For imported cheeses, sampling will occur at locations where the cheese normally enters the U.S.

### GFSI Recognizes SQF Code 7th Edition Scope Extension for Feed

SQF has successfully added the scope of Feed to the scopes for which they have already achieved recognition against the GFSI Guidance Document Sixth Edition. This is the first GFSI recognized scheme to cover the scope of Feed, which includes the production of animal feed and processing of pet food products, the requirements for which were included in the GFSI Guidance Document on June 1, 2012.

### 'Food Contract Lab Report'

According to Strategic Consulting's "Food Contract Lab Report," food companies around the world are sending increasing amounts of quality and safety testing to third-party contract testing laboratories. Total revenues for labs are estimated to reach $3.05 billion in 2013, up from $1.95 billion just five years ago, at a compound annual growth rate of 9.4 percent worldwide. The report includes revenues, test volumes, and growth rates by region (North America, Europe, Asia, and rest of the world) and by business area (microbiology, chemistry, and services). It also examines the drivers for the dramatic growth and provides market forecasts through 2018.




### Addressing Antimicrobial Resistance

FDA is implementing a plan to help phase out the use of medically important antimicrobials in food animals for food production purposes, such as to enhance growth or improve feed efficiency. The plan would also phase in veterinary oversight of the remaining appropriate therapeutic uses of such drugs. The FDA is laying out a roadmap for animal pharmaceutical companies to voluntarily revise the FDA-approved use conditions on the labels of these products to remove production indications. Plan also calls for changing the current over-the-counter status to bring the remaining appropriate therapeutic uses under veterinary oversight.

### Guide Safeguards Fresh Produce Operations Against *Listeria*

The United Fresh Food Safety & Technology Council's *Guidance on Environmental Monitoring and Control of Listeria for the Fresh Produce Industry* assists in developing practical and scientifically sound "search and destroy" programs for *Listeria*. Guide is applicable to all fresh and fresh-cut produce operations, including field and field packing, packinghouse, and other produce handling operations such as repack, value-added, and transport/distribution to retail/foodservice. It can help companies determine an operations' level of vulnerability to *Listeria* harborage that may lead to produce contamination, and also help develop and implement an effective *Listeria* monitoring and control program.

### Organic Seed Growers and Trade Association vs. Monsanto

On January 13, the U.S. Supreme Court declined to hear an appeal by organic farmers and others asking Monsanto to promise never to sue farmers if their fields inadvertently have plants containing the company's patented genetically modified traits. A company lawyer said Monsanto had not sued for inadvertent use of its biotech seeds and didn't plan to, but that it wouldn't make a blanket promise to that effect. Monsanto has sued more than 100 farmers for patent infringement, winning judgments against those found using its seed without paying required royalties. The Organic Seed Growers and Trade Association and a group of dozens of organic and conventional family farmers and seed companies sued Monsanto in March 2011 to prohibit the company from suing farmers whose fields became inadvertently contaminated with corn, soybeans, cotton, canola, and other crops containing Monsanto's genetic modifications.

## Business Briefs

**NSF International** acquires Brazil's Bioensaios Analysis and Environmental Consultancy, which will become known as NSF Bioensaios.

**Texture Technologies,** distributor of food texture analysis solutions, opens new service center in Brewster, N.Y.

**Mérieux NutriSciences' Silliker** launches a new laboratory dedicated to microbiology testing in Saint-Ouen l'Aumône, France.

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# Washington Report

## FDA Inspections in 2014: Big Ambitions Hampered by Limited Resources

Identifying how 'data quality challenges,' high-risk facilities, and budgets factor into the future of FDA's inspection capability

BY **TED AGRES**

Facing the likelihood of ongoing budget constraints, the FDA will be hard pressed this year to carry out the full range of inspections mandated by the Food Safety Modernization Act (FSMA). Weaknesses and gaps in its internal records systems have also hampered the agency's ability to identify which food facilities to inspect and even prevented it from determining the number of domestic and foreign facilities that had been scheduled to be inspected but were not.

In its "2013 Annual Report on Food Facilities, Food Imports, and FDA Foreign Offices" released in November 2013, the FDA acknowledges that "data quality challenges" in its so-called Section 415 facility registration database—the registry of firms required by the 2002 Public Health Security and Bioterrorism Preparedness and Response Act—forced the agency to rely instead on its Official Establishment Inventory (OEI) to determine which facilities were inspected in Fiscal 2011-12 and which were scheduled to be inspected in Fiscal 2013.

This is because the 2002 Bioterrorism Act gave FDA only limited authority to collect information from food facilities, such as addresses and the types of food being handled. OEI, on the other hand, is a long-standing database of information about companies under FDA inspection authority. It contains detailed information such as the types of processes and products each firm produces and its place in the supply chain. "The Official Establishment Inventory was used to determine the number of facilities because it contains additional information that was not captured in the [Section 415] facility registration database," an FDA spokesperson explains.

"For FDA to look across the list of all regulated establishments, the OEI provides more in-depth data and information to help prioritize, rank, and understand the operations going on in those facilities," says Faye Feldstein, a senior adviser with Deloitte Consulting LLP and former director of the Office of Food Defense, Communication, and Emergency Response in the FDA's Center for Food Safety and Applied Nutrition (CFSAN).

The Bioterrorism Act required companies to register but not update records unless there had been a major change, such as in ownership or responsible party. However under FSMA, firms must now renew and update their registration information every two years. "The biennial registration requirement under FSMA should improve the accuracy of the information in the registration database and FDA will transition to using the registration database to determine which facilities to inspect for future work planning cycles," the FDA spokesperson adds. Also, by law, FDA is prohibited from sharing certain information in its registration database with other agencies. Under OEI, however, FDA is able to share that information. "As an external party, I can say that it would be very helpful to have these two lists merged into one at some point in the future," Feldstein tells *Food Quality & Safety*.

FSMA was enacted in January 2011. Under the law, all high-risk domestic facilities must be inspected within five

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years of enactment and no less than every three years afterwards. Within one year of enactment, the law directs FDA to inspect at least 600 foreign facilities and double those inspections every year for the next five years. Despite limitations in its records, FDA had been aiming to inspect all foreign and domestic high-risk facilities within three years, two years earlier than directed by FSMA, and is attempting to inspect all non-high-risk facilities within seven years (by Fiscal 2017), according to the agency's annual report. During Fiscal 2012, the FDA and states under contract with FDA inspected or attempted to inspect 24,462 domestic food facilities while FDA inspected 1,342 foreign food facilities, the report says. The average cost to inspect a domestic non-high-risk facility was $9,200 while the average domestic high-risk facility cost $15,500. Foreign high-risk food facility inspections each averaged $23,600, the report says.

## Framework to Identify Risk

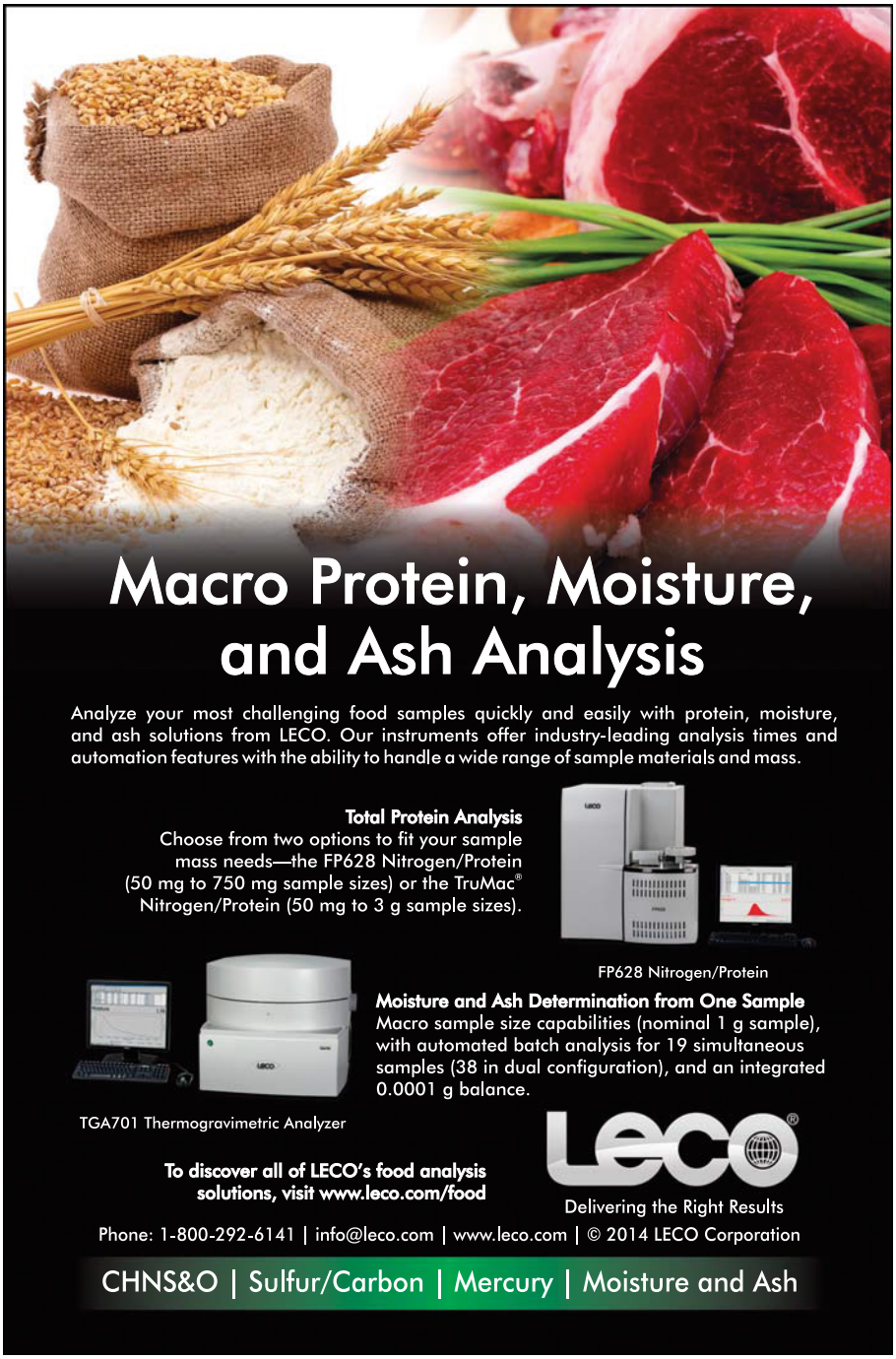
After FSMA was enacted, the agency began to develop models for determining risk levels. The agency then retrospectively looked back through the OEI to categorize the inspections that had been made by risk level. "Therefore, the usual sequence of scheduling certain facilities for inspection and then striving to meet that benchmark did not take place," the report says. Accordingly, the FDA was not able to determine the number of registered foreign and domestic facilities that had been scheduled but were not inspected. The agency does expect to report those numbers for Fiscal 2011-13 in a report later this year and to use the registration database going forward.

FDA's framework for identifying high-risk and non-high-risk facilities involved in producing food for human consumption is based on the following factors:

- The known safety risks of the food manufactured, processed, packed, or held at the facility;
- The facility's compliance history including food recalls, outbreaks of foodborne illness, and violations of food safety standards;
- The rigor and effectiveness of the facility's hazard analysis and risk-based preventive controls;
- Whether the food manufactured, processed, packed, or held at the facility meets the criteria for prioritization to detect intentional adulteration;
- Whether the food or the facility that manufactured, processed, packed, or held such food has received certification under the Voluntary Qualified Importer Program; and
- Any other criteria deemed necessary and appropriate for allocating inspection resources.

According to FDA's FSMA Domestic Facility Risk Categorization (FY 2012), the decision-making process for domestic facilities during Fiscal 2011-13 was based mainly on the first two factors. Data were not available to characterize the third factor for all industry types and will be incorporated as the Preventive Controls rule and data collection develop. The fourth factor applies

(Continued on p. 14)



(Continued from p. 13)

only to foreign facilities. The fifth factor may apply to some domestic facilities, but the relevant certification programs have not yet been established.

Craig Henry, a director at Deloitte & Touche LLP, says FDA needs to be more transparent in deciding how it will calculate facility risk levels. "Let's say you have a facility that mostly processes lemons but also produces a small amount of bean sprouts. Is that facility high-risk or low-risk? What is the weighted average of risk? FDA will have to fall back on whether there has ever been a recall or foodborne illness, and the agency has a ways to go in terms of transparency with industry," Henry tells *Food Quality & Safety*.

According to the FDA, inspection costs are not determined by risk level alone. Rather, risk level is one of many elements with others including the facility's size (both number of people and square footage), the complexity or level of automation of the manufacturing process, and the volume of products (both in terms of the quantity produced and the number of different types of products).

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FDA's cost to conduct high-risk foreign inspections has risen from $13,900 per facility three years ago to $23,600 in Fiscal 2012.

"Congress included so many mandates in the new law, including the inspection mandates that, as a practical matter, the agency just can't get out there and look at all these facilities; it's a physical impossibility given the resource constraints," says Arnold Friede, senior food and drug law attorney at Sandler, Travis & Rosenberg in Miami and a former associate chief counsel in the FDA's Office of the Chief Counsel. "It's all well and good to have the new statutory mandates—hopefully there will be a lot of voluntary compliance—but I'm skeptical FDA will have the needed resources for all the inspections across the areas they have to consider," Friede tells *Food Quality & Safety*. "The FDA can ask for more money but let's be real: In terms of budget cuts, it's hard to believe they will get a significant amount of increased resources," he says.

During Fiscal 2011, FDA's CFSAN identified 22,325 domestic food firms as being high-risk and 11,007 of them were inspected that year. In Fiscal 2012, another 8,023 facilities were inspected (or attempted), bringing the total to 19,030 or 85 percent of the high-risk firm inventory. In addition, another 3,736 firms inspected in FY 2011 were re-inspected (or attempted) in FY 2012.

"When you look at these inspections, it's a little more than 22,000 high-risk facilities or about 30 percent of the total facilities that would be addressed every three years," says Henry. According to Association of Food and Drug Officials, the states conduct about 60 percent of all federal food inspections under contract with FDA. In addition, FDA's cost to conduct high-risk foreign inspections has risen from $13,900 per facility three years ago to $23,600 in Fiscal 2012, Henry says. "The number of foreign food facility inspected per year is limited by budget constraints," an FDA spokesperson acknowledges. "Certainly, ongoing budget challenges such as sequestration and reductions in funding will have a huge impact on this," Henry says.

As in previous years, the FDA in Fiscal 2012 physically examined only about 1.9 percent of imported food lines, in this case 207,839 of the 11,136,599 total. Nevertheless, imports are electronically screened using the Predictive Risk-based Evaluation for Dynamic Import Compliance Targeting (PREDICT)—an automated IT system that was installed in all 16 import Districts in September 2009. PREDICT helps inspectors identify which products pose the greatest potential risk and should be physically examined. The system calculates risk scores for every line in an entry based on numerical weights assigned to inherent risk rules, data anomaly rules, data quality, rules and the compliance history of the manufacturer, shipper, and consignee and product associated with the line.

In Fiscal 2012, FDA inspectors electronically screened about 27 million import entry lines and were projected to have screened about 33 million in Fiscal 2013. According to FDA's annual report, the average cost of physically inspecting or sampling a line of food that is imported or offered for import is about $160 per field exam and about $3,100 per sample analyzed. Reducing the number of physical inspections can also result in cost savings, but the report did not quantify any such savings. ■

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# FSMA Update

## Animal Food Rule: The Road to Compliance is Much Longer for Some

Facilities are hoping for extra compliance time as they navigate through preventative controls, cGMPs, exemptions, and Qualified Individual requirements associated with the animal feed rule

BY **PATRICIA A. WESTER**

The release of the proposed rule on the Preventive Controls on Animal Food late last year gives us the complete picture of FDA's approach on the "big 5" proposed rules. While few if any new or groundbreaking requirements were included beyond what we have seen so far, it's important to view this proposed rule in terms of how far many in the industry will need to go to achieve compliance.

This proposed rule applies to animal facilities required to register with FDA under section 415 of the FD&C Act, unless subject to an exemption. This would include anyone involved in manufacturing, processing, packing, and holding of finished products that are intended to be fed to animals, including livestock, pets, and other captive animals; and ingredients that may be used in animal foods. Industry sectors, such as renderers and grain and oilseed processors, have long been considered animal food manufacturers and would now be subject to the proposed rule. Newer industry sectors, such as biofuels manufacturing, or other entities that may not have been thought of as animal food manufacturers in the past, such as mineral refining and manufacturing, would be subject to the proposed rule.

This rule applies to domestic and imported animal food in interstate commerce, including pet food, animal feed, and raw materials and ingredients to be sold in the U.S. The rule does not apply to farms that manufacture food for their own animals or fruits and vegetables, or other food facilities not required to register under section 415 of the FD&C Act.

### The Specifics

Modified Hazard Analysis and Critical Control Points (HACCP) Preventive Controls requirements apply to:

- A facility with animal food sales averaging less than $500,000 per year during last three years and sales to qualified end users exceeding sales to others.
- Very small businesses (pending FDA definition;
- Facilities, such as warehouses, that only store packaged animal foods not exposed to the environment; and
- Packaged animal food for which temperature control is required for safety.

Exempt from these requirements are:

- Animal foods subject to the low-acid canned food regulation;
- Activities within the definition of "farm," including farm activities that are covered by produce safety rule;
- Certain low-risk manufacturing/processing activities, packing or holding activities that are conducted by small or very small businesses on farms for specific animal foods. Examples including conveying/weighing/sorting/

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culling/grading grain, oilseed, grain and oilseed by-products, and forage;
- Facilities such as grain elevators and warehouses storing only raw agricultural commodities (other than fruits and vegetables covered under produce safety rule) intended for further distribution or processing provided they are solely engaged in such storage;
- Facilities such as warehouses that only store packaged animal foods that are not exposed to the environment; and
- Packaged animal food for which refrigeration is not required for safety.

A nutritional requirement is included in the hazard analysis based on data derived from the risk assessment, stating in part: *The Hazard Identification section of the RA (Risk Assessment) identified nutrient imbalances, too much or too little of essential nutrients, called subpotent and superpotent ratios of nutrients, as hazardous to animals. Proper nutrient balance is particularly important for animal food because often one animal food type is the sole source of an animal's diet.* ***Nutrient imbalance is therefore hazardous in a finished feed.***

## Good Manufacturing Practices

The proposed rule establishes a specific set of current Good Manufacturing Practices (cGMPs) for the animal food industry very similar to those involved in human food production. For the first time, the basic prerequisite programs for personnel and facilities that have been required elsewhere for years must be put in place by those covered by the proposed rule. The cGMP requirements cover:

- Personnel practices such as following good hygiene and protecting food against contamination from personal effects;
- The plant and grounds including proper cleaning, maintenance, and elimination of pests;
- Sanitary operations such as maintaining clean and sanitary conditions of food contact surfaces, proper use and storage of toxic cleaning compounds, and exclusion of pests;
- Sanitary facilities and controls such as the plant's water supply, plumbing, and toilet and handwashing facilities;
- Equipment and utensils including the cleaning and maintenance of such items and protecting animal food from contamination;
- Processes and controls including following adequate sanitation principles, proper labeling of ingredients and finished animal food, ensuring the safety of raw materials, and prevention of contamination of animal food during processing; and
- Warehousing and distribution to protect animal food against contamination and deterioration.

## Preventive Controls

The preventive control provisions intended to implement section 103 of the FDA Food Safety Modernization Act for animal food are also similar to those published for human food and produce safety. Along with language used in the cGMPs, they mirror terminology and definitions previously set forth by FDA to form the foundation. These preventive controls would include requirements to:

- Maintain a written food safety plan,
- Perform a written hazard analysis with preventive controls,
- Monitor procedures,
- Verify procedures were effective,
- Develop corrective actions, and
- Maintain records.

The proposed rule also establishes the baseline qualification requirements for a "qualified individual" (QI).

## Qualified Individual

A QI must prepare or oversee the preparation of the food safety plan, validation of preventive controls, review records for implementation and effectiveness of preventive controls and the appropriateness of corrective actions, and perform the reanalysis of a food safety plan.

Considering it is likely FDA's intent to be consistent across all three proposed preventive controls rules, then the QI requirements described in more detail in the human food rule apply here also. In that rule, it states the QI qualifications may be met by more than one individual on the HACCP or food safety team comprised of plant personnel or an outside consultant meeting the requirements.

Most stakeholders agree the animal feed/pet food sector has significant ground to cover to achieve compliance with the two major provisions of the rule and the need for technical support could be substantial. The QI could play a significant role to provide support as they mobilize resources to meet these requirements. However, as it currently stands, it appears it will operate under a model including an initial training and exam with a onetime certificate issued to the attendee. While that system has worked well in the past, many believe there's an opportunity to improve the QI training program and increase its value by operating it similar to an ISO 17024 Personnel Certification Program, which includes continuing education requirements, publicly available registry of credentialed personnel, and renewal frequency that ensures continued competency.

## Supplier Approval

FDA views a supplier approval program as an appropriate verification activity, even though it doesn't specifically require one at this time. Much of the raw materials used in animal food are derived from the human food sector via product that doesn't meet specifications for attributes such as color or shape, and concerns have been raised over the impact of a supplier approval program on this practice.

## Compliance Deadlines

The rule would take effect 60 days after the final rule is published in the Federal Register, with tiered compliance dates for small and very small businesses.

However, industry experts are supporting a submitted proposal to allow additional compliance time. Under this plan, GMPs and preventive controls would be in place within two years for large firms, three years for small businesses, and four years for very small businesses.

The animal food industry is facing tremendous challenges ahead, they must implement cGMP's *and* preventive controls, currently in the same timeframe and at a time when demand for competent technical support is high across all industry sectors. While some have already implemented programs and procedures that address these requirements, many have not or have not covered everything so the news of possible extended compliance is surely welcome indeed. ■

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# Social Media Stirs the Pot

## The fast-paced world of online communication offers impressions, impacts, tools, and lessons

BY **LINDA L. LEAKE, MS**


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Did you ever open a can of food and see something you thought might be a dead rat on top?

That was the experience of an Ohio woman when she opened a can of Chef Boyardee Spaghetti & Meatballs one day in 2010 and spied a large gray mass atop the entree.

The woman contacted ConAgra Foods, the Omaha, Neb.-based company that makes and sells food under various brand names, including Chef Boyardee, its signature canned ready-to-eat pasta products. ConAgra Foods asked this consumer to photograph and then freeze the can's contents, and they also sent a courier to pick up the contaminated product.

Laboratory tests demonstrated the mass was actually a big blob of mold likely caused as a result of damage to the can during shipping that allowed air to enter the can. Even though the blob was not a rat, it was initially perceived as a rat by a consumer, and that opened up a whole can of worms for ConAgra Foods.

It seems the aforementioned woman's nephew had filmed the can contents and posted the video on the social media sensation YouTube, complete with the verbal consumer rodent speculation. Within 48 hours, social media impressions soared as a result of retweets by heavy influencers.

This posting of the Chef Boyardee can contents on the Internet prompted ConAgra Foods to act fast to correct the misconception about the gray mass' identity.

Inspired by the incident, the company incorporated a more aggressive social strategy that has become an exemplary pacesetter for the food industry.

"The social strategy is based on a partnership with our Public Relations, Communication & External Relations, and Consumer Affairs teams," says Jeanne Jones, consumer affairs director for ConAgra Foods. "Each department plays a strategic role, aligned with the team's role within the organization. The Consumer Affairs team, as a part of the larger Food Safety and Quality organization, uses social media specifically to monitor and engage consumers on the topics of food safety, quality, and consumer education. If we see a consumer posting about anything that we would normally address via our traditional channels, namely phone, email, letter, then we engage or monitor appropriately."

ConAgra Foods set up an "auto alert" system to let staff internally know of any potential issue. "We learned to better communicate with our consumers and we implemented a process emphasizing trust and transparency," Jones relates.

"Our Consumer Affairs team has been utilizing social media to emphasize food safety since we began engaging with consumers in social channels in 2010," Jones continues. "We take every opportunity we can to educate consumers on food safety through responding to social posts, linking to information, and taking consumers 'off-line' to verbally discuss potential food safety risks in more detail. Examples include stressing the importance of following cooking instructions, using a food safety thermometer, proper storage of food, and safe handling during preparation."

As part of its dynamic and proactive social media strategy, ConAgra Foods now uses an assortment of social listening and monitoring software and services. Most notably, a tool called Astute SRM (Social Response Management) is key for social listening and response within the ConAgra Foods consumer affairs department. Astute SRM is monitoring software that pulls all contacts for any topic(s) one chooses from millions of websites including Facebook, Twitter, blogs, etc. Posts are then pulled in and analyzed to determine if the sentiment is positive, negative, or neutral.

The system will "push" the contacts to a company's social media employees based on how they are set up to be handled (escalate, flag, note, ignore). Employees can then engage, comment, ask questions, or request the person posting to take the conversation off line.

"Astute SRM complements our CRM (customer relationship management) software that we use to log all of our traditional contacts that come in via mail, phone, or letter," Jones explains. "This software has the capability to automatically integrate the social media contacts into our CRM system, which is key to enabling line of sight to emerging trends and enhancing risk mitigation.

"The integration capability also allows us to differentiate, through our extensive back end data analysis, how the behaviors and feedback in social channels differ from our traditional channels," Jones adds. "We can then use these insights to better predict the behaviors, and validate that our products are being used as intended. When it comes to food safety, the ability to quickly spot an emerging trend and ensure your products are being used as intended are critical."

Monitoring is happening 24/7, Jones emphasizes. "The system is set up to flag certain brands and key words to serve as triggers, and if there is any 'hit' on a brand and/or key word it will send an alert to the employees who monitor for us so they can respond real time," she says. "Alerts can be set up to come in as a text message, email, instant message, or directly into the CRM tool."

ConAgra Foods is using social media to mitigate risk through applying the same approaches in social channels as the company does in its traditional channels. Thus, emerging trends are quickly identified and responded to by applying CAPA (corrective action preventative action) processes and continuous improvement methodologies. Moreover, utilization of data and analytics drive actionable insights, as social media contacts are integrated in ConAgra Foods' consumer contact data.

"Good use of social media contributes to the top line and bottom line of our company by ensuring we adequately resolve all consumer issues, retain consumers we may have otherwise lost and deliver an exceptional experience that will be shared in a positive way to drive incremental sales and loyalty," Jones points out. "We're getting positive feedback and we're creating loyalty with our brands, which means we're boosting sales and our bottom line, with every social interaction we have."

Taking a very proactive, transparent approach to social media allows ConAgra Foods to not only mitigate risk, but also build trust with consumers, Jones says. "The impact is zero high-visibility social escalations and less of a chance of viral videos with erroneous information," she emphasizes.

## Academia Examples

Embracing all the hot, trendy Internet-driven social media forms of communicating, including blogs, Facebook, YouTube, and Twitter, Benjamin Chapman, PhD, an extension specialist in food safety at North Carolina State University, launched the citizen food safety project in September 2013. The project goals are to find out what food safety means to people, raise the public conscious-

*(Continued on p. 20)*

*(Continued from p. 19)*

ness of food safety, and build the public's support for better food safety practices.

To that end, Dr. Chapman is inviting folks to take photos that demonstrate what they believe to be food safety issues, including positive examples and those perceived as health risks or yuck factors encountered at home, markets, stores, and restaurants, and post them to Instagram or Twitter with the hashtag #citizenfoodsafety. A key tool Dr. Chapman is using to solicit photos is barfblog, a food safety blog with some 7,000 subscribers to which he regularly contributes commentary, videos, PowerPoint presentations, and podcasts (http://barfblog.com).

As of mid-December, Dr. Chapman has received about 140 photos from some 40 individuals via Twitter (https://twitter.com/benjaminchapman), Instagram (barfblogben), or email (benjamin_chapman@ncsu.edu). Photos received to date include apples in an orchard lying on the ground, salads with sprouts and a dirty toilet at a truck stop.

As Dr. Chapman collects photos from social media sites, he is sharing them indefinitely on a Tumblr site (http://citizenfoodsafety.org).

"Our audience is the online community, which includes all citizens of the eating world, including consumers, students, and food safety proponents," Dr. Chapman relates. "If we are going to continue to make progress in food safety, we must engage all people who eat, all citizen eaters."

Using social media, Dr. Chapman is dedicated to sharing evidence-based information to people who are interested in food safety even if they don't work in that area. "There's an increased hunger and thirst for food safety information," he says. "People want to be part of social media so they can get that information for themselves."

*(Continued on p. 22)*

## Food Safety's Social Media Presence

- Foodsafety.gov's Facebook page is www.facebook.com/FoodSafety.gov and its Twitter feed is located at https://twitter.com/foodsafetygov.
- USDA's food safety Twitter feed is located at https://twitter.com/USDAFoodSafety.
- FDA's food safety Twitter feed is located at https://twitter.com/FDAfood.
- CDC's Twitter feed, which includes food safety topics, is located at https://twitter.com/CDCgov.
- *Food Quality & Safety* magazine's Facebook page is www.facebook.com/FoodQualityandSafety.

*—L.L.*

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Currently boasting 1,300 followers on his Twitter feed, the savvy Dr. Chapman is quick to admit that he was not quick to join this particular social media phenomenon. "At first, I thought Twitter was kind of dumb," he admits. "I didn't see what utility it offered. But as I used Twitter more, I realized this networking system gets news out a lot quicker than other traditional media alerts."


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## Social Eye Opening Stats

- Twitter has 230 million+ active users.
- There are 1 billion tweets every two days.
- Instagram has 130 million+ total users.
- Facebook has 1.15 billion+ total users.
- There are over 1 billion unique monthly visitors on YouTube.
- YouTube reaches more U.S. adults aged 18 to 34 than any cable network.
- Food is the top category on Pinterest, with 57 percent discussing food-related content.
- 4.2 billion people use mobile devices to access social media sites.
- Social media has overtaken porn as the No. 1 activity on the Internet.

—L.L.

## Social Media Research

Under Dr. Chapman's leadership, NCSU graduate student Ben Raymond is pursuing a social media research project as part of a Master of Science in Food Science program.

For starters, Raymond is looking at the food safety practices of people featured in cooking videos posted on YouTube and the potential impact of these practices on consumers who view the videos.

"Our hypothesis is that users on YouTube are demonstrating poor food safety practices," Raymond says. "Since YouTube provides the number of viewers of all videos, we can see how many people may not be learning food safety behaviors that will keep them from getting sick."

Raymond conducted an online survey to determine how people search for YouTube food safety videos, then he looked at the most relevant videos based on his results that revealed where such videos show up in a search and how many views they have.

"Our goal is to see what people are learning online," Raymond relates. "Unfortunately, it appears they are not learning positive food safety behaviors because cooks in videos are demonstrating risky behaviors. For example, we observed people using a thermometer in only one of 89 videos, and good solid cross contamination was demonstrated in two-thirds of the videos. Only one video told people how to correctly determine if hamburger is done."

Raymond contends that if you watch a cooking show or demonstration online, any improper temperature the cook uses is not seen on the show. How to use a food thermometer or avoid cross contamination is not explained, so it is unlikely that the viewer will learn positive food safety behaviors watching online cooking videos.

"The conclusion is that people are learning negative behaviors by watching YouTube videos, especially those that demonstrate how to cook hamburgers," Raymond says, "because the people demonstrating how to prepare hamburgers often cook them rare, not to mention they also make a plethora of other food safety mistakes. The reality is that there is so little awareness of food safety in YouTube videos and sometimes there is even disdain for good food safety practices."

Based on his research to date, Raymond believes that if you see a cooking video online you should consider that the practices are likely not healthy. So, he wonders, how do you convince the public that what they are seeing is not best for consumers?

"What can be done to address this issue is a challenge," Raymond emphasizes. "How to use social media to reach an audience with positive food safety messages is not always understood. We can make a great video, but can we get anyone to watch it? That's our task."

## Expanding Government Reach

A "one-stop shop" for consumer information on food safety sums up www.foodsafety.gov, the gateway to food safety information provided by government agencies.

The USDA, FDA, and CDC collaboratively provide this vibrant consumer-friendly site that employs a number of social media tools to distribute food safety messages to diverse audiences.

Along with Facebook and Twitter, the agencies employ dynamic technologies that include e-cards, YouTube videos, podcasts, blogs, Web pages optimized for mobile phones, text messaging services, email alerts, and widgets.

"Social media from FSIS' standpoint is really about customer service," says Catherine Cochran, a public affairs specialist with USDA's Food Safety and Inspection Service (FSIS). "These platforms allow us to listen and deliver food safety messages to the public in real time and in ways that people are used to receiving information. Mobile services, like our Ask Karen app and mobile website, are becoming a major priority as we continue to improve our public health communications with consumers." ■

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# BRAND PROTECTION IN A SOCIAL MEDIA AGE

**Working together in building a proactive social media plan as part of an overall food defense strategy**

BY **ADRIAN MOSS** AND **DON HSIEH**

Today, everyone can be a global publisher, using text, images, and videos to comment on their experiences with companies—good or bad. In the era of social media, comments can easily be shared with dozens, hundreds, or even thousands of other consumers, just by hitting send. Once a comment is out there, it opens the door for other consumers to comment on similar experiences. Depending on the weight of the issue, and amount of visibility the comment had, the company in question may start "trending." Since these discussions are open to the public, a journalist who monitors for trending topics could decide there is value in reporting on the topic, raising even more awareness of the situation and spreading the "buzz."

## Global Food Supply Chain Meets Global Social Networks

At the same time social media interactions are impacting consumers' decisions, the food supply chain is growing increasingly global. According to FDA data, between 15 and 20 percent of all food consumed in the U.S. is imported from other countries. Furthermore, 50 percent of all fruits and 80 percent of seafood eaten in the U.S. comes from outside the country. An inherent risk of any global supply chain is of course the threat of adulteration, contamination, and counterfeiting. For example, of the 168 product recalls that occurred during the first half of 2013 for the food and drug categories, 138 were for food and consumer healthcare products.

The power of social media and the 24-hour news cycle enable consumers to hear about food adulteration cases faster than ever before. Food companies need to be mindful that news-worthy stories, especially when they negatively affect the safety of consumers, will spread quickly and make it nearly impossible for companies to react to negative publicity in a timely manner. If, for example, a food fraud incident results in a recall, the impact on the brand can directly affect prod-

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uct sales. According to Which?, a U.K. news and advice website, an independent survey revealed consumer trust in the food industry has dropped by 24 percent since the 2013 U.K. horsemeat scandal broke. Furthermore, 30 percent of shoppers were buying less processed meat at the time of the survey and 24 percent were buying fewer ready meals with meat in them, or were choosing vegetarian options. With the number of consumer product-fraud incidents growing, consumers are on higher alert when it comes to food fraud, and are less likely to forgive companies that have put their food at risk.

Numerous case studies in the food industry show a crisis situation that gained a lot of attention on social media is made worse when that brand loses valuable time at the get-go deciding how to react and respond to the situation. The potential speed of social media means preplanning is essential, as is monitoring the reaction to any responses made by the company online.

## The What If?

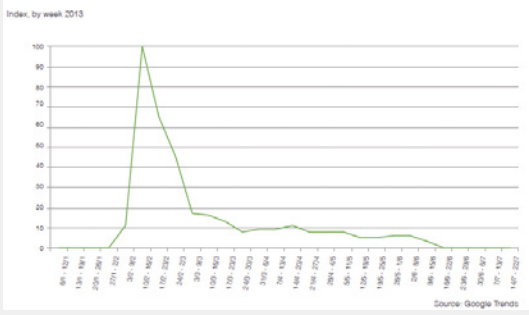
So what happens when the integrity of the food supply chain is compromised, and that issue is compounded by global social media discussion? Take the example of the 2013 horsemeat crisis. As discussed in a research report "Every Day Low Price, Every Day High Risk: Protecting the Integrity of Food and Drug Supply Chains," from SCM World vice president of content, Barry Blake, Google Trends illustrates the course of online conversations around the subject well with a graph shown at right "featuring a year-over-year flat line until the beginning of 2013 where the line suddenly spikes upward. It peaks in February only to return to a near flat line by June."

The Google Trends graph corresponds to the onset of the horsemeat scandal in Ireland and the U.K. earlier this year, and the subsequent dissipation of interest in the event. As far as the effects of the event on the brand, the day following the announcement that horsemeat was found in beef products sold by the British multinational retailer Tesco, its market value dropped by €360 million or $487 million. This figure is striking, yet doesn't even begin to quantify the overall impact to the Tesco brand. According to the company's chief executive, Philip Clarke, June 2013 sales reported down due to the crisis, with a "small but discernible impact" on sales of frozen and chilled foods at their convenience stores.

The costs associated with this kind of crisis include recall costs, revenue loss, and legal costs for damage to health or life and regulatory fines. Ultimately, complications in any supply chain impact a brand's reputation and require time and investment to rebuild trust among customers, partners, and the general public.

Several examples of food crises and the role social media played throughout illustrate the importance of both a proactive food defense plan and proactive social media practices. The 2013 horsemeat crisis in particular supports the need to participate in social media on an ongoing basis, not just when crisis hits. This notion was confirmed with a recent incident that occurred with the U.S. yogurt company, Chobani. The brand monitors social media proactively and recently noticed a number of people commenting on its social networks that the yogurt was fizzy and the fruit seemed off. Chobani's social media team replied to consumers on the brand's social networks, saying they would look into the issue. As part of this investigation, the brand found a production room had experienced some issues that were previously unknown to the company, so Chobani alerted its retailers and took back batches of the yogurt. In this instance, Chobani was able to preempt the crisis—to a certain degree—by listening to consumers and reacting quickly, investigating the situation, keeping consumers in the loop, and then engaging with the distribution channel and impacting the production cycle. The organization did ultimately receive criticism on social media over the issue and the way the company handled the issue—primarily because the scale and speed of the conversation was difficult to manage—however, this only further illustrates the need for proactive planning and preparation.

**2013 Horsemeat Crisis Conversations According to Google Trends**




**Combining the 4Ps of Brand Resilience and the 4As of Food Defense**

| Component | Food Defense | Social Media |
|---|---|---|
| Assess | Vulnerability assessment | Social media channels |
| Access | Mitigation strategies | Social media participation |
| Alert | Alert monitoring | Social media monitoring |
| Audit | Compliance | Social media response |

## The 4Ps of Brand Resilience

When it comes to food crises compounded by global social networking, there are a number of steps a brand can follow to ensure that not only is it proactively establishing a strong social media presence, but also that it is ready to react quickly, with full support from employees.

***Participate in Social Media Regularly.*** This means developing fans, friends, and followers; creating loyalty that can serve as resiliency during a crisis. Furthermore, a brand that is active in social media is more likely to learn quickly that it is being criticized than a brand that has no online presence at all. It's important to also track major competitors and the industry on social networks. While one brand may not be the initial focus of the comments, its reputation can be damaged simply by association with the industry. Other helpful practices including tracking and engaging with new sources. Brands should consider using the associated handles of influential media members and the hashtags industry thought leaders use so responses appear within the conversation stream or searches being made. It's also important to comment on posts and develop a rapport with other industry professionals on social networks.

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***Plan Organizational Responsibilities.*** Taking too much time to discuss what has to be done during a fast moving and escalating social media crisis is not recommended. It is much preferred to have the chain of command, approval process, and various scenarios reviewed, agreed upon, internally published, and understood in advance so the brand's full team is ready to react when needed.

***Pre-Audit Likely Issues and Prepare Responses.*** Have materials pre-prepared that can be easily edited to suit the specific situation, therefore saving time, rather than creating content during a crisis. While it is not always possible to be prepared for every eventuality, most brands should already know the likely areas which could result in negative comments. Have a range of scenarios prepared with plans for which subject matter experts can be called on.

***Practice.*** Many brands probably already have a crisis management plan prepared and run desktop exercises to ensure it is ready to activate. Include social media in this plan so it's not brand new material to anyone on the team during a real crisis. Ensure all involved parties and periphery staff are trained on the plans and confident about executing it.

## Integrating Social Media into a Food Defense Plan

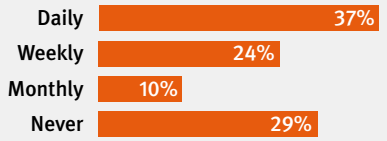
There's a remarkable parallel between social media and food defense. In both processes, when a company reacts and responds quickly, the negative brand impact is lessened. This means companies must be both proactive and diligent.

## 4As of Food Defense

The 4As of food defense are the core components of a proactive food defense program that delivers intelligence to help food companies and suppliers implement the preventive actions necessary to protect their brand.

***Assess.*** A proactive social media plan requires assessing the social media channels that your customers regularly utilize to ensure you are present in those channels if a crisis develops. Similarly, a proactive food defense plan begins by conducting a vulnerability assessment of all the critical control points where food is most vulnerable to adulteration.

**WWW.FOODQUALITY.COM POLL RESULTS: How often does your company monitor social media for food quality and safety issues, whether specific to the company or types of food products?**




***Access.*** Once those vulnerability points are identified, food defense requires allowing only authorized staff access to these critical control points to minimize vulnerability. In social media, a company needs to participate in the identified channels to minimize vulnerability.

***Alert.*** Continuous monitoring is equally important in both food defense and social media. In food defense, the whole supply chain needs to be monitored to alert appropriate individuals of intentional and unintentional instances of food adulteration anywhere along the chain, and respond quickly to minimize public health risks. In social media, all the relevant channels need to be continually monitored so a quick response is possible before a public firestorm brews.

***Audit.*** Finally, in food defense it is important to regularly audit procedures to determine operational and regulatory compliance to best food defense practices and provide documentation of compliance to regulators. In social media, a company needs to regularly audit compliance to the appropriateness of all social media responses, to ensure they are consistent with the company's image and brand promise.

How can a food and beverage brand protect itself against a social media firestorm when it comes to negative experiences? The trick is to build a social media brand defense plan that integrates into a proactive food defense plan. It is imperative that food and beverage manufacturers and distributors develop a proactive food defense program that delivers continuous and comprehensive control over the integrity of their supply chain to combat intentional food adulteration. Implementing preventive controls built on actionable intelligence to protect the food supply chain is much more effective than reacting to an adulteration event after it happens. The benefits of a strong food defense strategy that incorporates social media as an element to managing business and manufacturing processes can add value and defend the brand.

## Best Practices During a Crisis

In the event a food crisis and consequent social media firestorm does occur, there are several best practices a brand can follow to work toward recovering quickly and having the smallest impact possible on all involved parties. It's important to acknowledge the issue publicly and for the brand to state what it's doing to research and resolve the issue. Brands should also apologize unreservedly—many crises are made far worse when organizations take issue with what is being said, or how it is being said, and get into a public argument on social media. By all means brands should apply their house rules (i.e. no profanity or personal insults) but they should not censor, edit, or remove comments that they simply see as unfair. One benefit of having friends, followers, and fans is that while they can be a harsh critic, they can also be a moderating voice to unfair and unjustified comments by the online "mob."

Brands should always be honest and open, and sound human (as opposed to formal, or using legal jargon) when discussing the crisis publicly. If possible, brands in a crisis should consider creating a quick video from the chief executive officer or head of the organization to make a statement within several hours of the issue going public. Websites and microsites should also be updated as appropriate, and most importantly, brands must ensure they're keeping employees, key stakeholders, and the consumer consistently updated. When it comes to food defense and social media, it's all about communication! ■

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**INTERESTED IN LEARNING MORE about the topics discussed in this article? Go to www.TycoIS.com/social to view the "Social Media Crisis Planning" webinar that directly discusses this important issue.**

# Special Report

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## Alliance Gears Up to Develop Preventive Controls Curriculum

Beyond a basic FDA-recognized curriculum, the FSPCA will be expected to develop training modules for specific food types

BY **TIM DONALD**

A public-private alliance of industry, academic, and regulatory leaders is working to establish a standardized curriculum to help food companies comply with the preventive controls rules for human and for animal food required by the Food Safety Modernization Act (FSMA). Although the final regulations on preventive controls for human food are not expected to be published until mid-2015, the work of the Food Safety Preventive Controls Alliance (FSPCA) is already well underway, according to members of the steering committee. The aim is to have the curriculum in place at the time the final rule is published.

"We're very excited about this alliance," says Jenny Scott, senior advisor in the Office of Food Safety of the FDA's Center for Food Safety and Applied Nutrition. "We think the FSPCA is developing a good curriculum, and it's going to be very important as we go forward in moving the industry toward producing safer food products."

The FSPCA was funded as a part of an existing grant to the Illinois Institute of Technology (IIT) that helps to fund the Institute for Food Safety and Health (IFSH), the entity that hosts the FSPCA. The FDA will also offer ongoing input as the curriculum is developed and will review the final product, Scott says, "so that it can become an FDA-recognized curriculum."

The core curriculum and corresponding technical materials will be designed to help small- and mid-sized firms design food safety risk-reduction preventive controls that comply with federal regulations, says Purnendu Vasavada, PhD, outreach project manager for the FSPCA.

"Our mission is to support the FSMA requirements and help companies comply with those requirements to ensure a safe food supply. We will also provide additional technical information and serve as a go-to entity for industry to approach for help with FSMA compliance," Dr. Vasavada says.

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## Available to All

The FSPCA was conceived soon after the FSMA was signed into law in 2011, according to Robert E. Brackett, PhD, vice president of IIT and director of the IFSH.

"At that time there was recognized need for an institute to help small- and mid-sized members of industry to achieve compliance with FSMA, and a decision was made to use the model of the Seafood HACCP [Hazard Analysis and Critical Control Points] Alliance in terms of putting together the best thoughts from industry, academia, and government," Dr. Brackett says.

**"We think the FSPCA is developing a good curriculum, and it's going to be very important as we go forward in moving the industry toward producing safer food products."**

**—JENNY SCOTT,**
*senior advisor, Office of Food Safety of the FDA's CFSAN*

"From that time we have been working toward designing a curriculum that will be available to anybody in the industry, focusing on aspects of the preventive controls rule that will help companies have what they need to fulfill the requirements for the qualified individual," he adds. "Much of the work is already done, but we have to wait until the proposed rule is finalized so that our curriculum is completely in sync with what the rule says."

The "qualified individual," under the proposed FSMA rule, is to be responsible for preparing a company's food safety plan, developing a hazard analysis, validating preventive controls, and other functions.

"One way a person gets to be a qualified individual is by successfully completing training in the development and application of preventive controls that is at least equivalent to that received in a standardized curriculum that is recognized as adequate by the FDA," Scott explains, "That's the crux of why the FSPCA was established."

## Training the Trainers

The FSPCA steering committee hopes to finish a draft of the curriculum in the third quarter of 2014, Dr. Vasavada says.

"Then we will do a pilot to make sure the content and delivery of the curriculum is as smooth and effective as intended," he says. "We will issue a call for people who are interested in working as alliance-recognized trainers and offer train-the-trainer courses for them after the final curriculum is available. Anyone doing the alliance-recognized training must be giving out the same message, as it is intended for compliance with the regulation."

The curriculum will be publicly available, posted on the FDA and FSPCA websites, according to Scott, and anyone can use the curriculum for training. FSPCA-recognized training courses will have alliance-trained trainers, and only these courses will issue FSPCA certificates, she says.

Once the final rule is published, facilities will have one to three years, depending on size, to comply with the requirements. Until issuance of the final rule, Dr. Brackett says, interested parties can follow the progress of the curriculum development on the FSPCA website (www.iit.edu/ifsh/alliance).

**"At that time there was recognized need for an institute to help small- and mid-sized members of industry to achieve compliance with FSMA..."**

**—ROBERT E. BRACKETT, PHD,**
*vice president, IIT, and director, IFSH*

"We are trying to do a really great job of keeping the website as up-to-date as we can," he says. "People can watch the web page for developments."

## Curriculum 'Just the Beginning'

The FDA expects more from the FSPCA than just the development of the curriculum, Scott says.

"We think the curriculum is just the beginning," she says. "For training and education to be effective, there will have to be information available about specific foods produced by small businesses, which are the primary targets of this effort. Beyond the basic curriculum, we are expecting the alliance to help develop training modules for specific food types, so that the FSMA requirements can be related to a specific company or group."

The FDA will also expect the FSPCA to help develop information for food-type-specific guidance documents to help small businesses understand how to do a hazard analysis, the types of hazards that are likely to be associated with their particular types of products, and how to implement controls for those types of hazards, Scott says.

**"We will also provide additional technical information and serve as a go-to entity for industry to approach for help with FSMA compliance."**

**—PURNENDU VASAVADA, PHD,**
*outreach project manager, FSPCA*

"And we expect the alliance to do outreach to these types of companies, so the people involved in training may also become part of a network of experts that small businesses can call upon to help answer questions," Scott adds. "So hopefully the alliance can coordinate what we call a National Technical Assistance Network and post information on their website that companies can go to for help with their preventive control or food safety plans." ■

**Donald** is a veteran journalist with extensive experience covering a variety of industries. Reach him at timdonald2020@gmail.com.

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# Advancements in Pest Control

Greener services, scientific progress, and technical developments are contributing to the concept of 'Next Generation' Pest Management | BY **STOY A. HEDGES, BCE**

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Unlike most businesses, pest management professionals have access to the most sensitive areas of food processing facilities. Depending on the size and scope of the facility being managed, the pest professional will be on the premises from one to five days each week, conducting a range of services. Yet most everything in food safety from a pest management standpoint is not achieved through trap checks or treatments. Rather, the process requires focus on prevention for early detection and prompt attention to conditions that contribute to pest entry and survival.

## Food Plants: The Original 'Green' Pest Control Service

Food plants were one of the original types of commercial facilities to make use of a "green" pest strategy. This equates to minimal use of pesticides to control pests that might occur and addresses the causes of problematic activity. The concept is now being applied in other kinds of structures, such as office and retail buildings.

The first step in the "green" pest control process is to define and adjust the conditions that might contribute to pests—i.e., maintaining good sanitation practices, sealing up cracks, and eliminating the types of vegetation that attract pests, keeping doors closed, and having tight-fitting doors. Green pest management in food safety also addresses the causes of infestation related to product spillage, damaged packaging, incorrect product rotation and non-standard storage practices in warehouses.

In food processing, pest management has always been and will continue to be about prevention, which can entail interception, sanitation, habitat modification, monitoring, and exclusion. Interception involves spot inspections of incoming supplies to look for pest activity and rejecting infested products. During this step, suppliers may need to be examined to determine whether a consistent pest risk is involved. Some species of stored product beetles target whole grains and may be delivered with the corn, wheat, or barley, while others may develop in the facility, breeding in spilled grains, grain dust, or other accumulations. Along these same lines, truck trailers, box cars, etc. used by facilities shipping their finished products should have periodic inspection to help prevent shipped products from becoming infested in route to the customer.

Meanwhile, a proactive sanitation program should include training employees on recognition of the key pests and awareness of conditions that support pests or may allow pests to enter. Lines of communication need to be established where any employee can report not only pest activity, but items that may need to be checked and addressed. Your pest professional is a great resource for identifying such conditions, but the facility's employees spend far more time in all areas of the building and will notice more items that may need attention.

Monitoring pest activity through programs, traps, and recorded data helps pest professionals be more predictive when recommending which service options might be financially prudent for the customer. In the past 20 years, the pest control industry has introduced additional nonchemical methods such as vacuuming; a carbon dioxide technology that freezes small insects on contact; and pheromone strategies that help reduce the need for fumigations or space treatments.

Pest prevention needs to be incorporated as the raw food ingredients reach a facility following through the production

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process on to the packaging, storage, and shipment of finished products. It is vital that pest prevention is built into every step of this habitat modification to deny pests the things they need to survive—food, water, harborage, and access.

Prevention is proactive which is critical to the Hazard Analysis and Critical Control Points (HACCP) program. HACCP is designed to prevent biological, physical, and chemical contaminants from adulterating food products. The federal program mandates companies to analyze where their products become contaminated and institute procedures and guidelines to minimize or prevent any adulteration.

Since pest management is required under Good Manufacturing Practices (GMPs), it serves as an ancillary component of HACCP. Pest professionals help serve as an additional set of eyes in uncovering conditions that affect pest activity and thus one part of the food safety process.

## Science Continues to Improve Management

Pest professionals work with the facility staff to detect, monitor, and analyze data in order to prevent pest activity. Yet one of the challenges of pest management in food processing is the variability in the data that different facilities want collected and the kind of trend reports they desire. Technology advancements in barcoding and handheld devices have allowed pest professionals to deliver facility-specific data recording and reporting more proficiently as facilities and auditing agencies require more and more information.

Science has led to the development of new pheromone applications, such as mating disruption for Indian meal moths. Mating disruption involves introducing so much pheromone into the environment that the female moths cannot find a male with which to mate. Unmated females then lay nonviable eggs resulting in the crash of Indian meal moth populations over time.

The implementation of mating disruption in many cases can result in reducing the need for space treatments, which saves money and helps better protect stored food products. Fewer space treatments also means the facility avoids shut-down time necessary to do such treatments, thus helping productivity. Studies continue to research the application of mating disruption to cigarette beetles and potentially other pests for which pheromones exist.

## Technical Strides Lead to Efficiency

Where science has elevated pest control capabilities in food processing facilities, technical advances have created more user-friendly and efficient modes of action against infestations both indoors and outdoors. For instance, nonlethal exclusion devices like voltage shocks, spikes, and netting that provide long-term displacement of pest birds and other wildlife have become easier to install and far more sophisticated in nature. As an example, a tape with wires running through it can be connected together and hooked up to a solar-powered device that sends the high-voltage, no-amp current through to shock the birds.

## More on Next Generation Pest Management

BY **PATRICIA HOTTEL**

For many years, programs have utilized set distances for installation of monitoring and control equipment like multi-catch rodent traps and exterior rodent bait stations. Although standard distancing offers some benefit from an auditing system, it doesn't always equate to a program in the best interest of food facilities. Facilities with low rodent pressures can end up with the same amount of equipment as facilities with heavy pressures. In addition, some facilities may have heavy pressures on one side or area of the structure and little to no activity on another side of the building but have the same amount of equipment coverage in all areas. In the future, equipment will be utilized where it is needed and not based on set spacing. It is commonly called "Next Generation" Pest Management. Next Generation shifts from a set number of traps to a facility analysis and the development of a customized program placing equipment only where needed. Under this new form of pest management, visual inspections are still performed in all areas for pests and new services with specific value to facilities are substituted for the equipment removed. Additional services may include items like web removal, fecal dropping removal, pest proofing, or other monitoring programs or services. Next Generation Pest Management works well with the GFSI-based auditing standards which do not require set pest management equipment spacing, but measure whether or not the program is functioning as it should.

In addition, future technology will likely change the ability to monitor a wider variety of pests and monitor remotely. For instance, the wildlife industry and companies monitoring bulk grain storage have been able to monitor pest activity in traps remotely for several years. Electronic grain probes for grain bins are one example where technology can be used to count pests and send numbers electronically to a computer. In the near future, these grain probes will detect specific species and numbers of insects in bins. Wildlife professionals have utilized electronic systems based on cellphone technology to notify them when live traps have captured an animal. Several trap manufacturers have looked at similar technology for the structural pest management market. Although such remote monitoring and notification systems have not been perfected for the structural pest management industry, availability is expected sometime in the near future. The ability to determine exact date and time of capture can be beneficial in analysis for developing control plans.

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Further evidence of technical progress in food safety and pest control may be found in light technology. By replacing bright white lighting with yellow sodium vapor lamps, far fewer insects are attracted to the exterior of a building. In fact, the broader impact of lighting adjustments on a facility may surprise some food plant operators.

I once dealt with a food processing customer in the Southeast that was experiencing an issue with various beetles being found inside certain areas, especially offices and warehouse areas. Upon inspection, the beetles were found to be various species of water beetles and ground beetles which live and breed in aquatic environments and fields. The facility was located in a rural area, was surrounded by fields, and had marshy land and waterways not far away. The cause of the issue was the bright white metal halide lamps used to light the building's exterior. Such lighting is highly attractive to night flying insects such as these beetles, drawing large numbers to its exterior every night. Exterior doorways that were opened frequently or had gaps in their weather-strips on the bottom allowed some beetles to enter. Once inside, beetles could crawl or fly to other areas before expiring due to the drier interior of the building.

In this emerging approach to pest control, providers analyze data to figure out where time is best spent on services.

The solutions involved a recommendation to change the metal halide bulbs to sodium vapor lamps which produce a yellow spectrum that is far less attractive to insects. Although insects would still be attracted to the facility, the numbers would greatly be reduced. Weathers-strips on exterior doors were replaced with tight-fitting strips and employees advised to be mindful about how long doors would remain open, particularly at night when such insects were most active.

## Crystal Ball

Ultimately, data collection and analysis is headed into a concept that some in the industry are calling, "Next Generation" Pest Management. In this emerging approach to pest control, providers analyze data to figure out where time is best spent on services.

Innovations in handheld technology and barcode scanning will play a role by answering such questions as, "How many rodent devices are truly necessary?" and "Where should pest monitoring and inspection efforts best be spent?" Converting the time spent checking and maintaining unnecessary devices into more proactive inspections contributes to better early detection of pest activity, thus helping to reduce the need for treatments and, as a consequence, even less use of pesticides.

The future of Integrated Pest Management will rely on more data collected from internal facility sources in addition to that generated by the pest professional. Focusing efforts on determining where pest activity is most likely to occur in a given facility or warehouse focuses more effort on prevention and may, over time, reduce costs. ■

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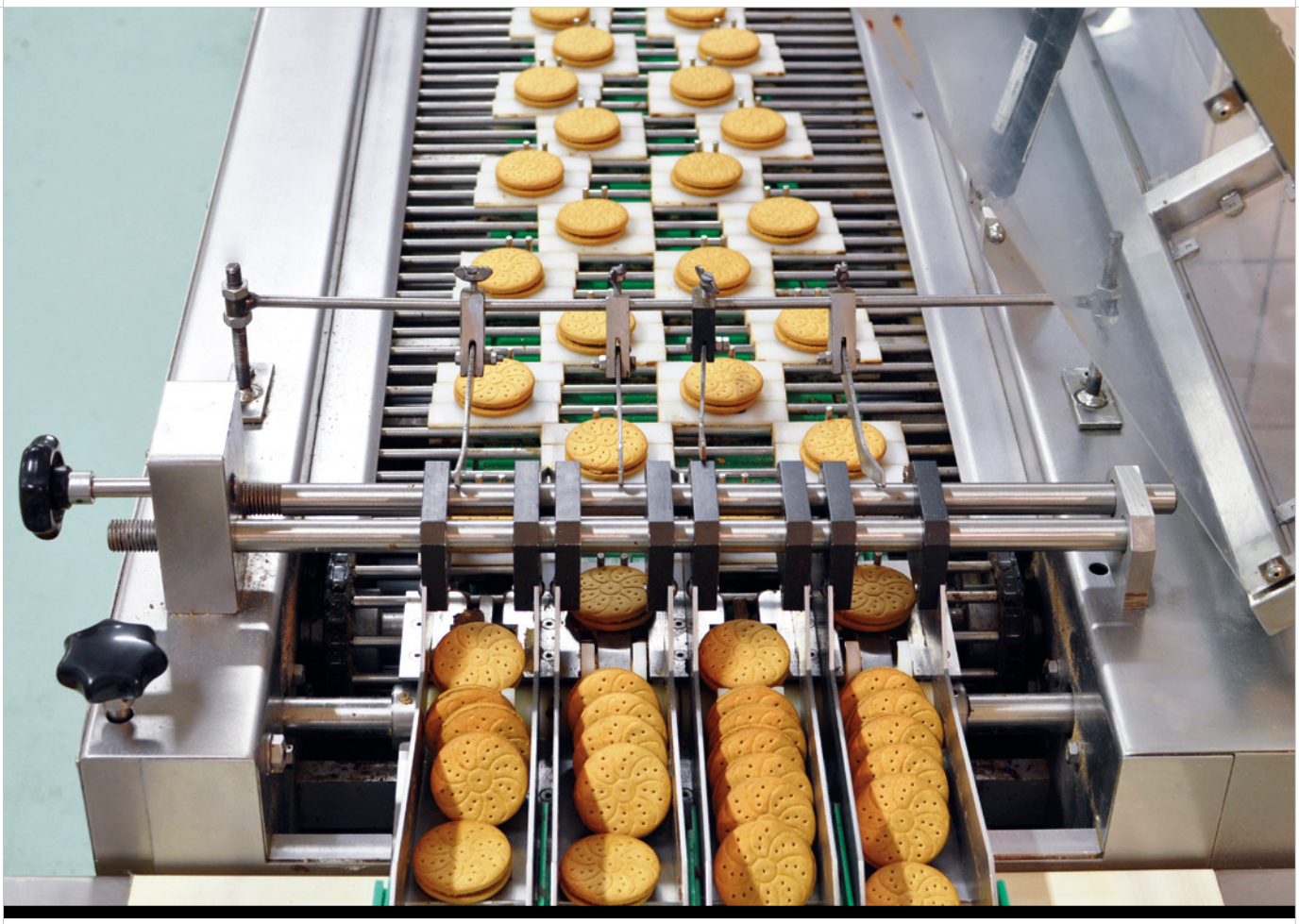

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# Components for an Effective Pathogen Environmental Monitoring Program

## Determining which organisms to target, the risk evaluation, factors in a sampling plan, and the corrective actions

BY **TIMOTHY FREIER, PHD** AND **JOSEPH SHEBUSKI, PHD**

Food safety for food manufacturing facilities has changed and evolved greatly in the last few decades. A large part of that change involved moving toward a more preventive food safety strategy. The application of hazard analysis has shifted the emphasis from finished product testing to more proactive approaches such as the use of validated critical control points with science-based critical limits to consistently reduce risk. In conjunction with this there has been an increased use of environmental monitoring as a means of verification of the prerequisite programs that serve as the foundation for Hazard Analysis and Critical Control Points (HACCP). Today many facilities are adding or strengthening their pathogen environmental monitoring programs (PEMPs) to enhance their food safety risk reduction efforts.

The two most common types of PEMP are *Listeria* spp. monitoring as an indicator for *Listeria monocytogenes* and *Salmonella* monitoring. Monitoring programs for other pathogens or indicators, such as monitoring for *Cronobacter sakazakii* in infant formula manufacturing facilities, share many similarities with the PEMPs discussed here. Monitoring for more generic indicator groups, such as sampling for total aerobic bacteria to verify sanitation, differs from the PEMPs discussed in this article. For food manufacturing facilities where there is a science-based reason for a PEMP, there are some common components that should be built into the PEMP to make the program as effective as possible.

### Management Commitment

The first component of an effective PEMP is management commitment. Corporate and facility leadership need to understand and support this program and supply appropriate resources and recognition

to ensure that it is viewed as an important part of the food safety culture for the organization. These programs can involve significant cost and major implications for production. For example, if the PEMP findings indicate an elevated risk for contamination of the finished product, product may need to be placed on hold and tested, or even reprocessed or destroyed. Effective corrective action could require an investment in new equipment, a product reformulation, or an improvement in the facility's sanitary design. In other words, management commitment means more than agreeing to pay for some lab tests. One never knows what will be found when a diligent environmental search for a potential product adulterant is conducted, so everyone involved must understand the risks and implications of a finding and be willing to support the program before the first swab is taken.

## Determination of Need for PEMP

Not every food manufacturing facility needs to have a PEMP. More testing does not necessarily equal more safety. Rather, the judicious use of food safety resources requires interventions and verifications to be targeted to the most appropriate areas for the greatest risk reduction. A thorough risk evaluation should be conducted to lead the food safety team to a determination of whether or not a PEMP is necessary, which organism or indicator group to monitor, and the degree of stringency of the PEMP. Any type of sampling and testing has the potential for "false" results. This is especially true for microbial testing. Therefore, if a product or process can be designed that precludes the need for a PEMP; this option should be carefully balanced with other considerations such as product safety and quality, consumer acceptance, regulatory requirements, and production expense. An example of a process change that could eliminate the need for a PEMP is to eliminate product exposure to the plant environment (hot filling or aseptic filling versus cold or ambient temperature filling) or pasteurization of the product in its final package. Another example is the reformulation of a product or changing distribution from refrigerated to frozen to prevent the growth of *L. monocytogenes*.

## Risk Evaluation

The next component is a complete evaluation of the science-based food safety risk. We have designed a simple decision tree (see Diagram 1 on page 35) that can be used as a first step to aid in this risk evaluation. This decision tree has been used for hundreds of products in numerous production facilities and has been found to work well for most products/processes. However, it is meant to be used as a tool to assist in completing the risk evaluation and not used to replace a complete evaluation.

While there are many similarities in the risk evaluations for *Salmonella* and *L. monocytogenes*, there are a few key differences. One is *L. monocytogenes* can grow slowly at refrigeration temperatures, while *Salmonella* cannot. Another key difference is *L. monocytogenes* typically needs to grow to high numbers to cause infection, even in immunocompromised individuals. *Salmonella* can cause illness at relatively low numbers and often causes illness in otherwise healthy individuals. In general terms, *L. monocytogenes* has the greatest risk in ready-to-eat (RTE) perishable refrigerated products that allow the growth of this organism and have relatively long shelf lives (e. g., certain soft cheeses, salads, cooked seafood, fresh-cut produce, deli meats, and hot dogs). Alternatively a *Salmonella* PEMP has the greatest value in facilities manufacturing dry shelf-stable RTE products (e.g., nuts, nut butters, soy products, dry pet food, breakfast cereals, snacks, chocolate). Salmonellosis has also been linked to raw unpasteurized products such as meat, poultry, eggs, dairy, grains, spices, and produce. However, these product contamination events were caused by the inherent presence of the pathogen in the raw products, and not by contamination originating from food manufacturing facilities. A *Salmonella* PEMP is typically not necessary in facilities manufacturing these types of non-RTE products.

Under some circumstances, for example in dry grain processing facilities that lack a processing step to ensure the elimination of pathogens in the final product and for which the product is not intended for RTE applications, "for cause" pathogen environmental monitoring may be conducted. In these cases routine monitoring is not conducted, but "for cause" monitoring is triggered by the occurrence of an unanticipated event involving the ingress of water into a normally dry processing environment. Water could allow for the potential multiplication of pathogens in the plant environment and a possible increased presence of a pathogen in the finished product. A "for cause" PEMP would be appropriate to evaluate this heightened food safety risk but once the situation returned to a normal operating condition the need for ongoing sampling and testing would be unnecessary.

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When the risk evaluation indicates a PEMP is necessary, the next component to consider is to determine the degree of stringency of the plan. Every product, process, and facility is different. The stringency of the plan is based on many factors, such as the historical linkage of the product type with illnesses (for *Salmonella*, often termed "*Salmonella*-sensitive ingredients or products). Another important factor is the degree of product exposure to the plant environment. Products exposed to the environment are those having a reasonable likelihood of becoming contaminated if the pathogen of concern exists in areas near product contact surfaces or in other places between the kill step and final product packaging. If product is conveyed in fully enclosed piping into the final container with little to no likelihood of contamination or "hot filled" under controlled conditions, the product would not be considered to be exposed to the plant environment. If the final kill step occurs after product is sealed in the final bacteria-impervious package, the product would also be considered to not be exposed. Other considerations include the history of pathogen findings in the facility, the amount of handling following the pathogen reduction step, the complexity and sanitary design of the equipment, packaging type, distribution conditions, shelf life, intended use of the product, and susceptibility of the targeted consumer. These factors will inform the facility personnel in developing the next component of the program, the sampling plan.

## A Sampling Plan

Each facility and product type should have a science-based sampling plan for any PEMP deemed necessary based on the risk evaluation. Critical components of the sampling plan include the determination of the number of samples to collect in each sampled room, area or zone, how often sampling will be conducted (daily, weekly, monthly, etc.), which days of the week, and at what time during the shift samples will be taken. Sampling sites should not be entirely random but should instead target the most likely sites to harbor the organism of concern. *Listeria* growth niches can occur on product contact surfaces, so these surfaces should be included in the *Listeria* PEMP sampling plan. Difficult-to-clean sites in product contact areas and close to product contact areas should be heavily targeted. Also, the sampling focus should be on the environment in the most critical area of the plant (the area between the kill step and final packaging). Areas historically associated with *Listeria* growth niches (e. g., hollow rollers on conveyors, gasket material around doors, hollow support structures, grease inside bearings, slicers, dicers) should be preferentially included in the plan.

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While the overall food safety goal is to maintain critical processing areas free of the pathogen or indicator group, the goal of the PEMP is to find these organisms.

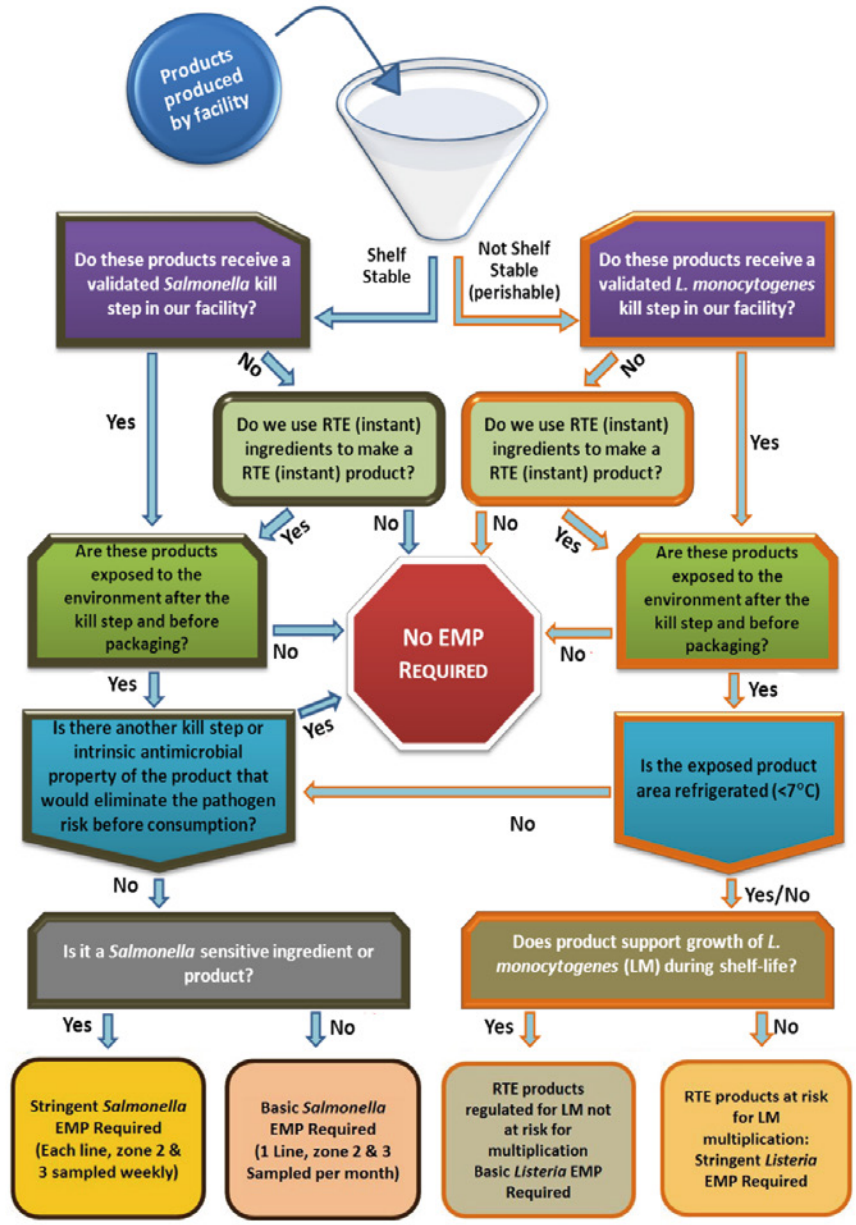
When developing a sampling plan for *Salmonella*, target warm (non-refrigerated) areas exposed to moisture (roof leaks, condensation, over-spray from cleaning, etc.), and product residue. Sampling sites are typically concentrated in areas near food contact surfaces and other areas in the primary *Salmonella* control area (PSCA), the area between the kill step and final packaging. In contrast to *Listeria*, *Salmonella* growth niches do not typically occur on product contact surfaces due to the dry nature of the product and the self-cleaning or scouring nature of the dry product passing over the contact surfaces. The *Salmonella* PEMP sampling plan should concentrate on non-product contact surfaces in the PSCA.

In addition to the samples scheduled to be taken based on the sampling plan, technicians should be allowed to take "creative" samples, investigating novel sites not sampled in the past. Technicians need to be trained to understand the difference in the implication to finished product between sampling a product contact surface and a non-product contact surface. Typically, if a pathogen such as *Salmonella* is found on a product contact surface, the product contacting that surface would be deemed to be adulterated and may need to be recalled if the product had not been placed on hold.

The goal of the PEMP is to find the intended target. Technicians doing the sampling should be incentivized to find positives. This is counterintuitive to many people. While the overall food safety goal is to maintain critical processing areas free of the pathogen or indicator group, the goal of the PEMP is to find these organisms. In the U.S. RTE meat and poultry industry, this mentality is known as "Seek and Destroy," and the diligent search for the target needs to become part of the food safety culture of the facility.

Investigational sampling in response to a positive routine finding should be conducted with the goal of finding the true root cause of the contamination. The stringency of the investigational sampling will depend on the circumstances of the finding. Finding the root cause of a contamination issue is often very difficult and can require intensive disassembly and sampling of equipment and the environment. This investigation can continue for several weeks and involve taking hundreds or even thousands of samples. As part of the investigation, the food safety team also needs to consider changes or disruptions to normal production such as improper employee practices, drain backups, flooding, contractor work, power outages, etc., in addition to evaluating the test results.

**Diagram 1, PEMP Decision Tree**

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**For more information and examples of each step, go to the *Food Quality & Safety* February/March issue at www.foodquality.com and click on this article.**

Special circumstance sampling may be initiated even without finding positives during routine sampling. This can include taking extra samples during non-routine events such as facility construction, installation of new equipment, power failure, roof leaks, kill-step failures, or any circumstance that might lead to enhanced risk of contamination of the final product.

## Sampling Methods

The next component of the PEMP should provide details about how samples will be collected, the type of sampling device to be used (e. g., sterile sponges with sterile gloves), the type of diluent to be used, and how the samples will be stored and transferred to the lab and tested. Typically, large areas should be sampled (greater than 1 square foot) using an abrasive sampling device, such as a microcellulose sponge wetted with a diluent like peptone water or a neutralizing buffer (if residual sanitizer might be present in the area being sampled). Samples should be refrigerated, not frozen, and processed by the laboratory within three days. Technicians taking samples should be trained in proper aseptic sampling procedures. Sampling should typically be conducted by starting in the cleanest area of the plant and ending with the dirtiest area to prevent inadvertent cross-contamination of the facility. Only methods validated for use with environmental samples should be used (AOAC International or rigorous internal validation). Testing should be conducted at a competent lab with appropriate quality control practices in place. The time from test initiation to result (turnaround time) is often thought to be less critical for PEMP than for finished product testing, as product is not typically placed on hold. However, quick turnaround time can be critical during an investigation. Similar to a crime investigation, clues are most helpful when the trail is still fresh.

## Evaluation of Results

The final critical components of a PEMP are the evaluation of the results of the sampling and corrective actions prompted by those results. The results should be reviewed on a timely basis. Positive findings should be reviewed by the facility food safety team. Results should be organized in a manner allowing easy visualization of findings. The use of data spreadsheets and facility maps indicating positive and negative findings is recommended. When routine and/or investigational and/or special circumstance sampling indicates a problem, timely and effective corrective action must be taken. This activity should target the root cause of the contamination. Most effective corrective actions will involve more than simply re-cleaning or re-sanitizing the problem area. The food safety team should also consider changes in personnel practices, training, equipment or facility modifications, process or product changes, or other activities resulting in a permanent fix of the problem. Additional testing may be necessary to verify the adequacy of the corrective actions. All activities involving the PEMP should be documented. ■

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# Fingerprinting Food: Augmenting Existing Near Infrared Technology to Fight Dairy Adulteration

## The food industry is working to prevent food fraud by focusing on tools that help detect 'unknown-unknowns'

BY **SHARON PALMER**

Due to the nature of economically motivated adulteration (EMA) and mislabeling, it is difficult to predict the exact nature of potential threats, so many in the food industry are looking to detection techniques that help detect "unknown-unknowns." The analytical testing strategy identified to provide this type of detection is known as "food fingerprinting." Unlike conventional approaches, which rely on detection of a known number of analytes as an indicator of authenticity, food fingerprinting measures a large number of variables and applies mathematics to generate a fingerprint specific to authentic samples of the commodity or ingredient of adulteration concern. A wide number of analytical techniques have been identified as useful in this approach, including nuclear magnetic resonance, molecular spectroscopy, stable isotope analysis, and mass spectrometry.

Fingerprinting of high-risk food types such as milk powder is valuable and NIR spectroscopy clearly has a role to play given its ubiquity in raw materials testing.

For a new approach to be successful and adopted widely, several characteristics are desirable. Namely, it should provide a rapid answer and be deployable in a manner that allows a large number of samples to be screened. Of course, it is highly desirable that it incurs minimal additional testing expense.

### NIR

Near infrared spectroscopy (NIR) is an ideal choice as it is extensively used today in the food industry, and as a result, capital investments in new detection instruments are minimized. In addition, NIR does not demand laboratory-type sample preparation protocols, lab-based environmental conditions or specific gases, and it generally provides an answer in less than a minute. This enables NIR to be deployed in manufacturing facilities and operated by non-laboratory trained personal, resulting in cost-effective, fast screening for adulteration issues.

### Example: Fingerprinting of Milk Powder

Milk powder is one of the most widely traded food commodities, with over 2.5 million metric tons exported annually, and is used in a huge array of food products, from infant formula to baked goods and confectionary. NIR is already widely

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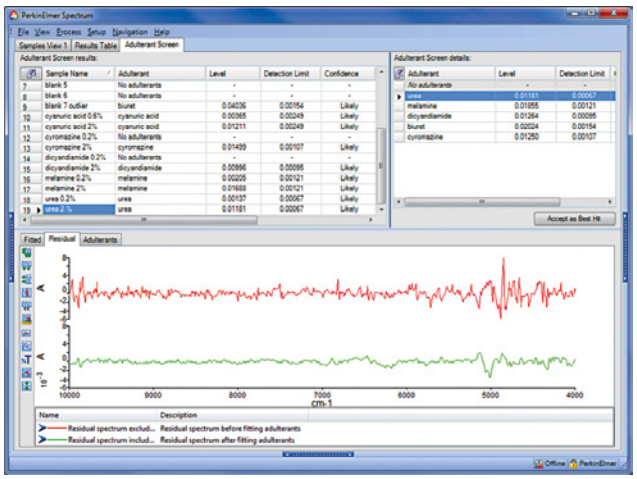

**Residual spectra for a contaminated sample. (Red trace: PCA residual, showing evidence of un-modelled components. Green trace: Adulterant Screen residual, showing a much improved fit.)**

applied to measure concentrations of key quality parameters such as protein, moisture, lactose, ash, and fat. Protein is a key quality parameter in milk linked to its value, and standard methods for protein analysis rely on a simple nitrogen assay with the protein concentration inferred from the nitrogen content. Addition of chemicals rich in nitrogen can artificially increase the apparent protein and the price demanded. Whilst regulators have responded and enforced tight regulations around some high nitrogen containing chemicals such as melamine, the "chemical space" is vast, and there are many more high-nitrogen compounds that could potentially be used in the same way. To stay ahead of criminals, it's important to look beyond currently known adulterants and consider other possibilities.

NIR's capability can be easily extended to screen samples of these potential unknown threats. NIR spectra contain information about the whole sample—including any adulterants present. There is no physical separation process at work, so the spectra must be processed with appropriate chemometric and mathematical tools to separate the contributions of the milk powder matrix and any adulterants.

A principal components analysis (PCA)-based method such as Soft Independent Modelling Class Analogy or SIMCA, in which a "fingerprint" is built for the unadulterated milk powder, and the degree of fit of the sample spectrum to this model is used to determine whether the result is a pass or a fail, can be used. While this approach is truly non-targeted and potentially sensitive to any adulterant, there is no indication of *why* a failing sample has failed (no identification of the adulterant) and, because the method makes no use of the adulterant spectrum, the sensitivity cannot be expected to be as high as a quantitative method.

Recent algorithm advances designed specifically to address the problem of screening for potentially numerous adulterants in a complex matrix combines the generality and simplicity of "fingerprinting" with some of the sensitivity benefits of a targeted approach. These algorithms require some information about the potential adulterants but are just a single spectrum of the pure sample. They can be readily shared between sites and even generated by the instrument manufacturers. The PerkinElmer DairyGuard Milk Powder Analyzer is an example of a complete system configured with a unique Adulterant Screen algorithm for the analysis of milk powders.

## Summary

Adulteration of food and food ingredients for economic gain is an old practice and, sadly, one that is unlikely to be eliminated in the near future. This problem needs to be tackled with all the analytical techniques at our disposal. Fingerprinting of high-risk food types such as milk powder is valuable and NIR spectroscopy clearly has a role to play given its ubiquity in raw materials testing. Food companies can find that extending their existing testing equipment is a fast and cost-effective way to enhancing their portfolio to help detect food fraud. ■

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# The Natural Power of Ozone

The benefits from ozone can be used in many capacities, such as for plant sanitation, extending product shelf life, or overall product safety | BY **JAMES BRANDT**

Whether ozone is assuring a pure and safe product for water bottlers or enhancing quality for seafood processors and distributors, ozone is being recognized as a valuable tool in improving product quality and safety. Ozone's increased usage for improving food plant sanitation has evolved over the past decade following the FDA's announcement in 2001 of approval "for the safe use of ozone in gaseous and aqueous phases as an antimicrobial agent on food, including meat and poultry." Many of our nation's largest companies are now using ozone to fight *Salmonella* and *Campylobacter* in poultry, botrytis in fruit, and *Listeria* in many foods including seafood.

## What is Ozone?

Ozone is a gas composed of three oxygen atoms. The oxygen molecule in the air we breathe consists of two oxygen atoms firmly bound together. When oxygen is subjected to high voltage discharge, some of the oxygen molecules disassociate and the freed oxygen atoms then combine with existing oxygen molecules to form ozone. The third oxygen atom in the ozone molecule is loosely bound to the other two atoms and turns ozone into a very strong oxidizing agent. In many respects, ozone can be considered a more powerful green alternative to chlorine.

Ozone and chlorine differ, however, in many ways. Ozone is much stronger and acts more quickly, meaning the contact time necessary to sanitize is lessened. Chlorine is generally used at concentrations of 100 to 200 parts per million (ppm) while aqueous ozone is used at 2 to 3 ppm and gaseous ozone at 0.05 to 0.1 ppm. Chlorine leaves a detectable chemical residue on the product and is prohibited on imports into many countries. Ozone leaves no chemical residue and permits organic certification. It simply reverts to pure clean oxygen.

## Why Ozone?

Ozone has the unique ability to sanitize while leaving no chemical residue. It is an aggressive sanitizing agent that when applied to a product causes no organoleptic alteration and permits organic labeling. This makes it possible to use ozone for continuous cleaning—in other words, to clean and sanitize both product and direct product contact surfaces continually during production.

The full value of ozone is industry specific but there are a number of benefits for all food processors. All processors struggle with product cross contamination and all have chronic bacterial and fungal reservoirs lurking within their plants. By incorporating a continual cleaning solution these concerns are lessened.

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Continuous aqueous ozone sprays keep conveyors and other direct contact surfaces sanitized during production. These sprays produce some runoff onto floors and into floor drains, well known reservoirs of contamination, helping them to remain clean. Gaseous ozone can be incorporated into the continuous cleaning protocol by using low levels of ozone in worker occupied areas and higher levels in unoccupied areas such as freezers and storage facilities and during plant shutdowns.

The capacity to be able to slow down the progressive contamination of a plant as processing proceeds is extremely useful. It provides assurance that the product produced at the end of the day matches the quality of the product produced at the beginning of the day. It lessens the likelihood that a contaminated product will contaminate everything behind it.

## Cleaning with Ozone

The cleaning power of ozone is visually grasped in several examples. The processing of ripe peaches in the San Joaquin Valley in California spans a relatively short period of eight to 10 weeks. The facilities are not air conditioned and Valley temperatures in July and August are quite warm making the peach residue on conveyors, pitters, and other contact surfaces very conducive to the growth of mold. Add to that the high sugar content of ripe peaches and the stage is set for a substantial problem. Several years ago, a trial of continuous aqueous ozone sprays on the peach conveyors was performed. A side-by-side comparison of one belt with ozone and the other without led to the worldwide adoption of ozone in stone fruit processing.

Another example of ozone's cleaning ability was proven effective on a very soiled floor drain. After an ozone system was installed in the plant, a very low flow line serving a dissolved ozone sensor was secured with zip ties to an existing drain line. Several months later, the area of the drain receiving the small ozone stream was visibly clean.

The first example shows the ability of ozone to keep a surface clean. The second shows ozone's ability to clean a dirty surface. Ozone is most effective if used continually. This stems from the fact that at 2 to 3 ppm it can easily be overwhelmed by heavy biological oxygen demand (BOD) loads. Low flow of continuous ozone sprays or low ambient levels of gaseous ozone are the most effective way to maintain clean surfaces and prevent biofilm formation. The ozone sprays are started minutes before production to coat the surfaces with ozonated water keeping them sanitized during the production day. This preemptive approach to cleaning virtually eliminates biofilm formation and, when coupled with interventional cleaning, can lengthen the interval for full plant sanitation.

When properly applied the addition of an ozone continuous cleaning program will enhance plant sanitation. It is not a replacement for an existing good sanitation program but rather a complement to that program. In the process, it can reduce sanitation costs in both labor time and chemicals.

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## Ozone in Seafood Processing

I mentioned earlier that many of the benefits of using ozone are industry specific. These benefits are not just theoretical but can be very quantifiable. Looking at a specific industry such as seafood, we find extensive adoption of ozone technology. Whole fish are initially sprayed with ozonated water on arrival at the plant. After the fish are headed and gutted, the insides of the fish are sprayed with ozonated water as are the knives, conveyors, deboners, fillet machines, and other direct contact surfaces. As the fish travel down the processing line, they pass under spray bars which provide an additional application of aqueous ozone. Augmenting that protocol is the interventional use of ozone on indirect surfaces during break times and shift changes.

What does this accomplish? For starters, it has been shown to lengthen shelf life and improve product safety. It should be noted that the degree of shelf life extension is dependent on the point of initiation of ozone processing. Processors will typically see a two to four day extension while distributors may see a one to two day extension. The result of this is that customer charge backs, a significant cost to seafood distributors, are dramatically reduced—producing significant additions to the bottom line.

Aquaculture operations also benefit from ozone. Onshore facilities use ozone to improve colloid flocculation, nitrite oxidation as well as to put more oxygen (the ozone by-product) into the water. In clear water aquaculture, the goal is to achieve a 95 percent reduction of pathogenic waterborne bacteria in water treatment systems. These benefits all contribute to better survival and faster growth. Hatchery operations are similarly enhanced with the use of ozone.

## Ozone's Role in Food Safety

From a food safety prospective, pathogenic bacteria get and deserve the biggest headlines. All bacteria are inactivated by ozone. But remember, ozone is a topical agent and is only lethal to what it can see. Most of the organisms we are concerned about are aerobic and therefore on exterior surfaces. But one bad actor is not—*Listeria monocytogenes* is a facultative anaerobe and it grows well in cooler environments as well as internally in protein products. The continuous cleaning capability of ozone provides the best defense against this serious food safety problem. Ready-to-eat (RTE) products are particularly susceptible to *Listeria* contamination and ozone's unique organoleptic property of leaving no residue has made it become a effective agent in many areas of RTE sanitation.

## Ozone Systems

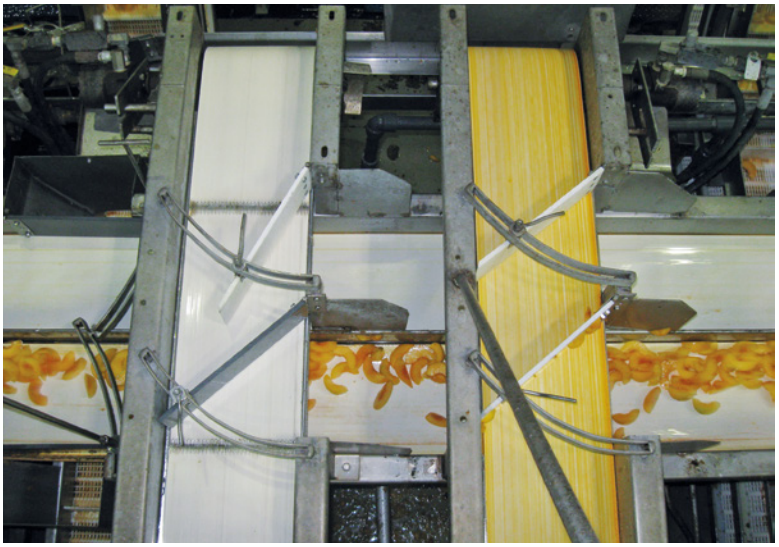
Systems vary in size to accommodate large processing plants as well as smaller distributor applications. Ozone systems can be likened to sophisticated HVAC systems in that they are quite reliable but do require some regular maintenance. Usually that maintenance capacity is not available "in house," which has necessitated OEMs developing nationwide service capabilities. Sometimes that work is subcontracted to local firms such as refrigeration companies, while larger OEMs are vertically integrated and have their own nationwide service organizations. This vertical integration, from the initial application engineering all the way through to real-time monitoring and servicing of an installed system, provides the customer the best assurance of reliable system performance.

The degree of shelf life extension is dependent on the point of initiation of ozone processing.

Reliability is very important to consider as plants become dependent on ozone. A nonworking ozone system can under some circumstances cause a complete plant shutdown, such as in water bottling facilities. Service and parts need to be readily available. This is best assured by knowing that the ozone system is being monitored 24/7 and comes with an assurance of quick service availability, both now and in the future. Be aware that many parts in an ozone system are specific to that OEM's system and not readily obtained from other vendors.

## Summing Up

As ozone's use has grown into so many areas of food processing, its future applications seem limited only by the imagination of "outside the box" thinkers. Unfortunately, some of these applications become proprietary and are not readily disseminated. The good news is that there are a multitude of applications for which ozone has become a pivotal agent in improving our nation's food quality. ■



OZONE INTERNATIONAL

**This side-by-side image of ozone versus no ozone in peach processing shows how when ozone is applied, hoses, belts, and other equipment stay cleaner—reducing the down time for sanitation.**

**Dr. Brandt,** a founder and chairman of Ozone International, is a retired surgeon with previous work in microbiological research, subclinical infections, and operating room disinfection. He can be reached at jim@o3international.com.

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# Ethylene Management Breakthroughs

## Improving the quality and shelf life of fresh produce

BY **GREG PAVETT**

The most recent report from the Food and Agriculture Organization of the United Nations estimates that a staggering 1.3 billion tons of food is wasted globally every year, resulting in direct, annual economic losses of $750 billion U.S. dollars. A projected 40 percent of food goes uneaten just in the U.S., according to the Natural Resources Defense Council.

The significance of these statistics takes on still more meaning when factoring in the environmental and social impacts of global food wastage. Some 3.3 billion tons of greenhouse gases are pumped into the planet's atmosphere just to produce food that is eventually discarded into landfills, which, incidentally, further emit damaging methane gas. Amidst all of this waste, 870 million world citizens go hungry every day.

What's responsible? The causes of food waste of course are varied, complex, and prevalent throughout the entire supply chain—overproduction, inadequate storage or packaging, inefficient stock management, consumer confusion about dating labels, and oversized portions to name some.

But there is also one simple culprit hidden within nature that's responsible for much of the wasted food, yet often overlooked: Ethylene. Ethylene is the naturally occurring gas emitted by many kinds of fruit which acts as a ripening hormone.

For more than 80 years, it's been known that ethylene is emitted by various kinds of produce when under stress or injured, such as when they are picked, peeled, pressed into packing containers, or bruised in consumers' grocery bags. This begins occurring immediately upon being harvested, but accelerates as the fruit ages.

Ethylene can be thought of as a distress signal, sent to other fruit and vegetables to warn of imminent danger, and to communicate the need to ripen as fast as possible. The gas is responsible for changes in taste, texture, color, and other ripening processes. Chlorophyll is degraded, new pigments are produced, and the activity of many maturation-related enzymes intensifies. Starches, acids, and lipids convert to sugars while fruit pectins degrade. Consequently, produce items respire, abscise, soften, and grow mold to the point of spoiling—shortening the shelf life.

### Slowing Down the Clock

Fortunately, there are certain best practices for managing ethylene exposure that can be used across the supply chain in order to slow the ripening process and reduce instances of premature rot, mold, and waste. Over the past 10 years, society has wised up to the significant impact ethylene can have on fresh produce. As a result, new processes, innovations, and technologies for produce supply chain players have become available that are far more effective at controlling ethylene than ever before.

For maximum shelf life and quality, certain climacteric fruits and vegetables (produce that rapidly ripen to a climax in response to ethylene) such as apples, mangos, tomatoes, peaches, and bananas should not be stored or shipped with non-climacteric produce like cherries, lemons, oranges, broccoli, or lettuce. In many ways, climacteric and non-climacteric fruits "speak" to one another, with ethylene being the common language. So for example, despite producing comparatively smaller amounts of ethylene on their own, strawberries exposed to more of the gas will take it as a sign to begin ripening more rapidly. Ethylene has a cumulative effect, so continuous exposure to even small amounts of ethylene can result in significantly shortened product lifespan. And overripe or rotting produce continue to emit ethylene, so should be removed promptly.

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While most who work inside the production and distribution of fruits and vegetables are accustomed to this segregation of climacteric and non-climacteric produce, this comes as a surprise to most people. After all, in retail settings the majority of produce is stored in a single space and then displayed in close proximity as a convenience and enticement to shoppers.


ITSFRESH!, INC.

The gas is responsible for changes in taste, texture, color, and other ripening processes.

It's also interesting to note that ethylene gas is a byproduct of combustion engines, so using electric forklifts rather than gas-powered ones can help reduce the presence of the gas. Trucks and gas forklifts should not be left idling near fresh produce, and proper ventilation of storage areas is another important factor.

## Turning to Materials Science Solutions

Beyond these process lessons and improvements, there have been several advances made in the field of ethylene management over the years.

Modified Atmosphere Packaging (MAP) is a technique in which fruits and vegetables are allowed to respire in a more enclosed environment, to slow their respiration rate. Membranes are used to allow some carbon dioxide to escape and some oxygen to enter. But for many ethylene-producing foods, MAP becomes a more tricky issue, as ethylene buildup can occur. Allowing the growth hormone to stay while lowering the oxygen is like breaking and accelerating a car at the same time. This generates confusion in the fruit's metabolic processes. Some refer to this as "fruit freak-out" as the food exhibits dramatic respiration levels and rapid degradation upon being removed from its controlled atmosphere and forced to acclimate to new environments.

Ethylene inhibitor 1-methylcyclopropene (1-MCP) is a gaseous ethylene inhibitor used in enclosed commercial environments, such as inside truck trailers, coolers. and storage facilities. 1-MCP is a chemical application that binds to the ethylene receptors on fruit surfaces. The danger here is that in many cases 1-MCP can permanently stop fruits and vegetables from ripening. That may be good for crunchy apples, but it's less desirable in the instance of hard avocados, for example. Blocking ethylene receptor sites also involves chemically spraying the produce, which can be unpopular with consumers. And it doesn't stop ethylene peel damage, like scald on pear skin, nor does it halt ethylene's involvement in the pathways of rots and molds in wounded fruit.

Ethylene-scrubbing filters, usually containing the inorganic (but toxic) compound Potassium permanganate, may also be used within cold chain storage areas as an oxidizing agent to convert ethylene into carbon dioxide and water. When using these filters, it's crucial for the oxidizing process to be fully complete as incomplete oxidation may potentially result in undesirable byproducts. And while there are various scrubber solutions on the market—some use Potassium permanganate pellets, others have ozone-based systems, and still others offer photocatalytic oxidation where UV light is used as a catalyst to break down ethylene—it's important to keep in mind that most all cannot be used in-store or at home, where more than 60 percent of waste occurs.

Recent materials science developments also provide new and effective deterrents against ethylene-induced ripening.

For example, It'sFresh! has developed an ethylene adsorption sheet capable of extending natural shelf life and the quality of fresh produce by up to three extra days in-store and at home. The paper-thin sheet, which can be inserted into fruit and vegetables crates and containers, includes a patented mixture of minerals and clay designed to capture ethylene and minimize ripening and other damaging effects. The sheet acts as a "scavenger"-type method that seeks out, adsorbs, and traps nearby ethylene molecules as they are released at any stage of the supply chain from immediately upon postharvest through to the consumer's home. The technology is effective in all temperatures and atmospheres, and can be used in harmony with MAP.

The produce and retail industry's efforts to extend shelf life will obviously have great commercial benefits. Shelf-life extension increases store availability of fresh produce, offering retailers more freedom to sell their stock, thereby reducing loss of inventory and increasing sales.

Ecological sustainability is another added benefit of using the latest materials science solutions to delay the ripening process. After all, less waste means greater efficiencies and an overall reduction of agricultural inputs, such as water usage and transport emissions, over time.

## A Team Effort

Certainly, the problem of food waste will not be solved by any single technology, law or campaign. This global issue will require a multi-faceted, global solution with contributions from scientists, regulators, academics, businesses, and consumers.

However, proper ethylene management in the produce supply chain is one crucial step toward creating a more sustainable, efficient, high-quality food supply. In an era of rapid worldwide population growth alongside persistent hunger and waste, the improving technologies for combating this ripening agent are an encouraging and hopeful sign. ■

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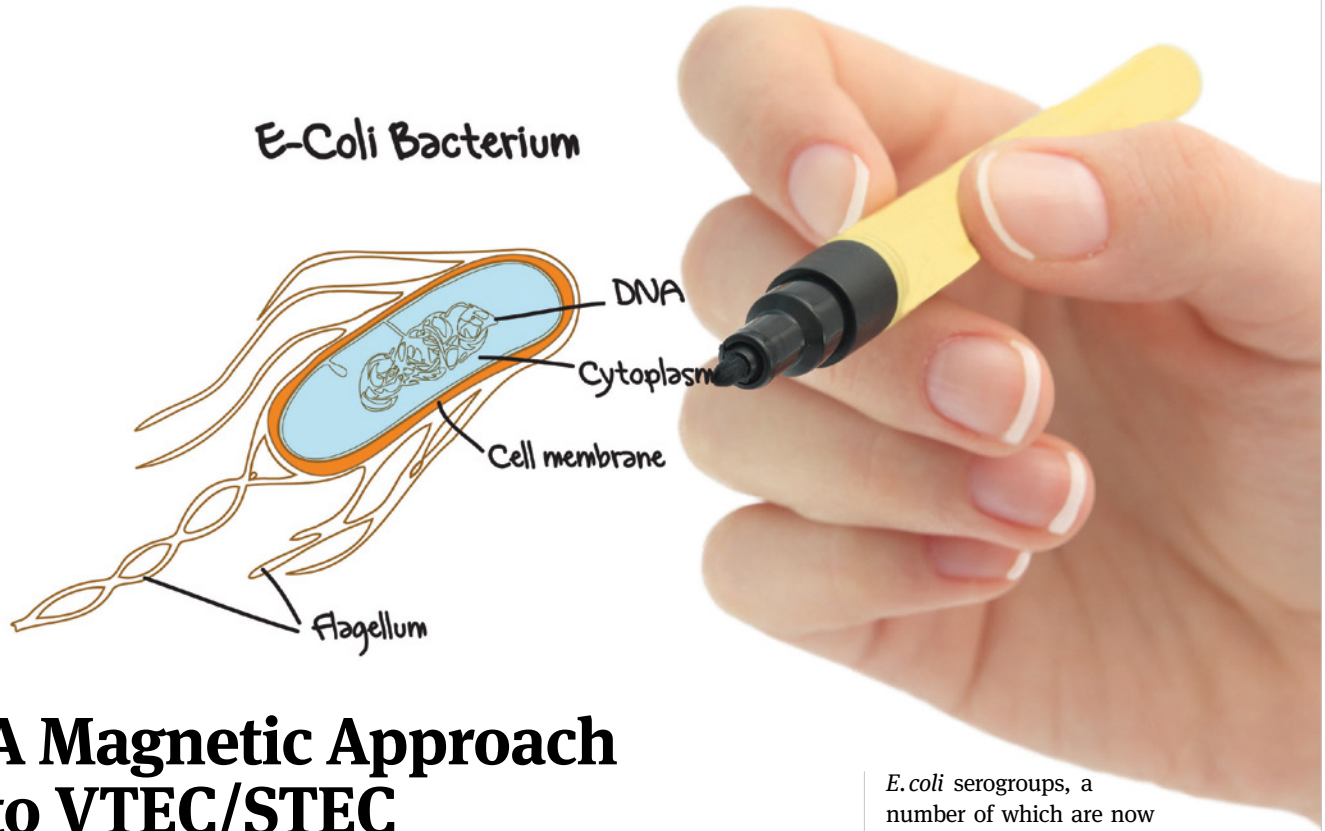


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# A Magnetic Approach to VTEC/STEC

## Examining the nature, characterization, and detection of non-O157 VTEC/STEC with a focus on immunomagnetic separation as a technique of interest

BY **CHRIS POTTER, PHD**

Non-O157 verocytotoxin-producing *E. coli* (VTEC)/Shiga toxin-producing *E. coli* (STEC) are organisms of significant and growing public health concern because of their ability to cause extremely severe illness and their high potential for foodborne transmission. Increasing regulation in the U.S. and in Europe now requires rigorous testing at various stages of food production processes. It is therefore timely to examine the nature, characterization, and detection of these organisms. Especially noteworthy is the reemergence of immunomagnetic separation (IMS) as a technique of interest. IMS is now written into USDA methodology for the detection and isolation of non-O157 STEC in meat products, alongside real-time polymerase chain reaction (PCR)-based testing, and so we are seeing a renewed emphasis on its use.

### Infection Risks

Used interchangeably, the terms VTEC and STEC refer to pathogenic strains of the organism that can cause not only diarrhea but also more severe disease in humans, including haemorrhagic colitis and haemolytic uremic syndrome (HUS). These bacteria are of several different *E. coli* serogroups, a number of which are now firmly associated with the risk of serious illness in vulnerable individuals and populations.

The most commonly identified VTEC/STEC strain is *E. coli* O157:H7. Often referred to simply as O157, this organism has been recognized as a foodborne pathogen since the early 1980s. It follows that much of what is known about STEC comes from studies of *E. coli* O157 infection, but over the years other "non-O157" STEC serogroups have continued to emerge as important causes of disease.

### STEC Characterization

The characteristics that are used to define STECs are their serotype, virulence factors, and biochemical profile. This latter relates to their phenotypic expression on diagnostic media and the biochemical similarities of many non-O157 STECs presents challenges when it comes to their isolation and identification.

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Immunomagnetic separation can be a powerful sorting process.

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Serotyping has a key role in the study of *E. coli* and follows a modified version of a scheme set out by Kauffmann in the 1940s. According to this scheme, *E. coli* are serotyped on the basis of their O (somatic), H (flagellar), and K (capsular) surface antigen profiles. The O antigen is the O-specific polysaccharide of the cell wall (LPS). A total of 178 different O antigens (O1 – O181), each defining a serogroup, are currently recognized and a further six have been demonstrated. A specific combination of O and H antigens defines the serotype of an isolate.

The main virulence genes for STEC are the Shiga toxin-encoding *stx1* and *stx2* genes, and the *eae* gene which encodes the intimin protein. Shiga toxin acts by shutting down cellular protein synthesis in target cells, including vascular epithelium where it can affect small blood vessels, such as those in the gastrointestinal tract and the kidneys, with potentially devastating consequences. The intimin protein is expressed on the bacterial cell surface and has a role in attaching to and effacing cell membranes.

## Emerging Requirements

Six non-O157 STECs were identified in a study at the CDC as being responsible for around 70 percent of non-O157 STEC infections in the U.S. over a 19-year period. In the U.S., the presence of these six is now prohibited in certain meats. Producers of ground beef, for example, for use in the U.S., are now required to test for *E. coli* O26, O45, O103, O111, O121, and O145 (the "big six"), as well as for *E. coli* O157:H7. As defined within USDA policy, these are classified as adulterants in raw non-intact beef and beef products and the USDA has issued a protocol for testing.

In Europe, an area of major concern is contamination in fresh sprouted seeds. This follows an outbreak of severe illness in 2011 for which the causative organism was found to be *E. coli* O104:H4, a serotype not previously associated with foodborne illness. Draft amendments to European Commission regulation (EC) No. 2073/2005 on microbiological criteria for foodstuffs will require the absence (in 25 grams of sprouted seeds) of STEC O157, O26, O111, O103, O145, and O104:H4. This regulation references the test protocols described in international standard ISO/TS 1316:2012: Microbiology of food and animal feed—PCR-based method for the detection of foodborne pathogens—Horizontal method for the detection of STEC and the determination of O157, O111, O26, O103, and O145 serogroups.

## Distinguishing STECs

While routine testing for *E. coli* may be standard throughout the food industry, rapidly identifying non-O157 STEC strains has brought some new challenges, primarily because many are biochemically indistinct from other *E. coli*. Although there is a wide choice of both conventional and chromogenic media available for the isolation and culture of *E. coli* O157:H7, on their own most do not enable non-O157 serotypes to be distinguished. A more targeted approach is therefore needed and this is bringing together molecular methods and more traditional microbiological testing techniques.

The USDA protocol for the detection and isolation of the proscribed non-O157 STECs sets out the use of real-time PCR for the detection of *stx1*, *stx2*, and *eae* genes followed by the detection of serogroup-specific genes. Any samples testing positive for *stx* and *eae* gene sequences as well as any serogroup-specific genes are subjected to serogroup-specific enrichment using IMS. Here beads coated with the appropriate serogroup-specific antibodies, as indicated from the PCR testing, are used and the resulting IMS concentrate is plated to an appropriate selective chromogenic medium. Resulting colonies are subjected to confirmatory serological, PCR, and biochemical testing.

Applying IMS to the sample allows concentration of target organisms while removing non-target cells, so improving the chances of E.coli O157:H7 isolation.

While the USDA protocol includes an immunocapture step alongside PCR, the ISO protocol specifies enrichment broth or serogroup-specific enrichment, e.g. IMS.

## Resurgence of IMS

Immunomagnetic separation is an established technique that is in effect a powerful sorting process. It involves the use of antibody-coated super paramagnetic particles and can be used in a number of different biological applications. As part of microbiology test protocols, it is generally there to help concentrate target organisms.

Once mixed with a sample, the antibody-coated beads bind to cell surface antigens forming an antibody-antigen complex between the bead and the target organism, thus capturing the target cell. The beads are then simply pulled out of suspension using a magnetic concentrator. Wash steps remove any nonspecifically

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bound material and the resulting bead concentrate is plated to a suitable medium or, depending on the application, is subjected to other testing.

A number of factors influence the effectiveness of this process. The robustness of the physical separation system itself is important, but the choice of antibody perhaps more so. Criteria for success include a highly specific and stable antibody (in this case targeted towards the O serogroup-specific antigen) that binds well to the surface of the bead, and that also demonstrates high avidity and affinity for the target antigen.

## Enhancing Conventional Culture

Despite the availability of a range of effective culture media for *E.coli* O157:H7, IMS also has a role in speeding up the isolation of this important organism. When culturing the sorbitol-negative O157 on conventional media, overgrowth of more numerous sorbitol-fermenting *E.coli* may obscure the colonies of interest. Applying IMS to the sample allows concentration of target organisms while removing non-target cells, so improving the chances of *E.coli* O157:H7 isolation.

## A Look Ahead

It is to be expected that future STEC testing will see a progressive move towards PCR or comparable rapid method technologies. These however will still require efficient enrichment broths to generate sufficient assay target for successful detection. In addition there will remain a need to isolate viable cells from enrichment cultures to enable the confirmation of presumptive positive isolates. It is anticipated that future developments in chromogenic plating media will allow enhanced differentiation of STEC by conventional culture methods and assist in this isolation. The efficient concentration and specificity that IMS can achieve will continue to make this a method of choice for this testing regime. ■

**Dr. Potter,** a microbiologist at Lab M with many years' experience in high level academic research at leading U.K. universities, is head of research and development. Reach him at Chris.Potter@labm.com.

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# Add Some Color!

## Best practices in implementing a color-coding system for food safety

BY **CRISTAL GARRISON**

With the signing of the Food Safety and Modernization Act (FSMA), many food processors have been taking a critical look at their production practices and looking for solutions to further enhance food safety procedures throughout their facilities. Many are considering or have already instituted some form of color coding of tools and equipment to help manage their food safety risks.

Color coding can help maintain hygienic standards and mitigate cross-contamination throughout a food processing facility by creating a clear distinction between tools that should be stored and used in designated areas. An effective color-coding system can support a food processor's current Good Manufacturing Practices (cGMPs) because by assigning tool and location colors, one can easily designate safe, appropriate areas for food contact tools to be stored, cleaned, and sanitized. Color coding may also be outlined in the written food safety plan for the operation.

GMPs, as part of a food safety plan, are outlined by the FDA in Title 21 of the Code of Federal Regulations, Part 110 (21CFR110): *GMPs describe the methods, equipment, facilities, and controls for producing processed food. As the minimum sanitary and processing requirements for producing safe and wholesome food, they are an important part of regulatory control over the safety of the nation's food supply. GMPs also serve as one basis for FDA inspections.*

To this end, good organization of tools via color coding not only demonstrates the effectiveness of a food safety plan, but can also make a good impression with inspecting authorities.

Many food processors have gone the extra step to apply color coding in the development and implementation of their Hazard Analysis and Critical Control Point (HACCP) Plans—those plans that manage the analysis and control of biological, chemical, and physical hazards from the time raw materials enter their facilities to when their finished products are completed. Under FSMA, eventually all regulated food companies will be required to have a written food safety plan or HACCP plan.

At the same time, some food processors are borrowing the principles of Lean Manufacturing's 5S System as a way to organize their workplaces and maintain equipment standards.

Regardless of the system considered, food safety should be of paramount importance in the development or revision of a color-coding system. Simply instituting a color-coding program does not in itself ensure the purity and quality of the finished food products, nor does it assure easy adoption by processing personnel. As with anything, there's a right way and wrong way to apply color coding to food processing. This article will address some basic color-coding best practices aimed at achieving optimal results.

### Determining Critical Food Safety Factors

First, determine the critical factors within your processing facility that should be controlled with color coding. The core objective of color coding within a food processing facility is to clearly establish areas where tool and equipment control is critical in maintaining sanitary conditions, and to clearly and effectively communicate the use areas of tools and equipment for personnel to control food safety risks throughout a facility. Thus, the first step in developing an effective color-coding program is to determine those factors that are critical in maintaining a safe food operation.

For example, in a facility where raw meat is processed and cross-contamination is a concern, one would not want the tools that touch raw meat to also be used on the final ready-to-eat product. One food manufacturing facility may be concerned with controlling the risk of pathogens (e.g., *Salmonella*, *E. coli*, *Listeria*, etc.), while another processor may worry about cross-contamination of common allergens (e.g., peanuts, eggs, milk, soy, etc.) within their processing facility.

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**It's recommended that color-coded storage racks coordinate with the color of the tools and not touch the walls or floors.**

That's why color coding is often applied to a food processing operation based on sanitation zones. It is critical that the cleaning of a production environment be

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effective and that the movement of ingredients, personnel, and materials be controlled throughout the environments in a facility. Sanitation zones are defined as: Zone 1—Food contact areas (e.g., utensils, conveyor surfaces, people's hands/feet, hoses, and items that can come in contact with Zone 1); Zone 2—Non-food contact areas (e.g., equipment panels, aprons, conveyor rollers); Zone 3—Non-food contact areas adjacent to food contact areas (e.g., processing area drains, equipment frames, table legs, and floors); and Zone 4—Remote and/or non-food processing (e.g., non-processing area drains, doorways, walls, and hand-wash stations).

Under this zone-based scenario, let's suppose there's a color-coding program for a candy manufacturer. The area of the facility that produces chocolate bars may be designated red, while the area that produces peanut clusters may be designated blue. Then, within each designated area, there may be color assignments based on sanitation zones. For instance, in the chocolate bar area, the equipment and tools within each zone could be: Zone 1—Red (same as area zone color), Zone 2 —Yellow, Zone 3—Green, and Zone 4—Orange. Note, the color assignments mentioned in this article are strictly examples to demonstrate the concept of color coding. Color assignments are not standardized, as each company will choose colors that best suit their product, process, facility, and company objectives. For example, a meat processor for use in direct food contact areas may select white tools, while a processor of flour or white gravy would likely choose a different color, such as blue.

## Intuitiveness

Second, make sure your color-coding system is intuitive. This may be the most important advice in developing an effective color-coding program. Too often food processors will designate a different color for every tiny aspect of their food operation, resulting in a myriad of colors. The key is to keep your color-coding assignments *simple*. Do not over complicate your system with too many colors.

Once you develop a draft of your color-coding plan, it's a good idea to take a step back and look at the color assignments with fresh eyes. Better yet, ask someone outside of your development team to review the plan and see if they understand where each color should be used. If the system doesn't immediately make sense, you run the risk of it not being successful.

When considering a color-coding system, it's also suggested to involve key managers and personnel within your organization to help with its development. A typical team may include plant manager, quality assurance manager, engineering manager, line supervisor, maintenance manager, sanitation manager, and shipping and receiving manager. In addition, if you have someone in charge of maintaining your HACCP plan, then that person may also be included. Don't discount the importance of gathering input from production line employees who will actually be using the

*(Continued on p. 48)*

(Continued from p. 47)

color-coded tools. Their input can be invaluable in helping to identify colors that should or shouldn't be used (e.g., taking into consideration employees who may be color blind and/or not capable of differentiating between certain colors).

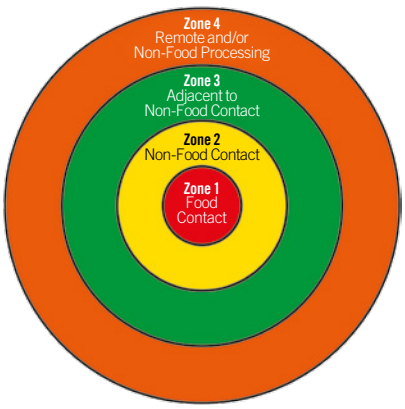
Assuming your color assignments are easily understood, it's important to properly communicate the details of your color-coding system to your employees. Employees should be instructed on why the program is important and how it should work. They also need to be trained on what to do when a breach in the system occurs. The entire company should be on board with your program's objective and support it in daily practice.

Here are some other common-sense tips for an intuitive color-coding program:

- ***Contrast the food being produced.*** For example, a processor of tomato sauces would most likely want to stay away from using red tools in direct contact with food products. Should a red hand tool, for instance, fall into a mixing vat or tank of tomatoes being processed into spaghetti sauce, it would be difficult to quickly identify it and ensure the tool, in its entirety, was retrieved from the food product.
- ***Maintain consistency.*** Be consistent with how you apply your colors. Tools and equipment, as well as walls, floors, and clothing should be considered. If different departments implement more than one color-coding scheme without consultation with each other, it is likely that all of the schemes will fail due to confusion. The application of each color selected should be unique and identify the areas in a process where the risk to be controlled is apparent. The color should be acknowledged by all color-coding schemes and used consistently regardless of the time or place the color may be encountered.
- ***Match storage unit and tool colors.*** Mitigating cross-contamination within a food processing facility is further enhanced with proper tool storage. It's recommended that color-coded storage racks coordinate with the color of the tools stored in each area. Proper tool storage also means tools should not touch walls or floors to maintain sanitary condition and further mitigate cross-contamination and assure food safety.
- ***Reinforce your color-coding program with proper signage.*** The more you can communicate with your employees to assure that color-coding standards are followed, the more effective the program will be.

## Accessing Proper Tools

Third, choose the right equipment and tools for your color-coding program. As you embark on developing a color-coding program, you shouldn't have to go it alone. You should be able to lean on your suppliers to help develop and implement a color-coding plan and supply the proper tools. Look to suppliers who have a track record of developing successful color-coding programs for food processors. Seek out companies with the expertise and an extensive product line to partner with you in implementing a color-coding system tailored to your specific operation. Similar to the consultative approach taken by many chemical companies, expect your tool supplier to also provide a certain level of service and advise you on the proper use of their products.




Sanitation zone "targets" with different colors for each zone.

As you procure color-coded tools and equipment for your facility, note that not all color-coded implements are the same. Look for tools and equipment that are hygienically designed and made for the specific tasks within your facility. Most important, consider tools that are intended for a color-coding program in a food manufacturing environment. These are tools that are all one color (with matching blocks and bristles) to help avoid any confusion among employees. (Note, labeling or painting tools as a way of identification is not recommended as these additions introduce new hazards into the manufacturing process.)

Your color-coded tools should also carry proper documentation showing that they are made from materials that meet FDA standards for food contact. A tool supplier should be able to provide this documentation. Ask your tool supplier for the appropriate documentation and if they can't provide it, you may want to consider another supplier who can.

## Assessment

Fourth, review your color-coding program regularly to assure its effectiveness. Implementing a color-coding system is one thing. Maintaining its effectiveness is quite another. Review your food safety program on an ongoing basis, which should include your color-coding designations. Whether it's once a month, once a quarter, or every week if necessary, diligent maintenance of your food safety program is paramount in minimizing food safety risks. This means regularly replacing tools when they start to show wear (i.e., tools that are discolored to the point that they are no longer matching your color-code scheme, have worn or poorly maintained bristles, etc.). It might also include reinforcing your program with ongoing employee training. Your color-coding team may also wish to regularly convene to reevaluate color assignments whenever something changes (e.g., you add a new piece of equipment that crosses sanitation zones).

## Conclusion

Color coding can be a successful system used to assist companies in conforming to food safety regulations and ensure the quality of processed foods. By following these best practices, food processors can ensure proper hygiene and reduce the risks of cross-contamination. In the end, the best color-coding systems are all about keeping it simple, clean, and maintained with tools that carry proper documentation. ■

**Garrison** is director of training and development for Remco Products Corp. She is a member of NEHA, IEHA, IAFP, AFDO, and holds certifications from the National Registry of Food Safety Professionals, International HACCP Alliance, and AIB. Reach her at cgarrison@remcoproducts.com.

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# NEW PRODUCTS

### Rapid 'Indicator Organism' Testing

MOCON has added rapid "indicator organism" testing capability to its GreenLight microbial detection platform, thereby reducing test time up to 60 percent, according to the company. In addition to the previously available total count testing capability, the GreenLight system now is able to simultaneously test for Enterobacteriaceae and total coliform counts using an oxygen depletion sensor and automated reader. Target applications include dairy, cheese, and meat, as well as sanitation initiatives. **MOCON, Inc., 763-493-6370, www.microbialdetection.com.**

### Food Traceability System

Traceability Plus provides retailers with near real-time monitoring of their supply chain. It's comprised of three components. First, the Digital Traceability System lets companies at each step in the supply chain securely record and share structured data. Second, Data Check module automatically monitors and analyzes structured data as it's recorded into the Digital Traceability System. It enables users to write rules against which they want the data to be checked. Third, the Marketing Module can educate consumers and buyers by sharing specific product details such as the exact farmer, fisherman, forager-harvester, or food manufacturer who delivered a product to market. **Trace Register, 206-621-1601, www.traceregister.com.**

### PCR Workstations

The AC600 Series PCR workstations are designed as application solutions for the manipulation and amplification of DNA and RNA. They are available in 24-in., 32-in., and 48-in. widths. Features include built-in 254 nm UV lights for irradiation and HEPA filtration. Standard on 32-in. and 48-in. wide models, the UVTect Microprocessor Controller maintains airflow to provide a clean Class 100 work area during PCR preparation. UVTect provides audible and visible alarms to alert the end user of insufficient airflow, UV bulb changes, and HEPA filter changes. **AirClean Systems, 800-849-0472, www.aircleansystems.com.**

### Simple Microbial Tests

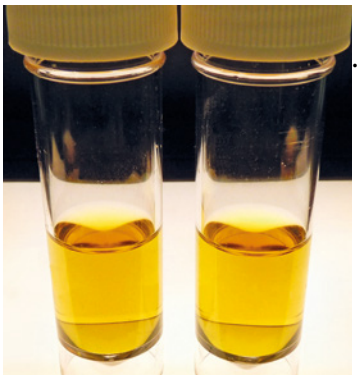
NeoFilm microbial tests require only the inoculation of a fabric sample pad and an incubation period. Following incubation, the sample pad is evaluated for bacterial colony growth. NeoFilm tests are available for coliforms, *E. coli,* yeast and mold, *Staphylococcus aureus,* and aerobic bacteria. The test films are color-coded for easy identification, and the required incubation time is printed right on the test to simplify the procedure for the technician. Test films can be stacked as they are inoculated. NeoFilm requires no "spreader" and there is no gelling or set-up time. **Neogen Corp., 800-234-5333, www.neogen.com.**

### Horizontal Beam X-ray System

The Xpert S400 is engineered to detect metal, glass, dense plastics, and other foreign objects in vertically-oriented containers such as metal cans, plastic bottles, cartons, and standup pouches. Its compact length enables placement into tight production spaces and the X-ray source/detector height easily adjusts to match the customer's conveyor passing through the inspection tunnel. Specific software algorithms developed for tall profile packages look for contaminants in problem areas such as package edges, bottom center, and top. **Thermo Fisher Scientific Inc., 763-783-2500, www.thermoscientific.com/productinspection.**

### Enrichment Broth

Listeria Express Enrichment (LEE) Broth enhances the expression of target antigens for most commercially available immunological test methods whilst maintaining suppression of non-target organisms. According to the company, the key to the efficacy and convenience of LEE Broth is the blending of selective components directly into the medium, eliminating any need for supplementation. LEE Broth is formulated to stimulate growth from low numbers of organisms in the original sample to achieve the high levels required for further testing within a 24-hour incubation period. **Lab M, www.labm.com.**



## In Other Product News

**The Texture Pro CT software from Brookfield Engineering is now 21CFR Part 11 compliant.**

**Union Jack now offers a new line of industrial water nozzles made by Columbia Products.**

**Invisible Sentinel partners with Jackson Family Wines on a rapid diagnostic to detect Brettanomyces, a wine spoiling yeast.**

**3M Food Safety's Petrifilm Rapid Yeast and Mold Count Plate receives AOAC-PTM approval.**

**Eppendorf North America launches five new models to ep*Motion* range of automated pipetting systems—ep*Motion* 5075 systems are used for automated liquid handling applications.**

# Laboratory Equipment: Traceability and Throughput, Driven by FSMA

## The right tools and services can keep labs running smoothly

By **Gina Shaw**

Traceability mandates from the Food Safety Modernization Act, which has finally been given more or less complete life as the FDA has issued most of its proposed regulations, are a big driver of technology choices in laboratory equipment for food safety, say industry representatives.

"People are looking more rigorously at testing," says Paula De Oliveira, marketing manager, food and environmental markets for Thermo Fisher Scientific. "They want computer systems that are better able to help them keep track of their products and sample results, manage vendors and many of different pieces of data so that if the need arises, they can easily access that data for purposes of an audit or a recall."

In regards to microbiology, the push is always toward solutions that give a faster result, with polymerase chain reaction still dominating. "On the chemical analysis side, whereas in the past a lab may have been satisfied with a single quadrupole mass spectrometer, these days people are looking more for triple quad technology," says the Thermo Fisher spokesperson. "Laws are getting more stringent in terms of what you can have in terms of chemical residue, and the newer technologies can make complying with those requirements easier," De Oliveira says. Triple quadrupole systems offer higher selectivity, better signal-to-noise ratios, and better accuracy and reproducibility, particularly at lower concentrations.

When it comes to sample preparation, microwave technology is meeting a growing demand for higher throughput, says Robert Walker, product manager for the analytical division at CEM. Concerns about mercury in ocean fish, on the wane for a time, has led to a higher demand for mercury sample preparation as consumers try to eat healthier.

Other areas of increasing interest for product testing include nutritional supplements sourced from overseas. "There is concern about lead, arsenic, cadmium, and mercury in 'nutraceuticals' from places like China," Walker says. Packaging is also a growing area of concern. "I went to a packaging show in November, and there are more and more worries about anything migrating from the packing material to the foodstuff, especially if it's stored at temperatures hotter than those recommended." ■

**Shaw** is a writer for *Food Quality & Safety's* eUpdate enewsletter. She also writes frequently about science, medicine, and health while serving as a regular contributor on notable medical publications. Reach her at ginashaw@vagabondmedia.com.

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*(Continued on p. 52)*

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**24-27**
**4-Day Low Acid Foods Workshop**
Orange, Calif.
Visit www.chapman.edu/bpcs or call 714-997-6566.

### APRIL

**24-25**
**JIFSAN Annual Spring Symposium: "The Case of Avoiding RISK: Truth or Consequences"**
Beltsville, Md.
Visit tinyurl.com/jifac14registration or call 301-405-8382.

**28-1**
**Fundamentals of Food Science Short Course**
University Park, Penn.
Visit http://agsci.psu.edu/fundamentals or call 877-778-2937.

**29-30**
**Dairy Plant Food Safety Workshop**
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# Honoring Outstanding Commitment to Food Protection

## The 13th annual Food Quality & Safety Award to be presented at 2014 Food Safety Summit Conference & Expo

The redesigned Award trophy.


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Members of last year's winner Taylor Farms pictured with associates from the Award sponsor DuPont.
*From left to right on top row:* Doris Engesser-Sudlow, DuPont; Cosme Pina, Taylor Farms; Angelica Estrada, Taylor Farms; Letty Zavala, Taylor Farms; and Jason Kawata, Taylor Farms.
*From left to right on bottom row:* Hector Chappa, Taylor Farms; Martin Alfaro, Taylor Farms; Mark Borman, Taylor Farms; and Dave Charest, DuPont.

Sponsored by DuPont Nutrition & Health and presented by *Food Quality & Safety* magazine, the Food Quality & Safety Award honors the dedication and achievement of a North American food processor, food service, or food retailer that has made significant improvements in safety and consumer satisfaction with a positive impact on business results.

The 13th annual Award trophy, which has been redesigned with a sleek new look, will be presented to this year's winner on April 9 at a special reception and ceremony hosted by DuPont Nutrition & Health during the Food Safety Summit Conference & Expo in Baltimore, Md., scheduled from April 8 to April 10.

Last year's Award winner Taylor Farms, a producer of value-added fresh vegetables in Salinas, Calif., was selected for its commitment to food protection through innovation, research, and employee training. Its patented SmartWash technology removes cross contamination, reduces failures in food safety practices, and ensures quality. Mark Borman, president, and Jason Kawata, director of quality assurance, accepted the Award on behalf of their team during the ceremony.

"With the most advanced fresh cut processing plants in the world, combined with our investments in state-of-the-art processing facilities, our customers know they can trust us to provide fresh, safe, and high-quality produce," said Borman.

The Award presentation is part of the Summit's focus on educational and informational activities for the food industry. For the second year in a row, it will be held at the Baltimore Convention Center. This year's keynote presentation will feature Ed Lonergan, CEO of Chiquita Brands, and Don Zietlow, CEO of Kwik Trip, Inc., as the speakers.

After the keynote, attendees can learn the top strategies on how to work more effectively with C-suite/senior management in a follow-up session with a panel of leading food safety professionals, including Dr. Jay L.E. Ellingson, corporate director food safety and quality, Kwik Trip, and Courtney Parker, PhD, vice president quality and food safety, Chiquita Brands.

To view the entire Summit schedule, go to www.foodsafetysummit.com. And don't forget to celebrate this year's Award winner at the April 9 reception, open to all registered Summit attendees! ■

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# SCIENTIFIC FINDINGS

For access to complete articles mentioned below, go to the "Scientific Findings" section of the February/March issue at www.foodquality.com.

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### ARTICLE: Potential Utility of High-Pressure Processing to Address the Risk of Food Allergen Concerns

In recent years, researchers have actively sought processing methods that reduce the allergenicity of food allergens. This study describes the effects of the current high-pressure processing technology on allergen activity. Also discussed are topics such as the induction of protein denaturation, the change in protein conformation, allergen removal using high-pressure extraction technology, and the promotion of enzymatic hydrolysis to alter the sensitization of the allergens. ***Comprehensive Reviews in Food Science and Food Safety.*** **Volume 13, Issue 1, pages 78–90, January 2014.**

### ARTICLE: Assessing Knowledge and Attitudes of U.S. Healthcare Providers about Benefits and Risks of Consuming Seafood

An online needs assessment survey of healthcare providers was developed to determine knowledge and attitudes about the benefits and risks of consuming seafood. The survey found that understanding of seafood safety and contaminants was low. While the majority of healthcare respondents knew the correct recommendation for seafood meals per week, they failed to identify the groups that were targeted by the FDA/EPA advisory about seafood and mercury and therefore could be providing inaccurate information. ***Journal of Food Science Education.*** **Volume 12, Issue 4, pages 75–80, September 2013.**

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### ARTICLE: The Influence of Starch Pasting Properties and Grain Protein Content on Water Uptake in Barley

Steeping is the first operation of malting and its purpose is to increase the water content of the grain up to 43 percent to 46 percent; however, such a simple step encompasses several metabolic processes that affect germination and the final malt quality. The aim of this study was to evaluate the effect of initial grain protein content and starch pasting properties, measured using the Rapid Visco Analyser on water uptake in different barley varieties. ***Journal of the Institute of Brewing.*** **Volume 120, Issue 1, pages 38–44, 2014.**

### ARTICLE: A Novel On-Package Sticker Sensor Based on Methyl Red for Real-Time Monitoring of Broiler Chicken Cut Freshness

Reliable methods for assessing the freshness of meat would benefit both consumers and the meat industry. As a result, a novel sticker sensor was constructed based on methyl red, and tests conducted to detect the freshness of broiler chicken cuts. Methyl red was immobilized onto a bacterial cellulose membrane via absorption method. The methyl red/cellulose membrane as a freshness sensor worked based on pH increase as the basic spoilage volatile amines produced gradually in the package headspace, and subsequently, the color of the sensor will change from red to yellow for spoilage indication, easily visible to the naked eye. ***Packaging Technology and Science.*** **Volume 27, Issue 1, pages 69–81, January 2014.**

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