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Volume 20 Number 3
JUNE/JULY 2013

Food Quality & Safety

FARM TO FORK SAFETY

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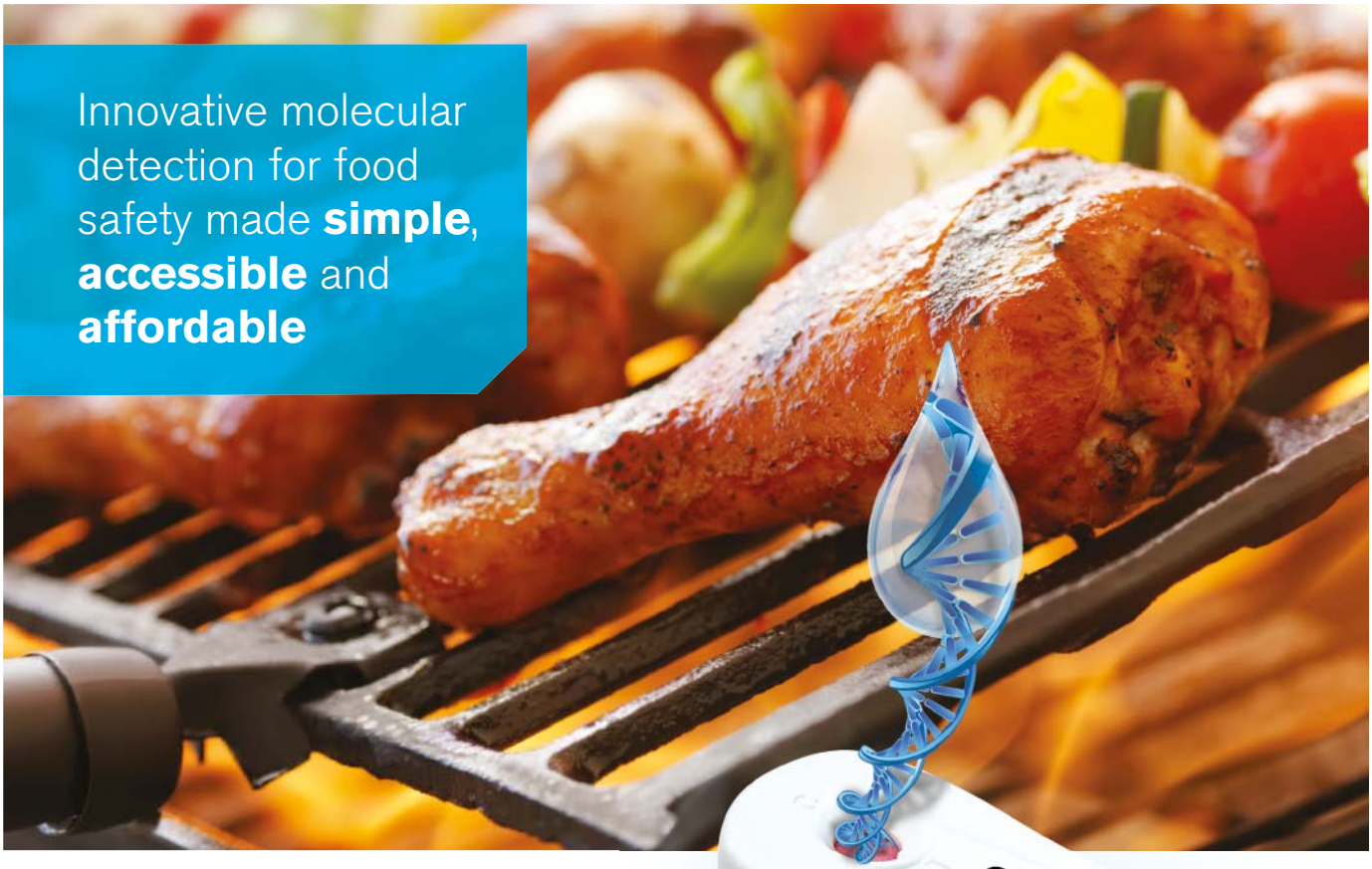

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Contents

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Features

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Features cont.

Safety & Sanitation

Testing

Quality

In The Lab

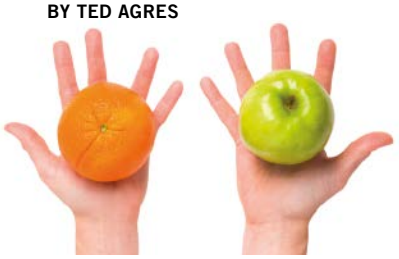
Manufacturing & Distribution

Equipment

Food Service & Retail

Columns

Washington Report



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From The Editor

Welcome to our celebratory 20th anniversary issue! This issue marks the introduction of a few new names. Let's start with me, Marian Zboraj–the new editor. I join the magazine with over a decade's worth of editorial experience in publishing, however I'm fairly new to the food safety and quality arena. Fortunately, I've recently been able to attend two major industry events: the Global Food Safety Conference in Barcelona and the Food Safety Summit in Baltimore, both of which opened my eyes to key issues and trends in the industry. One topic on everyone's minds at both events was the "Era of Globalization." The globalization of our food supply has no doubt complicated efforts to ensure its safety and quality. Consequently, food safety has become a joint responsibility. In fact, in his keynote presentation at the Food Safety Summit, Earthbound Farms' Will Daniels, sr. vice president of operations and organic integrity, challenged everyone in the audience to make a pledge to find a common ground on Trust, Transparency, and Collaboration. This calls for industry, academia, and government agencies to develop effective ways to share information.

Food Quality & Safety will continue to do its part in reporting on important topics, which brings me to the second new name. This issue is the debut of the publication's official name change to *Food Quality & Safety*. For 20 years, *Food Quality* has indeed always encompassed safety; the new name simply puts it at the forefront to make it more apparent on what the publication is all about.

In addition to an editor and a name change, a Facebook page (www.facebook.com/FoodQualityandSafety) is now available so you can stay connected to the latest news and join in on discussions that interest you. The Editorial Advisory Panel has also been updated to help ensure *Food Quality & Safety*'s content stays relevant. In fact, some of the members are featured in this issue's special cover story, sharing their thoughts on food safety's past and future.

I'm honored to be joining *Food Quality & Safety* at such an exciting time and I hope to continue to share valuable content to you during the magazine's next 20 years!

Marian Zboraj
Editor

Food Quality & Safety
FARM TO FORK SAFETY

PUBLISHING DIRECTOR Heiko Baumgartner, hbaumgar@wiley.com
ASSOCIATE PUBLISHER Ken Potuznik, kpotuznik@wiley.com
EDITOR Marian Zboraj, mzboraj@wiley.com
DESIGN Maria Ender, mender@wiley.com
PRODUCTION Claudia Vogel, cvogel@wiley.com
Christiane Potthast, cpotthast@wiley.com
Elli Palzer, palzer@wiley.com

Advertising Sales Manager
Sciences, Corporate Sales, Americas
Joe Tomaszewski
111 River St. 8-01
Hoboken, NJ 07030-5774
(201) 748-8895 • Cell: (908) 514-0776
jtomaszews@wiley.com

Sales Office
U.S./Canada/International
Ken Potuznik
29822 N 51st Place, Cave Creek, AZ 85331
(480) 419-1851 • fax (480) 718-7719
kpotuzni@wiley.com

Editorial Office
111 River Street, Hoboken, NJ 07030-5774, USA

Reprints: E-mail labelson@optonline.net
Editorial Submissions: E-mail mzboraj@wiley.com

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Be prepared as the new Food Safety Modernization Act (FSMA) requirements come online for documentation and traceability.

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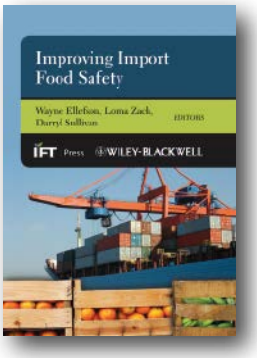


Improving Import Food Safety

Published by Wiley-Blackwell, the recently released *Improving Import Food Safety* book gathers together vital information on the food safety programs of national governments, the food industry, and the testing industry. Chapters have been contributed by authors from the U.S., Latin America, Europe, and Asia. Readers will learn about a variety of regulatory approaches to food safety at the federal and state levels in the U.S., as well as in selected countries and within the food industry itself. They will also gain insights into the nature and source of safety problems, in addition to approaches to food safety around the world.

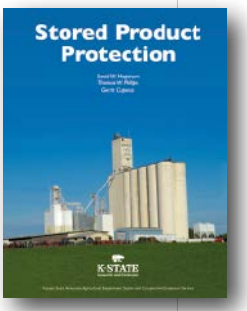
Online CORE HACCP Series

CERT ID is offering CORE HACCP online courses that are recognized by the International HACCP Alliance. These self-paced courses are ideal for HACCP team leaders, team members, or anyone responsible for monitoring and verification activities required to maintain a HACCP plan. CERT ID CORE HACCP helps students quickly understand what they can do to identify and control the possible food safety hazards that might impact the safety and quality of finished products. A few learning objectives include understanding how Good Manufacturing Practices support a successful HACCP plan, and learning what documents are required for a HACCP plan and how to write them in plain English. Course information is available on the new CERT ID online shop (www.cert-id.com/Online-Shop.aspx).

Pollution Insurance Protection

To recover from accidental ammonia discharges, pathogen contamination, or wastewater treatment gone awry, the food and beverage industry now has a new pollution insurance policy option from XL Group's Environmental team that helps address environmental liability, cleanup, and disaster response concerns. XL Group's Environmental Food and Beverage Industry policy adds protection for both disinfection and disaster response expenses including costs to clean and disinfect storage areas and processing equipment, disaster response advisory expenses, medical expenses, and temporary living expenses.

Best Practices for Stored Grains



Many of the world's leading experts on food and commodity storage have combined their efforts in a new publication that is available from Kansas State University. The book, *Stored Product Protection*, provides the industry's most updated guidelines for safely storing durable food (or, food not needing refrigeration) and raw commodities, as well as managing the pests that can potentially contaminate stored foods. It covers such topics as biology and ecology of insects, molds and vertebrates in storage systems; pests of grains and legumes, dried fruit and nuts; prevention and monitoring of pests; economics; regulations; marketing of stored commodities; insect-resistant packaging; and more.

GFSI Recognizes GLOBALG.A.P.'s Standards and GAA

The Global Food Safety Initiative (GFSI) has recognized the GLOBALG.A.P. North America Inc.'s (GGNA) Integrated Farm Assurance (IFA V4.0 - Fruit & Vegetables Sub-scope) and Produce Safety Standard (PSS V4.0) according to GFSI Guidance Document Sixth Edition, BI and D Scopes (Farming of Plants and Pre-Processing Handling of Plants respectively), for food safety and traceability.

In addition, the Global Aquaculture Alliance (GAA) Seafood Processing Standard Issue 2 (August 2012) has been successfully re-benchmarked by GFSI and has achieved recognition against the GFSI Guidance Document Sixth Edition.

Release of SQF Code, Edition 7.1

Edition 7.1 of the SQF Code applies to all industry sectors and replaces the SQF 2000 Code edition 6 and SQF 1000 Code edition 5. A few significant changes include the addition of the feed and pet food modules (modules 3 and 4) and the harmonized produce standard (module 7H); the requirement for auditors to review the entire facility, regardless of the scope of certification (Part A, 2.7); the addition of a requirement for facilities to report all regulatory warning letters to SQF (Part A, 5.3); and an added element that requires the facility to follow the requirements of Appendix 3: SQF Quality Shield and Logo Rules of Use (2.4.4.2). Edition 7.1 takes effect on July 1, 2013, to which the new modules will be available for use.

Business Briefs

Eurofins collaborates with **AB SCIEX** and **Phenomenex** to develop methods to analyze animal feed for the presence of antibiotic and fungicide residues. The first output of this collaboration is an application for the analysis of nine antibiotics and four insecticides in poultry feeds, covering five different antibiotic drug classes.

DuPont recently combined three of its food-related units (Danisco, Solae and Qualicon) into one business called **DuPont Nutrition & Health**. This newly organized business is dedicated to delivering premier ingredients and advanced diagnostics that help food companies deliver safer, healthier, and more nutritious food.

SAI Global Limited expands its food assurance activities with the completion of its purchase of the Supply Chain Certification Services business assets from the Steritech Group. This business offers a range of auditing, training, and other services to companies seeking to better manage food safety risks throughout their supply chains.

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Washington Report

IFT's Traceability Pilot Projects: Should All Food Be Treated Equally?

Most major food industry organizations are supporting recommendations for food traceability made to the FDA | BY **TED AGRES**

The Institute of Food Technologists' (IFT) "Pilot Projects for Improving Tracing Along the Food Supply System—Final Report" covers two food tracing projects sponsored by the FDA. In its report, the IFT recommends that the agency establish a uniform set of recordkeeping requirements for all FDA-regulated foods and not allow exemptions based on risk categories or the size of the firm involved.

In addition, the IFT recommends every company involved in the food supply chain should be required to develop, document, and exercise its own product tracing plan and to identify and maintain records of so-called key data elements (KDEs), such as lot or batch numbers, to make product tracking more efficient.

"We think these recommendations are sufficient and directly on point," says Angela Fernandez, vice president of retail and grocery for GS1 US, a member of the GS1 international supply-chain information standards organization. "The pilots validated the reality of what's happening inside of the food supply chain today. The recommendations address all of the challenges that companies are facing."

The FDA is currently accepting public comments on the 334-page report through July 3, 2013, after which it will submit its own recommendations on food traceability requirements to Congress and then prepare proposed regulations—steps required by Section 204 of the Food Safety Modernization Act (FSMA). While the law requires the FDA to establish recordkeeping requirements only for "high-risk" foods, the IFT recommends that this should be extended to all food categories because "low-risk" products can quickly become "high-risk" when an unexpected outbreak occurs.

Tomatoes, Kung Pao Dishes, and Peanut Butter

In September 2011, the FDA tasked IFT with conducting two traceability pilots, one involving produce and the other processed foods. FDA selected tomatoes for the produce test because they've been implicated in a number of significant outbreaks from 2005 to 2010 and their supply chain can be complex. The agency chose frozen Kung Pao-style dishes containing peanut products, red pepper spice, and chicken for the processed food test because they contain multiple ingredients implicated in outbreaks and they too move through a variety of supply channels. Finally, jarred peanut butter and dry, packaged peanut/spices were included "to enhance the complexity of the pilots," according to IFT.

IFT convened a group of federal, state, and local traceback investigators to establish an historical "baseline" of the time and effort involved in various investigations. In all, 45 food industry participants voluntarily submitted data to be analyzed in the pilots. IFT also selected 10 technology vendors from companies that had volunteered to showcase their capabilities using blinded pilot data. Deloitte Consulting and Auburn University helped conduct cost-benefit analyses. "This was not a laboratory experiment," recalled Jennifer McEntire, PhD, a senior director at Leavitt Partners' food safety practice who worked with IFT on the pilots and coauthored the final report. "We simply didn't have the time to ask people to implement hardware, software, or procedural changes within their facilities. We assembled a diverse group of about 45 industry members and worked with the records they had, and examined the systems they used for recordkeeping," Dr. McEntire wrote in a March 7, 2013 blog posting.

Using current technologies to analyze company-supplied data, IFT found that it was "tedious and difficult" to sort through hundreds of pages of documents. IFT also found that confusion arose when data definitions were lacking; delays occurred when item descriptions were inconsistent

or wrong or when information was incomplete; and sources were hard to identify because companies often went by different names. The pilots highlighted many areas for improvements and in its final report, submitted to the FDA in August 2012, the IFT made 10 recommendations. They include the following.

Uniform recordkeeping requirements. FDA should establish uniform recordkeeping requirements for all FDA-regulated foods and not permit exemptions based on risk classification. While FSMA restricts FDA recordkeeping requirements to high-risk foods, the IFT anticipates that confusion will arise if companies maintain different standards. GS1 US's Fernandez explains why. "If we have to maintain dual processes based on high-risk and non-high risk foods, people will have to have multiple methodologies in place. One-size-fits-all can be more efficient. It will also address future scenarios: A food is non-high risk only if it hasn't been subject to a recall. If a new non-high risk product does get recalled, we won't have to change tracing processes for it," she said. This recommendation "bubbled up" from industry itself, Dr. McEntyre adds.

Product tracing plans. FDA should require each member of the food supply chain, regardless of its size, to develop, document, and exercise a product tracing plan. While product tracing plans are currently not required by federal agencies, some companies have them as best practices, IFT says. Product tracebacks are different from product recalls in that the details of the product of interest in a traceback are not known. Having and exercising a product tracing plan "will increase the speed with which a firm can respond to an investigation and reduce the likelihood of errors," IFT says. And while FSMA limits the FDA's reach in seeking data to "one up, one back" in a company's supply chain, the IFT recommends the agency should request additional information from companies in hopes that "capable supply chain partners" will have the extra information and will make it available.

Standardized, structured, electronic recordkeeping. FDA should develop mechanisms for industry to provide key data elements (date, time, item, lot, or batch number) and critical tracking events (transportation or exchange of goods, transformation or creation or manipulation of products, and depletion or exit from system) during a specific food safety investigation. "The pilot project verified that if all the information is stored electronically, the tracing process can be sped up significantly compared to having to manually go through paper records and manifests by hand," says Ed Treacy, vice president of supply chain efficiencies at the Produce Marketing Association (PMA). "Electronic records could be Excel spreadsheets. This should not be a burden on companies as there are very few companies that do not use computers in their business," he tells *Food Quality & Safety* magazine.

Nevertheless, while having data in electronic format would be ideal, IFT believes industry shouldn't be required to maintain electronic records, especially since small and large firms have different needs and capabilities. However, providing data in a standardized and structured way may be required of all companies, says IFT. In the baseline study, most traceback records consisted of printed and handwritten documents sent by fax to regulatory agencies. In the pilot studies, most records were submitted in Adobe Acrobat pdf format. But even then, a pdf of a handwritten note could not be analyzed in a structured and standardized way, the report noted.

"The key point is, different size companies in the food chain are going to capture and hold that data in different ways," says Fernandez. "Not everyone has robust databases and electronic capabilities, but if they can make sure their records are capturing those elements around a product or transaction, however they choose to do so, that is going to help FDA when a product is identified around a possible outbreak."

Technology platform. FDA should adopt a technology platform that will allow it to aggregate and analyze data reported in response to a specific request. Such a secure platform could be a central repository of information for investigators and for other regulatory agencies. It could reduce the need for companies to send their data to multiple agencies. Because such a platform would require submissions in electronic format, it may not become a requirement, Fernandez notes. "But some of the larger and mid-size firms do have these electronic records and it could definitely help in doing a traceback," she adds.

Other recommendations. FDA should clearly identify the types of data that industry needs to provide during an outbreak investigation; coordinate traceback investigations and develop response protocols between and among state and local health and regulatory agencies; and offer extensive outreach and education around future regulations and expectations.

Costs and Benefits

The IFT report devotes 57 pages to cost-benefit analyses but determines that conclusions are not possible to draw because the pilots were narrow and represented, by definition, "an artificial view of reality." Nevertheless, the report described several companies that had instituted traceability technologies. For example, a small produce grower in Mexico who shipped 100,000 cases annually installed a barcode tracking system. First-year costs, including equipment and installation, totalled $5,500. The company estimated ongoing annual costs of about $1,500 plus a half-cent per label. "That's not bad at all," says PMA's Treacy. While other larger growers, producers, and shippers have spent anywhere from tens to thousands to millions of dollars implementing advanced control systems, these are large systems not specifically installed because of FSMA.

Overall, GS1 US, the PMA, and other members of the Produce Traceability Initiative (PTI) were highly supportive of IFT's recommendations. "Many of us in the grower/packer/shipper community are pleased to see that the IFT recommends a uniform set of recordkeeping requirements, encourages current industry-led initiatives, and suggests the development of standardized electronic mechanisms for the reporting of traceability data," said Sabrina Pokomandy, marketing and public relations manager for JemD Farms and cochair of PTI's Communications Working Group, in a statement. "These recommendations are in alignment with the goals and vision of PTI and help us move forward with industry-wide traceability implementations."

To submit comments on the IFT report, go to www.regulations.gov and enter docket number FDA-2012-N-1153-0002. Comments are accepted by July 3, 2013. ■

Agres is based in Laurel, Md. Reach him at tedagres@yahoo.com.

Industry Insights

The Implications of Food Fraud

Who's horsing around with our food and what can we do about it?

BY **KAREN EVERSTINE, PHD, MPH, AMY KIRCHER, DRPH,** AND **ELIZABETH CUNNINGHAM**

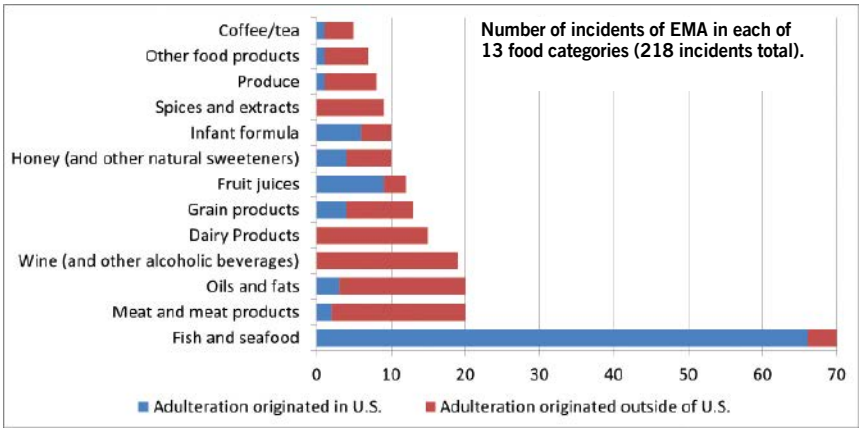
As we write this, there are more news reports every day of new products that have been found to contain horse meat in the European horse meat scandal. Horse meat substitution is unfortunately only the most recent example of food fraud, and horse isn't the only meat being substituted. According to the *Daily Mail* on February 25, seven in 10 lamb kabobs sold in British takeout restaurants were bulked up with cheaper meats. *Food Manufacture* reported on March 14 that pork DNA had been found in a school's halal chicken sausages. Yahoo! News reported that 90 percent of South African kudu (antelope) jerky was actually horse, pork, beef, giraffe, kangaroo—or even endangered mountain zebra.

Food comprises a globally distributed infrastructure, with the U.S. both importing from and exporting to more countries in food and agriculture than in any other sector. Importing large quantities of food products from other countries makes us reliant upon the food safety systems of those countries. Regulatory or quality assurance deficiencies in any part of the food supply chain can leave us vulnerable to contamination or adulteration. Increased prices can also leave the food supply vulnerable to adulteration since they can result in changes to the supply chain structure. Ensuring food safety requires identifying and mitigating potential risks along the supply chain. Food safety demands that these risks be identified and they can only be addressed if there is a good understanding of the supply chain and the product is authentic. Furthermore, the need for food defense is heightened by the globalized supply chain, and the possibility of deliberate contamination and adulteration—either with the intent to cause harm or generate extra profit. Since we cannot have complete food safety without effective food defense, food quality cannot be assured without a comprehensive food protection program that addresses both food safety and food defense.

EMA

Food fraud, or what the FDA calls economically motivated adulteration (EMA), is the intentional sale of food products that are not up to recognized standards for economic gain. This includes the addition of inferior or foreign substances to a food, dilution with water, or the intentional mislabeling of food products. Food fraud may be receiving heightened media attention in recent months, but it is an old problem that was addressed by U.S. food laws as far back as 1784. While usually harmless, some food fraud incidents have resulted in serious public health consequences, and they illustrate vulnerabilities in regulatory and quality assurance systems that could be exploited for intentional harm.

In today's environment, there is a strong financial motivation for food fraud. In the ongoing case involving six companies accused of conspiring to illegally import honey, the defendants allegedly avoided almost $80 million in anti-dumping duties by falsely declaring the country of origin. The Grocery Manufacturers Association estimates that adulterated food products cost industry 10 to 15 billion dollars a year and the problem is thought to be widespread. The Food Standards Agency of the U.K. has estimated 10 percent of the food we buy on the shelf may be adulterated. In most cases, the adulteration doesn't pose a health risk since the motivation is not intended to cause harm. Unfortunately, by not understanding their



actions, perpetrators have created risks to human and animal health.

Understanding the Scope of the Problem

Since the perpetrators of food fraud do not intend to cause health harm and know how to get around quality assurance testing methodologies, food fraud incidents frequently evade detection. This makes it challenging to know the true scope of fraud in the food supply. The National Center for Food Protection and Defense (NCFPD) has conducted an extensive literature and media search for documented incidents of food fraud since 1980. This search has resulted in over 200 isolated incidents of food fraud in many categories of products, including seafood, oils, wine, dairy products, and fruit juices (see chart above). The U.S. Pharmacopeial Convention has also compiled a food fraud database, using a different methodology (www.foodfraud.org). Both databases contribute valuable information about what is known about the history of food fraud. However, what is represented in the databases is almost certainly only the tip of the iceberg when it comes to the true scope of food fraud.

The adulteration of beef products with horse meat has fortunately not resulted in public health consequences; however, EMA is not always benign. Melamine adulteration of wheat gluten in 2007 caused illnesses and deaths in thousands of pets in the U.S., and melamine-tainted feed entered the supply chain for animals intended for human consumption. A year later, melamine adulteration of dairy products in China resulted in hundreds of thousands of illnesses and at least six infant deaths. In 1981, industrial-grade rapeseed oil that was sold as olive oil in Spain caused more than 20,000 illnesses and at least 300 deaths.

How Do Incidents Go Undetected?

EMA incidents are challenging for industry and regulators to prevent because the adulterants are usually innocuous and the adulteration is designed specifically not to be detected. Often, the most successful adulterants are novel; therefore, quality assurance testing methodologies are not designed to detect them. For example, in the mid-1980s, sweet white dessert wines in Austria were adulterated with diethylene glycol (an industrial solvent) because it improved the body and sweetness of the wines. At the time, there was no reason to test for the presence of diethylene glycol in wines because it was not an expected adulterant. Since there were no short-term health effects, the adulteration could have continued if a tax inspector hadn't uncovered the fraud by investigating tax refunds claimed by a wine producer for large quantities of diethylene glycol. Testing methodologies for more commonly adulterated products, such as honey and olive oil, are continually evolving to keep up with advances in adulteration methods. However, analytical methods for food products can be expensive, and it is not practical or feasible to test all food products for every possible adulterant.

Getting Ahead of the Problem

Identification of EMA events must come sooner to mitigate human health consequences and economic loss. Better detection methods are important, but they are not the only solution. Early warning analysis that takes advantage of multiple data sources has the potential to alert us to elevated risk of EMA in certain food products for relatively few resources. Inspection, laboratory testing, and other crucial and cost-prohibitive resources can then be targeted towards the riskiest food products.

Individual industry members and regulatory agencies have much of the information and food system knowledge that could help early identification an adverse food event, but it is not currently compiled for real-time analysis. Collaboration and information sharing between public and private interests are also essential to ensure that the food supply remains well protected and resilient.

The development of data management technologies in which the food and agriculture stakeholders can regularly and proactively share real-time information across the globe is key to identifying risks and initiating the appropriate response to mitigate adverse consequences. Various data sources, compiled and analyzed to detect a signal, can serve as a trigger for decision makers to take action. Using data sources such as weather information, global trade data, pricing indexes, policy changes, and indications of political and civil unrest, we can build algorithms that can assist in identifying the environments where food fraud is likely to occur or may already be in the system.

The NCFPD has initiated research and development of technology solutions, known as the FIDES and EMA projects, which support data fusion, analytics, and dissemination within and across organizations to help identify and warn of food threats such as EMA, provide risk management assessments, and provide decision makers tools to make informed assessments and decisions.

Increased awareness of and research on food fraud provides an opportunity to improve testing methodologies and develop new capabilities for rapidly identifying adulteration in the system prior to seeing adverse health and economic consequences. These dedicated efforts will serve as a deterrent to those seeking to adulterate our food supply. ■

Dr. Everstine, ever0152@umn.edu, is research fellow at National Center for Food Protection and Defense (NCFPD). **Dr. Kircher**, akircher@umn.edu, is acting director for NCFPD. And **Cunningham**, cunning@umn.edu, is the communications manager for NCFPD.

REFERENCES FURNISHED UPON REQUEST

20 YEARS IN FOOD SAFETY: A LOOK BACK AND BEYOND

Food Quality & Safety magazine takes a look back at some important events in food safety and also considers what the next 20 years might hold

BY **TIM DONALD**

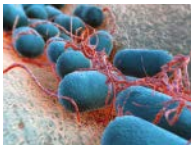
In celebration of *Food Quality*'s (now *FOOD QUALITY & SAFETY*) 20th anniversary, and with the help of its Editorial Advisory Panel, we reflect on the events in food safety that has helped shaped today's food and beverage industry and also look ahead to what future developments might bring to the market.

The first part of this article provides a food safety timeline spanning 20 years based on news reports as well as insights offered by members of the *Food Quality & Safety* Editorial Advisory Panel. In the second part, we asked members of the Panel to offer their predictions—hopes, wishes, challenges, fears—for various segments of the industry for the next 20 years.

PART 1

Food Safety's Past

A statement from Panel member Purnendu Vasavada, PhD, makes a good introduction to the timeline, "The past 20 years, in regard to food safety and food microbiology, remind me of Dickens' *Tale of Two Cities*. 'It was the best of times, it was the worst of times...'"



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Jan. 1993 - E. coli O157:H7 outbreak at Jack in the Box

This event brings food safety and foodborne disease emphatically to the attention of the nation and introduces the organism *Escherichia coli* into the public consciousness. The outbreak, traced to undercooked hamburger meat containing *E. coli* O157:H7 served by the fast-food chain, sickens more than 600 people in four western states. Four children die of hemolytic uremic syndrome (HUS).

"It was the first time people focused on the pathogen *E. coli* 0157:H7, and that outbreak really created the urgency for the federal government to take action," comments Caroline Smith DeWaal, food safety director, at the Center for Science in the Public Interest (CSPI).

Feb. 1993 - "Assay for motile facultative anaerobic pathogens" patent

This patent, on a method to detect *L. monocytogenes* in a total time of 24 to 36 hours, is the first of several issued to Daniel Y.C. Fung, PhD, a charter member of the *Food Quality & Safety* Editorial Advisory Panel and one of the originators of rapid methods and automation in microbiology, and Linda Yu.

Late 1993 - Efforts begin to develop steam pasteurization of beef carcasses

The Jack in the Box *E. coli* outbreak prompts Panel member Craig Wilson, who at the time was working at Frigoscandia (Bellvue, Wash.), and others to begin discussion of ways to prevent such outbreaks. They begin development of steam pasteurization of beef. By late 1994, they file a U.S. patent application, "Method and Apparatus for Steam Pasteurization of Meats."

Sept. 1994 - E. coli 0157:H7 declared an adulterant in raw ground beef

In a landmark speech to the American Meat Institute, Michael R. Taylor, then administrator of the USDA's Food Safety and Inspection Service (FSIS), states "we consider raw ground beef that is contaminated with *E. coli* O157:H7 to be adulterated within the meaning of the Federal Meat Inspection Act...We plan to conduct targeted sampling and testing of raw ground beef at plants and in the marketplace for possible contamination. We know that the ultimate solution to the O157:H7 problem lies not in comprehensive end-product testing but rather in the development and implementation of science-based preventive controls with product testing to verify process control."

1995-1996 - Creation of several food safety networks

In response to the *E. coli* 0157:H7 outbreak, several government initiatives to improve food safety intelligence were founded, including PulseNet, FoodNet, and NARMS.

PulseNet is a national network of public health and food regulatory agency laboratories coordinated by the Centers for Disease Control and Prevention (CDC). The name derives from the use of standardized pulsed-field gel electrophoresis (PFGE) molecular subtyping (DNA fingerprinting) to identify and distinguish foodborne disease-causing bacteria. This allows ability to establish links among illnesses occurring in different times and locations.

Foodborne Diseases Active Surveillance Network (FoodNet) tracks trends in infections commonly transmitted through food and reports the number of laboratory-confirmed illnesses caused by foodborne infections. By estimating the incidences of foodborne illnesses and their associations with specific foods, and monitoring trends over time, the network provides a foundation for food safety policy and prevention efforts.

The National Antimicrobial Resistance Monitoring System (NARMS) is a public health surveillance system that tracks antibiotic resistance in foodborne enteric bacteria from humans, retail meats, and food animals. NARMS collaborates with similar monitoring efforts in other countries. It also examines foodborne bacteria for genetic relatedness using PFGE and contributes this data to the PulseNet database.

July 1996 - The "Mega-reg"

FSIS enacts the final rule implementing "Pathogen Reduction; Hazard Analysis and Critical Control Point (HACCP) Systems" for meat and poultry facilities. This landmark ruling establishes requirements for meat and poultry facilities to reduce the occurrence and numbers of pathogenic organisms on their products through implementation of sanitation standard operating procedures, regular microbial testing, and the development of preventive controls known as HACCP.

Oct. 1996 - Recall of Odwalla juice

E. coli 0157:H7 is identified in stool samples from people with HUS who had drunk Odwalla brand unpasteurized juice. The products had been distributed in several western states and British Columbia.

"As we continue to test and examine illnesses, we will continue to discover foods associated with illness that we never thought caused illness before," says Jennifer McEntire, PhD, senior director, food and import safety, Leavitt Partners. "A case in point is the outbreak associated with Odwalla apple juice. Apple juice was considered an acidic product: No pathogen was supposed to grow in it. And yet there was an outbreak of *E. coli* 0157:H7 because the organism changed. We didn't know that 0157 had a slightly different acid tolerance than other pathogens. Bacteria evolve; that's what they do."

Sept. 1997 - CSPI Outbreak Database

The CSPI establishes its Outbreak Alert! database to allow CSPI to independently evaluate problems and progress in the U.S. food supply. The database contains information and analysis on outbreaks that have been fully investigated, i.e., in which both a pathogen and a food are identified. CSPI also regularly publishes Outbreak Alert! and

(Continued on p. 18)

(Continued from p. 17)

analyzes state reporting practices in reports such as All Over the Map.

"Today the outbreak database contains 7,000 outbreaks, tracking more than 20 years, starting in 1990, and cataloguing more than 200,000 illnesses in the U.S.," comments DeWaal.

Dec. 1997 - Seafood HACCP rule

The HACCP Regulation for Fish and Fishery Products, requiring processers of fish and fishery products to develop and implement HACCP systems for their operations, becomes effective.

"For food safety in seafood, the major milestone was the 1997 HACCP regulations," says Steven Wilson, chief quality officer, USDC Seafood Inspection Program. "That has been the model for the FDA putting out other HACCP regulations. After the seafood HACCP regulations came those for fruit juice."

2000 - Founding of the GFSI

The Global Food Safety Initiative (GFSI) is an industry initiative devoted to continuous improvement of food safety management systems to ensure confidence in the safety of the food supply worldwide. Experts collaborate in numerous working groups to address food safety issues defined by GFSI stakeholders.

Jan. 2002 - HACCP rules for juice

Effective in 2002 (January 2003 for small businesses), the FDA circulates HACCP rules for production of fruit juice and juice concentrate. Processors making 100 percent juice or a concentrate for subsequent beverage use must apply HACCP principles. For beverages containing less than 100 percent juice, only the juice ingredient must apply to HACCP principles.

2005 - ISO 22000 management standard

The International Organization for Standardization (ISO) promulgates ISO 22000, addressing food safety management to help facilities identify and control safety hazards. The standard stresses interactive communication, systems management, and HACCP principles. It emphasizes a combined effort of all parties in the food chain is needed since hazards can occur at any point.

"When ISO 22000 came out, that was a milestone, not just in seafood but foods in general," says Wilson. "It was the first time a private management standard for food safety was internationally recognized. That standard made a number of regulatory agencies sit up and take notice. Also, it made differences in ISO's way of thinking. At that time they had quality management in ISO 9001, environmental management in ISO 14001, and now here was a new management standard. This was when ISO decided through their business plan to get more involved in management systems."

Jan. 2006 - Food allergen labeling

The Food Allergen Labeling and Consumer Protection Act of 2004 (FALCPA), an amendment to the Federal Food, Drug, and Cosmetic Act, requires the labels of foods that contains a "major food allergen" to declare the presence of the allergen.

"FALCPA was the culmination of an increasing awareness of the importance of providing clear and simple information to food-allergic consumers so they can make safe food choices without having to worry about misunderstanding what is on the label or what is in their foods," says Steven Gendel, food allergen coordinator , FDA.

Aug.-Oct. 2006 - Multi-state E. coli 0157:H7 outbreak in spinach

The outbreak results in 205 confirmed illnesses in 26 states and three deaths, according to the FDA. The CDC reported that 102 people were hospitalized and 31 developed HUS. All spinach implicated in the outbreak was traced to a California firm.

"One thing that really came to light in the 2000s was the risks that are carried on our fresh produce, like fresh leafy greens and fresh vegetables," comments DeWaal. "Fresh produce is linked to a large number of outbreaks and illnesses in our database, but consumers didn't really become aware of it until the spinach outbreak in 2006."

2008 - Melamine in infant formula

China reports melamine contamination in infant formula, causing kidney problems and kidney stones in babies. Melamine was intentionally added to milk to artificially increase the measured protein content.

2008-2009 – Salmonella and peanuts

The Peanut Corp. of America's (PCA) products were the source in an outbreak of *Salmonella typhimurium* illnesses that killed nine people and sickened more than 700. The recall prompted by the outbreak involved thousands of products made by more than 300 companies. This February, criminal charges were filed against the former owner and other company employees, charging that they misled customers—not revealing when tests detected *Salmonella* in products from a plant in Blakely, Ga.

(Continued on p. 20)

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"The PCA scare really had an effect on auditing processes, and that will have an effect on how third parties are accepted by regulatory agencies," says Wilson. "Those kinds of events have ripples throughout the entire food chain, not just one particular product group."

May-Nov. 2010 - Outbreak of Salmonella enteritidis in eggs

The CDC identifies a nationwide, sustained increase in cases of *Salmonella enteritidis* infections uploaded to the PulseNet database. The CDC estimates that approximately 1,939 reported illnesses are likely associated with the outbreak. Epidemiologic investigations pointed to eggs as the source, and a nationwide recall followed. By August, according to a CNN report, the recall included half a billion eggs.

July 2010 - Egg safety regulations

Food safety requirements for egg producers with 50,000 laying hens or more take effect. Among other things, the new rules require producers to adopt preventive control measures and to use refrigeration during egg storage and transportation.

Jan. 2011 - FSMA signed into law

The Food Safety Modernization Act (FSMA), the most sweeping U.S. reform of food safety law in more than 70 years, was signed into law by President Obama. The reform, which is still in the process of being implemented, is intended to improve the safety of the U.S. food supply by shifting the focus of regulators to prevention of contamination. Major components include the following.

Preventive controls. FDA has a legislative mandate to require comprehensive, prevention-based controls across the food supply.

Inspection and compliance. The law specifies how often FDA should inspect food producers, calling for risk-based and innovative inspection approaches.

Imported food safety. Importers must verify that foreign suppliers have adequate preventive controls in place. The FDA will be able to accredit third-party auditors to certify that foreign food facilities are complying with U.S. standards.

Response. Mandatory recall authority by FDA for all food products.

Enhanced partnerships. Recognition of the importance of strengthening existing collaboration among food safety agencies, from local to federal to international; directs FDA to improve training of state, local, territorial, and tribal food safety officials.

"FSMA is once-in-a-lifetime regulation," says Virginia Deibel, PhD, director of microbiology, Covance. "We likely will not see another change in FDA law this significant in our lifetimes...the FDA no longer needs to prove an adulteration. They can instill regulatory action if they believe a facility is producing food in unsanitary conditions."

"The FDA calls the new FSMA regulation HACCP on steroids," adds another *Food Quality & Safety* Panel member.

2011 - Germany's E. coli outbreak

A deadly strain of *E. coli* kills more than 40 and sickens more than 4,000 in Germany and other parts of Europe. On June 10, German authorities stated epidemiological and food-chain evidence found bean and seed sprouts were the vehicle of outbreak.

Aug.-Oct. 2011 - Multistate outbreak of listeriosis in whole cantaloupes

An outbreak of *Listeria monocytogenes* infections (listeriosis) sickens almost 150 people in 28 states. The outbreak was blamed for 33 deaths reported to CDC, and one miscarriage in a woman pregnant at the time of infection.

"We continue to find new pathogens, or find old pathogens in new places, causing problems that we had not seen before," notes Gendel. "The outbreak of *L. monocytogenes* infections linked to whole cantaloupes is an example of such a situation. We continue to find that Mother Nature and the microbes are very good at exploiting new opportunities."

Dec. 2012 - Hold-and-test strategy

The USDA FSIS announces that beginning in 2013 producers will be required to hold shipments of non-intact raw beef and all ready-to-eat products containing meat and poultry until they pass USDA testing for foodborne adulterants. Products will not be allowed to enter the market until they test negative for Shiga-toxin producing *E. coli*.

Jan. 2013 – Undeclared horse meat

Irish food inspectors detect horse meat in beef burgers and shortly thereafter similar incidents occur in more than 10 other European countries, propelling food fraud into the public spotlight. The scandal shakes consumer confidence, prompting proposed penalties for this type of labeling fraud.

PART 2

The Future of Food Safety

What does the future hold? A few of our Editorial Advisory Panel members offered up their thoughts on possible developments during next 20 years for the segments of industry they specialize in. Here's what they had to say.

Caroline Smith DeWaal, Food Safety Director, CSPI, Washington, D.C.

Our focus at the CSPI is on modernizing the food safety system in the U.S. in ways that maximize and promote consumer protection policies and programs. There are opportunities, for instance, to modernize how meat and poultry are inspected—the legal basis for meat inspection is still based on a 1906 model—and to bring inspections under a more scientific legal framework. A second emphasis is to continue to look for opportunities to merge the U.S. food safety agencies into a unified agency, combining programs at USDA and FDA. A final focus, one that already takes a lot of our time, is to work in the international sphere to ensure consumer protection is considered in the development of international standards by Codex Alimentarius and other international bodies.

The wide distribution of food products is a challenge, but not a new issue. The fact a food safety problem can enter a product in one plant and be shipped all over the world certainly poses challenges. CSPI has advocated for the adoption of rapid alert systems, similar to those in Europe, to notify national authorities. We'd like these rapid alerts to go all the way to the consumer, so we can be made aware of problems as they occur.

The rise in use of social media potentially provides the food industry and government with the means to get information to the public rapidly. The tools to accom-

(Continued on p. 22)

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plish this exist, but a strategy is needed to put such a system in place. If consumers know information isn't being hidden from them but rather is provided at the earliest opportunity, this increases their confidence in the government and food supply.

Gerry Broski, Senior Marketing Director, Food Safety, Neogen Corp., Lansing, Mich.

The next 20 years are going to be interesting as we set the stage to address the food and nutrition requirements for a growing population while recognizing we have finite and precious resources. A projected 15 percent increase in the global population, from 7 billion currently to 8 billion by 2025, is becoming a concern of many in the field of food safety. We'll have to proactively manage food safety plans and production to meet growing needs. FSMA is a step forward in addressing the needs of modern food production and distribution systems.

Technology continues to advance as new technology and solutions from the clinical, research, and life science areas are applied to food matrices. Food is a complicated product that can be made from many ingredients sourced from many areas, and food contaminants can be difficult to detect. Because many foods are perishable, the need for speed in testing will continue to be a target for improvement, and, because food safety is a basic requirement and not a competitive advantage, the cost of testing will be an area where simplicity and performance determine the adoption of new technology.

Having spent much of my career in food-related industries, my biggest fear is that looking forward we may not have enough qualified people at all levels to support the growing needs of the food safety industry. From lab technicians and analysts to managers, to quality control, to sales and marketing, qualified, educated, and trained people are needed to support the growing food and nutrition needs of the next generation.

Daniel Y. C. Fung, MSPH, PhD, Professor of Food Science and Animal Sciences, Kansas State University Manhattan, Kan.

Using standard microbiology methods, several decades ago, it could take a week to identify an organism—to say definitively, for example, that this sample contains *Salmonella typhimurium*. As methods were improved, the time needed for these determinations was shortened. Within the past three or four years, the time for identification of an organism has been shortened to 12 hours. Within the next five to 10 years, we hope to further shorten that time to four hours. Then two hours, one hour—and eventually to get results instantaneously.

Microbiology is a very dynamic field. Processes are continually getting faster and more efficient. The basic problem in microbiology is we must start with a pure culture to identify an organism. Many researchers' efforts now are centered on ways to achieve that pure culture: Perhaps a laser can pick out from a sample a single microdrop containing a single organism, and a puff of air can blow that microdrop into a tube or well for multiplication of the organism. Once this or some other method is used to isolate the pure culture, PCR and other tests can be performed to identify the organism.

Continued advances in rapid methods will require ingenious thinking and innovation in microbiology, immunology, electronics, lab-on-a-chip technologies, and perhaps other areas not yet envisioned. The field of food microbiology has developed very well in the past 30 years, and there is no reason to think that it will not continue to progress as new microbiologists and food scientists innovate and build on what has been done in the past.

Steven Gendel, Food Allergen Coordinator, FDA, College Park, Md.

One of the themes of [this year's Food Safety Summit] meeting, in some cases explicitly stated, in other cases implicit in the things people talked about, was the connectedness of the food system and food safety. Everyone is part of the same system, and everybody's food safety problem affects everyone else. In the future we are going to recognize this more and more. In coming years the food safety system will become more networked, integrated, and interactive than ever before.

There was a lot of discussion at the meeting around variations of this theme: More interaction is needed, whether among the federal agencies, between the federal agencies and the states, or among international bodies. We use terms like globalization and integration, but it really comes down to the fact that we are all now operating in a networked world. People are increasingly beginning to recognize that food production, food safety, and food sales are all part of a networked system. In the future, all the pieces of this system will need to communicate well with each other in order to make sure everyone knows what is going on so that we can keep the global food supply safe.

Jennifer McEntire, PhD, Senior Director, Food and Import Safety, Leavitt Partners, Washington, D.C.

Over the past 20 years the extent of global food trade has increased dramatically. With that increase, people are handling and consuming different types of foods, and the proper preparation and handling of those foods, as well as the pathogens and other contaminants that could be associated, might not be fully understood.

The industry is in a state of flux with the pending implementation of FSMA. Importers now have to ensure the food they bring into this country is produced safely under applicable regulations. Other countries too are weighing in with their own food safety laws and plans. How these changes will affect the global supply chain remains to be seen.

The use of technology shows great potential for development: How we alert people to a hazard, how we track products, how we monitor temperatures in real time, how we analyze data—in short, how we make decisions rapidly about a product—can be facilitated by technology. New technologies will give us a better grasp over what's happening with a product to ensure food safety.

There are tremendous opportunities to leverage technology for these purposes. And in fact, developing economies, where the physical infrastructure for food safety (including the communication infrastructure) is still taking shape, may perhaps have greater ability to leverage some of these new technologies than more established economies where the infrastructure is already set.

A recent trend likely to continue in the future is interest in natural, local, and organic products, including raw and unprocessed foods. Industry will be pressured not only to provide these foods, but to provide them safely. Hopefully we'll see the development of innovative processes to ensure this safety.

Purnendu Vasavada, PhD, Professor Emeritus of Food Science, University of Wisconsin-River Falls, River Falls, Wis.

Twenty years ago, isolating and characterizing *Salmonella* from ground beef could take seven to eight days. Now, because of the advances in molecular biology and DNA-based methods, we can do this in less than a day. With improvements in instrumentation, reagents, automation, etc., projects that used to take PhD students months or years to do are now done by high school students for their science fair. So we've come a long way.

Within the next few years it is not unreasonable that we could have multiplex assays to identify pathogenic organisms within a single shift. The challenge then, as now, is what do we do with this information? If you don't use the information to improve your operation, to manage your inventory or improve food safety, then that information is useless—no matter how sophisticated the instrument or how quickly the information is generated.

Another challenge for the future is the threat of bioterrorism through intentional contamination of food or water. The envelope containing anthrax or ricin may be a threat to individuals, but how widespread is the havoc that it causes? Intentional contamination of food or water could cause a major disaster. Early warning systems will be vital to manage the situation in the event of something like that.

Craig Wilson, Vice President, Food Safety and Quality Assurance, Costco Wholesale, Issaquah, Wash.

I am excited about the advent of new intervention strategies, mainly in the produce area. Fresh-cut produce is a relatively weak area right now from a food safety perspective, and the produce industry is working on some marvelous intervention strategies. Some of these technologies, such as use of chlorine dioxide gas to inactivate pathogens on green leafy vegetables, are already being deployed today. There are other strategies being investigated, not only in produce but in every area of food production, to improve the overall microbial quality of food items.

I do not think the globalization of the food supply is a concern. Globalization of the food supply should be based on specifications. As a food safety professional for a major grocery retail chain, I am at the end of the food chain, so to speak. I can develop specifications and say to suppliers that if their food item does not meet those specs, we are not going to buy them. With those specifications in place and being met, whether the source of the food item is domestic or international is not an issue.

The advancement of technologies for rapid pathogen detection is very exciting. We are constantly looking at rapid detection methods and how our systems can be improved, and I think that's going to be an area of continual improvement in the future because its importance is recognized.

Virginia Deibel, PhD, Director of Microbiology, Covance, Madison, Wis.

Most food companies would find significant value with the capability of real-time microbiological detection. Quality assurance staff could analyze products and product contact equipment and immediately determine whether or not a contaminant or adulterant is present. While real-time bacterial detection isn't available today, the time to results has diminished considerably over the past five to 10 years. Many of the advances have been the move from cultural to genetic detection. There are genetic detection platforms currently in use that mainly utilize PCR or antibody capture. There are other models to detect ribosomal RNA (rRNA) rather than DNA used with PCR. Manufacturers suggest rRNA platforms provide greater sensitivity and less enrichment time even with rapid and sensitive assays. Current confirmation methods for pathogens still rely on many cultural techniques, which require time and scientific expertise. There's a continued race against the clock to find ways that reduce overall assay time while maintaining or even increasing sensitivity, however the cost-per-test of these models is ever increasing. High test costs make the Environmental Control Program design and execution critical. Choosing where and how to test in a plant environment continues to be a key component of the testing process. So as much as a company may wish to have real-time detection, the road leading to this end-goal will be costly–financially and with needed scientific expertise. Partnering with a contract lab will be of value.

Steven Wilson, Chief Quality Officer, USDC Seafood Inspection Program, Silver Spring, Md.

When it comes to seafood, right now the best analysis is achieved by the nose, eyes, ears, and taste buds of the human inspector or auditor—sensory analysis. No mechanical method has been able to challenge the sensitivity of the human sensory apparatus, from a quality standpoint. That will continue to be the case for the foreseeable future. The challenge is to train inspectors well. That is hard work.

I see potential positives in the movement of regulatory assessment to third parties. Audit reports from certifying bodies can be used as intelligence, and trend analysis can help to pinpoint problems geographically to allow adjustment of import strategies. This true buyer-supplier information can provide a better picture of what's going on in the field. A potential concern, however, is the use of those third parties in lieu of government inspection. Whenever there is a profit motive involved, one must be careful of perceived bias. Certifying bodies are in fact a business. So this can be a negative or a positive depending on how regulators use it.

I also hope to see the USDA move away from its 100-year-old practice of carcass-by-carcass inspection and focus more on system evaluation, auditing, and other advanced methods. USDA has had a dramatic impact on the world, and if other bodies would follow its lead in this area and combine forces on food inspection, this would help move toward a strong method in general for evaluating foods in the future. The question is, how long will it take to get there? ■

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

FOOD QUALITY AWARD

At Taylor Farms, New Technologies Make Produce Safer

The most recent winner of the Food Quality Award attributes its high standards for food safety to investments in technology and training

BY **LORI VALIGRA**

Taylor Farms, a major producer of value-added fresh vegetables based in Salinas, Calif., won the 12th annual Food Quality Award based on its focus on food safety and quality, employee training, and beneficial use of new technologies such as a clean wash and a data acquisition system. Mark Borman, president of Taylor Farms, and Jason Kawata, director of quality assurance, accepted the Award on behalf of their team on May 1 during a special reception at the 2013 Food Safety Summit in Baltimore, Md.

"I'm super proud of winning the Award and of our team here," says Borman. "Food service operation customers worry about their own brand, so food safety is paramount."

Some past winners of the annual Food Quality Award include Hans Kissle, Mastronardi Produce, Michigan Turkey Producers, Fieldale Farms, West Liberty Foods, Hormel Foods, Tyson Food, and Sysco.

"What brings us ahead is our allocation of resources," comments Angelina Estrada, food safety technical support manager at Taylor Farms, a subsidiary of Taylor Fresh Foods Inc. "A great part of our commitment goes to resources such as equipment, chemicals, R&D, and getting self-motivated, qualified personnel."

That has impressed David Charest, vice president of bioprotection at DuPont Nutrition & Health, which sponsors the Award. "Taylor Farms has made impressive investments in sustainable technology and training to improve both the quality and safety of their products," says Charest.

Paul Grothe, produce vice president at Diversified Restaurant Systems Inc., a San Diego food consulting group that is respon-

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Taylor Farms recently started using SmartWash, a food wash solution it developed to help prevent cross contamination.

sible for all Subway store procurement, including Taylor Farms products, agrees. "Taylor Farms is always ahead of the game when it comes to food safety and the quality control aspect of everything they do. They're probably one of the more innovative in staying on top of food safety," comments Grothe.

And that goes beyond the company's own facilities. According to Grothe, Taylor Farms hired a person in California who is solely responsible for going into Subway stores and teaching employees there how to handle produce. "They do a really good job with store visits, getting hands on with franchisees, and helping them tackle problems," he explains. "There are usually quality problems when you're handling produce. It's the nature of the business."

Privately held Taylor Farms was established in 1995 in Salinas. It operates there from April to November, and then moves its operations to Yuma, Ariz., from the end of November to the beginning of April to follow the growing season. The company makes value-added produce such as lettuce, broccoli, and cauliflower that is washed, ready to eat, and sold to broadline distributors including Sysco, produce specialist distributors like FreshPoint, quick serve restaurants like McDonald's and Subway, club stores like Sam's and Costco, and casual dining restaurants like Ruby Tuesday and Chipotle.

Taylor Farms claims to be North America's largest supplier of fresh cut fruits and vegetables to the food service industry, with a raw product harvest topping 1,800 acres per week. Some 22 million pounds of fresh cut vegetables are produced every week throughout all of its operations, with 12 million produced in California alone. Taylor Farms sources raw materials from 17 U.S. states and Mexico, and has 12 processing plants across North America, 11 of them in the U.S. and one in Mexico.

Investing in Technology

The company recently started using SmartWash, a food wash solution it developed to help prevent cross contamination. It also installed a supervisory control and data acquisition (SCADA) system to monitor its processing room floor in real-time for parameters such as temperature in cold storage, the distribution warehouse, and in areas specified by its hazard analysis and critical control points (HACCP) program.

"I can look at pH readings in any of the wash lines and the operating status of the dryers, whether they are running, stopped, or in cycle," says Estrada. "It picks out what product is being run, metal detection, how many bags are rejected, and the cut settings. I manage all of this from my computer."

The investment in technology has been especially heavy recently, Borman says. Revenue for the last year ended June 30, 2012 and was about 11 percent higher than the previous year. The company was profitable, but costs ate into earnings. "There was a head wind in the food industry overall," Borman explains. "Pulp and paper and fuel and fertilizer drove costs. And we've had a heavy reinvestment strategy the past couple years." In Salinas and Yuma, 12 percent of revenue is ploughed back mainly into food safety R&D each year, he says.

SmartWash started as an internal R&D project seven years ago. Also known as T-128, the food-grade chemical solution helps assure consistent levels of contamination-fighting agents in wash water. When the water becomes too turbid (dirty), the chlorine isn't as effective. SmartWash stabilizes the chlorine, says Borman.

Taylor Farms validated SmartWash through third parties and the USDA. A spin-off company called SmartWash Solutions LLC now sells the chemical, which Taylor Farms has been rolling out the past two years. "Return on investment is hard to quantify," Borman admits. "But we feel it's helped us grow our systems with customers." Taylor Farms recently completed implementation of SmartWash in all of its leafy greens wash systems. Borman views SmartWash as a a good start toward a "kill step," a holy grail for killing all pathogens.

SmartWash is not proprietary to Taylor Farms, and Scott Horton, the company's vice president of food service sales, says he'd

(Continued on p. 26)

TAYLOR FARMS

EDDIE ARROSSI PHOTOGRAPHY

Mark Borman, Taylor Farms president, accepted the Food Quality Award during a special reception at this year's Food Safety Summit.

Taylor Farms has set its sights in addressing school lunch programs' move to healthier, greener foods.

PAUL DESMOND

(Continued from p. 25)

like to see all companies in his business use it. "Consumer confidence is eroded even if we don't have a problem, but other companies do," says Horton.

A watershed event for produce food quality occurred in 2006, when a major *E. coli* outbreak in a competitor's spinach caused the entire U.S. spinach industry to shut down. According to Borman, Taylor Farms was the largest U.S. spinach producer at the time, and while its spinach wasn't contaminated, it still couldn't sell its product for three weeks. "There was a slow ramp-up after that. We took a huge hit in consumer confidence," Borman adds.

Following the Harvest

With its twice-yearly moves, Taylor Farms needed a SCADA system that could handle the moves from Salinas to Yuma and back again with as little disruption and reconfiguration as possible. About 100 truckloads of equipment are moved, and the SCADA system must be able to detect the location of each piece of equipment on the floor and reconfigure it accordingly. The company has about 1,100 employees, but only 250 travel between the plants, with most of the remaining seasonal workers returning each year, Borman says. Each move allows the company to improve its systems, add technology, and perform maintenance on the facility left behind.

The company also recently invested in optical sorting technology to remove foreign materials and quality defects from its baby spinach products for the food service industry. It plans to buy more optical sorting technology for more fresh-cut processing lines. "About one year ago we added optical sorting of romaine and iceberg lettuce to find foreign materials such as bugs. The payback is more customer assurance and confidence, and a volume increase from customers," says Kawata.

In addition, Taylor Farms recently began using a lettuce harvester, which is checked daily for bacteria counts. The harvester is made entirely of stainless steel, including all working parts, not just the contact points. The machine cuts at 17,000 pounds per square inch (high pressure, low volume) and utilizes about 3 gallons of water per minute, which the company says is lower than conventional harvesters.

Commitment to Training

The greatest challenge for Taylor Farms is making sure every person on the floor understands what the company is doing for food safety and why it is important, says Estrada. "For every product, we have a specification from the customer as to what they expect. We have a quality evaluation for every production run looking for defects like decay and cut size."

According to the company, training has improved results; for example, Taylor Farms was among the first in the fresh-cut industry to become Safe Quality Food Institute Global Food Safety Initiative (SQF GFSI) certified in 2009. It earned an SQF Level 3 certification in 2010.

Training is done weekly, monthly, and yearly for management and hourly workers. It includes refresher education in developing and applying good manufacturing practices, HACCP, raw material and finished product specifications, customer requirements, a food quality plan, and food regulatory issues. The company also sends key managers to food safety and quality seminars across North America, and brings in professional trainers for specific key areas such as sanitation and microbiological testing.

Tangible Results

Taylor Farms cited some environmental benefits to its programs, including SmartWash, which impacts its chlorine use. The SCADA system has enabled significant reductions in energy use and reduced the amount of water used. And the romaine lettuce harvester uses higher pressure in the water knife system, limiting water use.

The company says the 15 to 16 day shelf-life for its value-added produce exceeds the industry benchmark of less than 14 days, an improvement it attributed to its investments and attention to food safety and quality. It also conducts modified atmospheric readings and sensory evaluations to validate and verify its shelf-life performance.

Going forward, Borman points to two major market trends the company will address. One is the 13 percent growth in people switching to Taylor Farms organic foods, more in the retail arena than food service. The second is the change in the school lunch programs to healthier, greener foods. ■

Valigra is a writer based in Cambridge, Mass. Reach her at lvaligra@gmail.com.

CIP: The Industrial-Grade Dishwasher

Modern CIP systems are heavily automated and integrated to reduce manual intervention while ensuring efficiency, repeatability, and overall quality | BY **CHAD ENCK**

There is an episode of the '90s hit comedy show *Home Improvement* that I think of every time I pull out dirty dishes from the dishwasher at home. You know, after they've supposedly been cleaned... it's the peanut butter spoons, the charred grit burnt onto the bottom of the pan, the baked on meatloaf, etc....In this episode, Tim "The Toolman" Taylor observes his wife pre-rinsing the dishes prior to putting them into the dishwasher. This was an action The Toolman couldn't wrap his head around. After all to Tim's point—isn't that the purpose of the dishwasher? What proceeded from there is Tim's extreme attempt to "beef-up" the dishwasher with extra horsepower to handle those sticky situations. And while humorous, Tim's goal to address this issue is a serious matter within the food and beverage industry. Just ask any dairy farmer, production supervisor, sanitation technician, process engineer, or quality manager what their solution to ensuring food safety is in their industry and they'll point to the clean-in-place (CIP) system, an industrial-grade dishwasher sure to gain the approving nod, and primitive grunt "ooo, ooo, ooo..." from Tim The Toolman himself.

CIP systems are process systems tasked with the objective to clean the equipment used in the receiving, delivery, distribution, processing, and manufacturing of food and beverage products. The systems themselves are an arrangement of tanks, valves, pumps, heat exchangers, and associated instrumentation such as temperature/level/pressure/conductivity transmitters, flowmeters, chart recorders, and automated control systems. These components are traditionally assembled onto a prefabricated stainless steel skid, giving way to the commonly used term of CIP skid.

(Continued on p. 28)

(Continued from p. 27)

The primary advantage of CIP systems is they relieve the burden of having to tear down equipment to be cleaned. Instead of running ingredients through the process system, as would be done while in production, the line and/or equipment is connected to the CIP skid which runs the cleaning solution through the process. Therefore, they are used to clean virtually everything, including the pipes, valves, fillers, homogenizers, pasteurizers, tanker trucks, and all other associated equipment.

To gain a better understanding of these industrial-grade dishwashers, here are the answers to frequently asked CIP questions.

Q: Are CIP systems automated?

A: Yes, but they weren't always this way. Early CIP systems consisted of a CIP skid with wash and rinse tanks like they do today. However, those early systems were independent islands of control that lacked automation and integration with the systems being cleaned. Once upon a time, device sequencing was made possible with rotary cam switches and other electro-mechanical devices. These mechanical sequencers limited control capabilities to the skid devices only. Field devices relied on isolated relay valve pulsing that could never be fully synchronized with the skid sequence—resulting in improper and inefficient cleaning.

For example, due to the disconnect between skid and field device sequencing, water-hammer would result. This occurs when the skid's supply pump is running at full speed and the field routing valves close at the wrong time, causing liquid in the line to abruptly slam like a "hammer." Water-hammering is detrimental to valve seals and pipe welds. Additionally, because of a lack of instrumentation and monitoring, often length of time for a run had to be extended just to ensure the circuit was cleaned.

Some chemical engineers and process engineers still see the skid and field as two separate entities. But that limits the advantages a fully automated system can provide.

Automated system advantages include:

- Integrated skid and field device sequencing, resulting in coordinated and optimized routing paths (the elimination of water-hammer);
- Use of valve position feedbacks to generate routing path faults to halt the CIP process;
- Accurate flow monitoring using flow meters instead of flow switches;
- Tracking total water usage;
- Ensuring proper supply and return temperatures are achieved;
- Conductivity monitoring to verify desired chemical strengths are satisfied;
- Level and pressure monitoring;
- Allergen-wash categorization; and
- Electronic records, reporting, alarm/fault logs, and time/date stamping.

Q: What components comprise the CIP control system?

A: At the heart of the control system is the programmable automation controller (PAC) that runs the program(s) controlling the operation. The devices (i.e. valves, pumps, sensors, meters, etc.) on the CIP skid are wired to the PAC as analog or digital inputs/outputs (I/O) points. Tethered to the PAC is the operator interface, or human machine interface (HMI), which is used to monitor the CIP system, select the circuit to clean, and to start/stop/abort the process. Additional components include the chart recorder and the pin-sheet.

Chart recorders are used to monitor and record the system's key performance indicators (KPI) as they pertain to temperature, level, pressure, conductivity, and flow. Pin-sheets are used to document the system's circuits, phases, and device sequences. The Information Age has enveloped both the chart recorder and pin-sheet. Many systems now feature "chartless" electronic records and trending. Refer to Figure 1. These trends provide the same information as a chart but with the added advantages of being retrieved, viewed, and stored with the click of a mouse. Additionally, the use of electronic signatures permits supervisory "sign-off" of the overall effectiveness of the cleaning process. Industry regulations such as the Pasteurized Milk Ordinance recognize the benefits of electronic chart recorders. Additionally, pin-sheets are being improved upon functionally by their electronic counterparts. Electronic pin-sheets, through the use of spreadsheet software or the HMI, have been embraced as a valuable tool for supervisory level staff to create and modify the CIP process.

Q: What defines the CIP automated process?

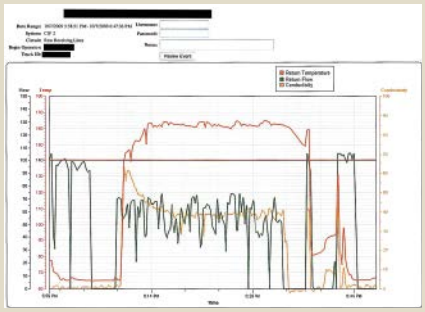
A: In many ways, the CIP process can be likened to the batch process used to make a product. Batching is comprised of recipes, steps, ingredient additions, and timed holds/agitations sequences. Similarly, CIP processes are comprised of circuits, phases, steps, and sequences. Circuits can be categorized as to the function and/or equipment they are cleaning. Some common circuit types can be Line, Tank, Tank and Line, or a specific piece of equipment like Filler, for example. Circuits are comprised of cycles or phases. Common phases include Prerinse, Wash, Postrinse, and Sanitize. These are easily remembered by thinking how the dishwasher cycles (pre-rinse the plates to drain before washing, wash, rinse-off the detergent, then sanitize). Phases are made up of steps. Steps might include rinse to drain, pump down, caustic wash, acid wash, fresh water rinse, and air blow. The specific sequence executed involves the "pinning" of the devices through the use of the pin-sheet.

The pin-sheet is a spreadsheet that serves as the master schedule for the CIP process. The pin-sheet identifies the system name, the circuit name, and contains detailed sequence information per its phases: step description, number, time, targeted supply line temperature and flow rate, and return line conductivity. Furthermore, the pin-sheet contains a bit position within the sequence word(s) for every device residing on the CIP skid and within the field. This bit position represents the "device pin" for which the sheet gets its name.

Recall that a primary advantage of modern CIP systems is the integration of the CIP PAC with the production system

GES AUTOMATION

Figure 1: Trends



Figures 2: The CIP Setup Screen

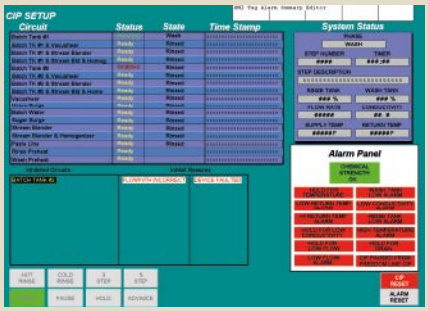
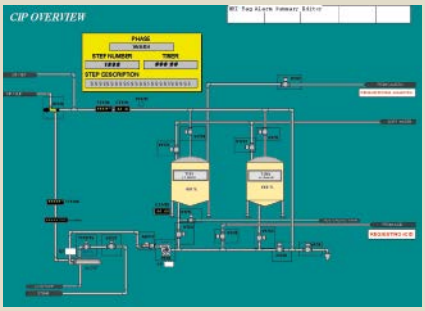


Figure 3: The CIP Overview Screen



PACs. The pin-sheet has the ability to reach across into the production controller to set and cycle process equipment as part of the CIP program.

Q: How is the data in the pin-sheet brought into the PAC?

A: The fields on the pin-sheet are translated into programming parameters that are downloaded into the PAC. The PAC executes the CIP program based on this data. The data takes on two forms: discrete (digital 1s and 0s) and analog values (percentages, flow rates, time, temperature, etc.).

Discrete signals passing from the pin-sheet to the PAC are used as run requests. Devices are assigned a bit position within the sequence word that corresponds to the column assignment for the device. If a device is required to run on a specific step, then its bit position will be assigned a logical "1." The device is now considered "pinned" and when the logic sequencer executes that step, the bit position is referenced as a run condition for that pump or valve and it is commanded to turn on. If assigned a logical "0" then the condition is not true and the device is not requested to run.

Analog values passing from the pin-sheet to the PAC are used as set points. For example, on a hold for temperature step, the return water temperature set point specified in the pin-sheet is referenced and the actual temperature transmitter is monitored to satisfy that targeted value.

Q: What are some user interface features?

A: The HMI is the primary interface for operations personnel interacting with the CIP process. Figures 2 and 3 show two graphic display screens: The CIP Setup screen and the CIP Overview screen.

The Setup screen provides a means to configure and control the process. Here the operator selects the circuit, can further refine the type of wash, and control the process via start/stop/pause alarm reset and abort buttons. Pertinent status information and alarms are displayed for the user to show what is happening in the process. The cycle name, current step and description, remaining time and started/paused/stopped status are displayed. Additionally, all "hold for conditions" are populated.

The Overview screen is very similar to that found on many process control systems in that the environment is shown through the use of graphical symbols representing the real world devices on the CIP skid. Tanks and their levels, pumps and speed feedbacks, valves, and instrumentation KPIs are displayed and animated accordingly. Navigation buttons to the setup and past cycles screens provide the user with access to the CIP cycle currently running and access to logged data trends on previously cleaned circuits.

Q: How does data collection benefit the CIP system?

A: Simply stated, it closes the loop by using the data already available for purposes of verifying food safety and efficiency. Consider when the production line is being cleaned, it is worse than downtime. It is not just losing money—it is using money. Data collection allows the users to investigate the process and optimize their return on investment.

Most importantly is food safety. Trending the instrumentation KPIs on electronic chartless recorders allows technicians, engineers, and quality personnel to confidently review the CIP for compliance and diagnose areas of concern. Consider, for example, the quality assurance gained in comparing active trends to a previously captured "ideal" trend.

Monitoring the time taken to clean a circuit is merited because it affects the plant's indirect costs in many ways. Cleaning too long increases labor requirements and challenges production/cleaning schedules. By adding simple time and date stamps, registered at the completion of a CIP run, will ensure the circuit won't be cleaned prematurely and quality is not short changed.

Usage reports showing the amount of water and chemicals consumed in the process can be investigated so that circuits can be optimized to reduce costs. For instance, strategies can be launched to use the least amount of fresh water necessary, reclaim post-rinses for subsequent pre-rinses, and adjust chemical doses to their desired strengths for proper cleaning. These cost saving efforts also contribute to water treatment as well.

The CIP system has come a long way in recent years with advancements in automation, integration, and data collection. These tools have taken a once self-contained process and enhanced it to become the intelligent system it is today. Because of those combined efforts, CIP systems are handling the most challenging cleaning requirements that industry demands while benefitting from the highest level of performance, quality, and efficiency being offered. ■

Looking for more information on CIP technology? Then check out this issue's online exclusive, "A Straight-Forward Approach to CIP Automation," which explores the benefits of a recipe managed CIP system. Available online under the June/July issue.

Enck is the sales engineer and quality manager at GES Automation Technology, a certified member of the Control System Integrators Association (CSIA), www.controlsys.org, a global non-profit professional association that seeks to advance the industry of control system integration. He can be reached at ChadE@gestech.com.

Dry Floor Products Won't Slip Up

Various dry floor treatments are gaining ground in facilities when it comes to enhancing sanitation and preventing cross contamination throughout the processing day

BY **ALEX JOSOWITZ**

Historically dry floor treatment products are powdered or granular formulations that can be applied to a dry or wet floor to prevent slipping, provide cleaning and deodorizing activity, or in some cases, sanitize floors once activated. There are a variety of dry floor treatment chemistries on the market, with different characteristics and approvals for use.

Types of Dry Floor Products

Dry floor products can generally be segmented into the following three categories: anti-slip, cleaning/deodorizing, and sanitizing. Anti-slip and cleaning and deodorizing formulations are limited by the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) to making performance and marketing claims that include cleaning, removing stains, and deodorizing. Marketing these products for uses other than these is in violation of federal law. A new class of sanitizing products has recently been introduced by several manufacturers that are registered with the EPA. These products have been shown to be effective antimicrobial control agents and therefore are allowed to legally make sanitizing claims.

Anti-Slip Powders. Anti-slip powders are used to absorb moisture and break down oils, fats, and grease to increase traction. Most anti-slip floor powders contain sodium bicarbonate as a primary ingredient, and are relatively inexpensive. Dry products to aid traction are normally free flowing powders or formulated into small granules to avoid a slipping hazard. The key components of an effective anti-slip powder are: degreasing performance, moisture absorbance, and long lasting, slow-dissolving granules.

Floor Cleaners/Deodorizers. The majority of dry floor treatments can be classified as cleaners/deodorizers. A number of chemistries are currently available for cleaning and deodorizing, including quaternary ammonium-based products (with or without urea), sodium percarbonate-based products, surfactant blends, and acids. It is important to note, however, that these products can only be used to clean and to deodorize, and do not have approval as sanitizers without an EPA registration for floor sanitization. Many dry floor cleaners are also formulated with sodium bicarbonate to aid in traction as well.

Quaternary ammonium compounds (QACs) are a class of cationic surfactants that are often used in deodorizers, sanitizers, or anti-static products. In dry form, QACs are frequently blended with urea and provide cleaning and deodorizing activity once the powder or granule comes into contact with moisture. The advantage of QAC-based dry floor treatments includes a longer residual deodorizing activity once activated by moisture as compared to other formulations. However, QACs are rapidly consumed in the presence of organic soils and under hard water conditions. Urea containing formulations are used for cost reasons but can have negative effects on wastewater. When activated by moisture, urea produces ammonia which can result in high ammonia levels in plant wastewater if usage levels are not monitored.

Sodium percarbonate-based cleaners release sodium carbonate and hydrogen peroxide once activated by moisture, producing an alkaline hydrogen peroxide solution. Used as an oxidizing agent to clean and whiten/bleach floors, dry sodium percarbonate-based floor cleaners are more compatible with wastewater than urea/QAC blends because they ultimately break down into sodium carbonate, water, and oxygen. However, sodium percarbonate based formulations do not have a cleaning and deodorizing residual profile comparable to dry QAC based compounds.

Floor Sanitizing. It has been widely documented that the most prevalent location for positive *Listeria monocytogenes* findings in USDA inspected meat plants are "floors" and "floor drains." In 2004, the University of Wisconsin-Madison conducted an audit of 31 USDA inspected RTE meat plants and found 27.8% of the floors and drains they tested were positive for *Listeria* (32 positives/115 samples). Similar studies have been conducted in non RTE environments, and include other organisms such as *Salmonella spp*. and *E. coli spp*.

While the use of cleaners and sanitizers during sanitation are designed to mitigate the risk of these pathogens, floors and drains are notoriously difficult to clean and are easily re-contaminated during production. Used correctly, dry floor sanitizers can be a valuable tool in eliminating pathogens on floors, in drains, and in entryways by providing a continuous residual sanitizer in cracks, crevices, and other difficult to clean areas of the floor.

In order to use a dry floor treatment as a floor sanitizer in a USDA or FDA inspected plant, the product must be registered with the EPA with specific claims as a "floor sanitizer." Under the FIFRA, a product must be registered with the EPA if it is intended for "preventing, destroying, repelling, or mitigating any pest." Further clarifying, any agent used to "disinfect, sanitize, reduce, or mitigate growth or development of microbiological organisms" on hard surfaces is considered a pesticide and must be registered with the EPA.

To date, only two products have submitted the required efficacy data to kill organisms on floors and received EPA approval as floor sanitizers: a powder-based upon a proprietary PerQuat formulation (Sterilex Corp., Hunt Valley, Md.) and a blended QAC-based bead (Ecolab Inc., St. Paul, Minn.).

QAC based floor sanitizers differ from available dry QAC floor cleaners in that QAC sanitizer manufacturers have submitted the required efficacy data to the EPA to demonstrate at least a 3 log reduction to kill food pathogens such as *Listeria*, *Salmonella*, and *E. coli* on floors. QAC based floor sanitizers have broad spectrum activity on clean floors but are less effective in areas of high organic load such as when mixed with dairy residues or if biofilms are present on a surface.

Another product approved by the EPA as a floor sanitizer is a proprietary dry formulation based upon PerQuat technology. PerQuat based products have been marketed for several years in liquid form as hard surface disinfectants and biofilm removal agents, and that same technology is now offered in a dry form for floor sanitization. This dry product contains both percarbonates as well as QAC components to provide broad spectrum sanitizing activity in the presence of organic soils as well as residual activity. This product has EPA approval to kill organisms such as *Listeria*, *Salmonella*, and *E. Coli*.

If your HACCP plan includes the use of a dry floor sanitizer to prevent pathogens from surviving on the floor, one of these two products must be used in order to be in compliance. If you intend to use your existing dry floor product to kill microorganisms, make sure to ask the manufacturer for a copy of the EPA registered label with use directions for "floor sanitization." Floor sanitizers should always be applied as per the use instructions on the product label.

Product Attributes

Dry floor treatments are available in a number of forms. Most dry products are either sold as beads, large granules, or as free flowing powders. Beads and large granules are generally less dusty than free flowing powders but can make the floor slippery. Free flowing powders, on the other hand, are commonly designed to crush when

(Continued on p. 32)

(Continued from p. 31)

walked on or when a forklift drives over the treated area, and should aid with traction. In addition, unlike larger beads, smaller granules and free flowing powders are more likely to fit into small cracks in concrete floors, treating difficult to reach areas.

A number of dry floor products are marketed as "time release." Dry floor products are typically reapplied once most of the applied powder has been activated by moisture and/or are no longer on a surface. Time between re-application varies depending upon the amount of water on the floor, the amount of moisture in the air, the size of the dry product's bead or granule, and the microbial/soil load on the floor. In general, the larger the bead, the longer it will take for the bead to dissolve in moisture.

Some dry products are available with a dye to help differentiate the cleaner/sanitizer from edible ingredients. If choosing a dry product with a color, it may be best to trial the product in a small inconspicuous area to ensure that the dye in the product does not stain the floor surface.

Application

Unlike liquid cleaners and sanitizers which are typically applied as a spray, foam, or soak during set sanitation shifts, dry floor treatments often remain in place during production, providing residual activity between sanitation shifts. Therefore, the use of dry floor treatments offers particular benefit for plants with extended production runs or very dry environments where wet cleaning is seldom performed, if at all.

All dry floor products currently require moisture to be activated. As moisture generated from production, on the bottom of boots or forklifts, or from the general environment comes into contact with a dry floor compound, the chemicals are released. Without moisture, dry products have the potential to clean or sanitize, but water is always needed in order to solubilize the active agents. However, the moisture needed to activate a dry product does not always have to be manually added. In some cases, environmental moisture may be sufficient to activate the floor product.

Dry cleaners and sanitizers are most active in areas that will be coming into contact with water during the day. Floors near and around drains, trench drains, and difficult to reach areas under processing equipment are ideal areas for application of dry floor treatments. In addition, many processors are now incorporating dry floor sanitizers in footbaths and floor mats at the entrance to processing areas. As personnel walk through the activated dry products, the bottoms of boots are sanitized, preventing cross contamination.

It is common practice to "broadcast" dry floor treatments onto a floor using either large scoops or fertilizer spreaders. While these methods may be efficient in spreading large quantities of dry compounds in a short period of time, it is highly recommended to apply a dry product as per the label instructions (for EPA registered floor sanitizers, it is required that label dosage directions be followed). Simply broadcasting large quantities of a floor cleaner or sanitizer can result in unnecessarily wasted product.

When applying any dry product, proper PPE should be worn by anyone applying the product. By their nature, dry products will release some dust when applied. At a minimum, dust masks, gloves, and eye protection (goggles/face shields) are recommended when applying dry products to a floor and application should be done in a well-ventilated environment. In addition, dust can be minimized by avoiding shaking the drum of dry chemical which can cause granules to break up into smaller, dustier particles. If possible, applying the product to a damp floor can also help to diminish dust particles and activate the product.

It is also important to be aware of your dry product's compatibility with floor materials such as concrete (treated and untreated) as well as terrazzo tiles. Treated as well as untreated concrete floors are generally compatible with most QAC-based and percarbonate-based dry floor products; however, individual products should be tested in a small area prior to general use to verify compatibility.

Choosing a Floor Treatment

The first factor in choosing a dry floor treatment to use in your facility is determining required product performance attributes; what do you expect the product to accomplish? If you wish to use the dry treatment to sanitize floors and prevent organisms from cross contaminating, you are limited to a dry product which is EPA registered to sanitize floors, of which there are two currently available on the market.

However, if your goal is to clean and deodorize, your options are less limited. Your choice of an ideal active agent depends upon the organic load you expect to be on the floors, the residual cleaning, and deodorizing activity provided by your floor treatment, as well as your wastewater sensitivity to QACs or high levels of ammonia.

Another factor to consider is the size of granule. Larger granules are generally less dusty than powders and may last a longer period of time in dry form before needing to re-apply. However, they can also make a floor slippery.

When comparing the cost of dry floor treatments, price per pound is usually not the best method to estimate the total cost of a dry program. Instead, look at each product's label for dosage recommendations and instead compare price per square foot. For example, if a floor sanitizer costs $3.00/lb. and has label instructions to apply 4 oz./100 SF, the total cost of this program is $0.75/SF. However, a floor sanitizer sold at $1.50/lb. but labeled to apply at 4 oz./10 SF, would cost $3.75/SF to apply.

Finally, it is important to set clear metrics for success when trialing a new dry floor treatment. If trialing a floor sanitizer, having baseline microbiological data on floors and drains for pre- and post-treatment comparison is valuable. When comparing floor deodorizers, choose two similar areas of the plant and document odors and cleanliness over the course of a two-week period. Note how many re-applications were needed over those two weeks, any changes to the floor's appearance, slipperiness, and if any wastewater effects were seen.

In summary, dry floor products are a valuable tool as part of a comprehensive plant sanitation program. The ability to apply a product that is slowly activated by moisture over time offers a clear value to plants with extended runs, infrequent or nonexistent wet cleaning shifts, and in areas that are difficult to clean and prone to contamination during production including high traffic areas. However, it is crucial that attention be paid to label claims, efficacy parameters, and regulatory approvals of the products under consideration. ■

Josowitz is the director of business development for Sterilex Corp., a provider of proprietary sanitation solutions to the food industry. He can be reached at 800-511-1639 ext. 103 or by email at alex@sterilex.com.

REFERENCES FURNISHED UPON REQUEST

Protecting the Hands that Feeds

How do you determine what glove to use for each application in such a multifaceted industry? | BY **SHARON ANN QUINN**

Frequent contact with blood and bacteria, extreme fluctuations in temperature, sharp knives, and dangerous cutting machines... it's hardly surprising that the food industry accounts for roughly 15.3 percent of all manufacturing injuries. At the same time, food regulations are getting more stringent every day. Personal protective equipment (PPE) therefore is more important than ever in the food sector. With the majority of food handling operations being manual, efficient hand protection is an excellent starting point.

Recent statistics from the U.S. Occupational Safety and Health Administration (2010) show that the incidence rate for manufacturing injuries in the food industry lies considerably higher than in general manufacturing: 5.8 compared to 4.4, per 100 workers. Not only do these numbers give an insight into the often risky conditions on the floor, they also define a clear need for more adequate protection.

When considering the procurement of protective equipment, purchasers are often overwhelmed by a seemingly infinite amount of choices. This is especially true for hand protection and gloves, where terms like "gauge," "dexterity," "grip," "cut resistance," and "cut protection" may cause confusion. Picking the wrong glove can be expensive—a nightmare for a cost-driven industry like food—and can have a negative impact on productivity. Keeping in mind a few key aspects will stand you in good stead.

A Unique Set of Circumstances

Before determining the necessary steps to assign the right glove to the right task, there is one important consideration to make: The food industry differs greatly from other sectors when it comes to hand protection. In most other industries, automation continues to increase while the need for human intervention diminishes. In contrast, many tasks in the food processing industry are still done by hand. As workers' hands are in direct contact with cutting and slicing machinery, cut- and puncture-resistance is key but the complexity of the tasks demands dexterity and comfort. Additionally, the hands are exposed to animal blood, fats, and bacteria, which make efficient liquid protection an absolute priority. The rapidly changing legislation concerning food processing and contamination risks backs up that requirement. Last but not least, the carpal tunnel syndrome debate has lowered the proportion of repetitive work in food and other industries. As a result, one worker now has several tasks to attend to, each with their own safety hazards and equipment requirements.

Rethinking the Selection Process

Intensive market research has shown that the classic approach of selecting protection gear through risk categories—mechanical, chemical, and liquid protection—does not work for the food industry. It is rather the protection need—cut resistance, thermal resistance, puncture and abrasion resistance, and liquid resistance that determines which glove is the most suitable. Users need to consider the type of operation (e.g. meat processing, beverages, dairy products, cereal, and milling), the primary type of food handled, and the worker task (e.g. reception of live animals, sawing machines, slicing, cleaning). In this way, it makes far more sense for manufacturers as well as end-users to categorize the equipment by application segments that define the gloves' purpose: Cut-resistant, thermal-resistant, liners, general-purpose, puncture- and abrasion-resistant, and liquid resistant gloves.

Cut Resistance

Despite their immediate link with food quality, cut injuries continue to be one of the most common risks in food processing. Prevention requires a thorough understanding of the influences that cause these injuries. Obvious risks are the handling of sharp objects like knives, blades, and cutting tools. Still, there are other contributing factors too, such as the weight of the object being handled, grip, and handling angle, and the fact that workers often have to stand close to each other, which heightens the risk of accidentally hurting one another. These cannot be tackled by equipment alone, but require an analysis of the working conditions, including machine guarding, setup, and training.

(Continued on p. 34)

(Continued from p. 33)

In the case of safety gloves, cut resistance is a function of the material composition and, to some extent, thickness. Ensuring that workers wear the proper cut-resistant gloves or sleeves is the first step in lowering the number of cut injuries in the workplace.

Liquid Protection

Through an abundance of moisture, oils, and fats, food-processing operations can get pretty messy. Most importantly, these substances can make it difficult to handle materials and food particles, thus creating major challenges for hand protection and productivity. In this case, proprietary material blends and surfacing methods can offer a solution for wet, dry, and oily conditions. Each surface pattern or webbing is specifically intended for a certain kind of food processing application. For example, a fish scale pattern could offer a good suction grip for working with wet or fatty food, such as poultry and fish processing, while a sand patch design channels fats and greases away from the surface of the glove and makes handling beef or lamb a lot easier.

Apart from surface and grip, cuffs greatly impact the functionality of a liquid-resistant glove as well. The design of the cuff is applied to a specific type of glove to solve problems associated with the environment and applications for which the glove is used. For instance, most disposable or single-use gloves are used in applications that are wet or oily, thus making a beaded cuff design (which catches droplets of liquids, oils, and chemicals) the most logical solution.

Other variables of importance include material, liners, abrasion, length, and thickness. In materials, natural rubber latex (NRL) and nitrile are the two most common options. NRL is most frequently used in poultry and fish operations, while nitrile is recommended when working with the types of fats inherent in meats like beef, lamb, and pork. When making a choice, keep in mind potential latex allergies as well.

Lined gloves have an internal knitted or woven liner. They are also a good choice for a liquid-resistant glove when worn over cut protection gloves. That adds increased protection and improved sweat management. Flock-lined means the gloves have an internal coating of short cotton fibers that promote easier donning of gloves as well as improved comfort. Not only do lined gloves offer a higher degree of dexterity and tactility than unlined gloves, depending on what type of coverage you are seeking, glove length is also something to consider. Essentially, the longer the glove, the more protection it offers the wearer.

In many food processing operations, workers choose to wear a liner for warmth or moisture management under a cut-resistant glove with a liquid-resistant glove on top. Depending on the type of operation, the reverse (a cut resistant over a liquid-resistant glove), is also possible. In PPE, manufacturers are constantly conducting research to develop a glove that combines the functionalities of several different products.

Closely linked to liquid protection is chemical resistance; an application that's not too common in food processing but still worth considering when working with harmful chemicals to sanitize food processing operations. Protecting workers' hands is vital to a successful sanitation program.

Disposable Gloves

When looking at gloves for the food processing market, there's a relatively even mix of both high performance gloves for interacting directly with raw food products and commoditized single-use gloves. In this heavily regulated industry, it is hardly surprising that disposable gloves take up such a big part of the market as they significantly diminish the risk of contamination. Some of the most commonly used materials are NRL, PVC, and nitrile. Each has its own advantages. For instance, NRL is known for its elasticity, sensitivity, and liquid resistance, while vinyl feels less restricting, and nitrile contains no organic proteins that can cause allergic reactions.

One of the most common misconceptions is that a thicker glove is a better glove. Nowadays, through advances in research and development, many 3 mil gloves offer the same or even better tensile strength than a standard 5 mil glove. Therefore, it is important to consider other factors, such as the type of food product being handled and which grip pattern is best suited for it, when choosing disposable gloves.

In many food processing applications, workers wear a disposable or liquid protective glove over a cut-resistant or thermal glove to increase grip or help protect the under-glove from becoming wet or soiled quickly. Because disposables are relatively thin and flexible, they are well-suited for this purpose as bulkiness is kept to a minimum.

Thermal Resistance

The environment ambient temperature where the gloves will be worn, the tasks the workers will be performing, the length of contact with extreme cold or heat, and the type of materials being handled (wet, chemicals, or raw food products) are things to consider when choosing the right glove for thermal protection. For example, working outdoors in the cold or working in a freezer environment will require two different pairs of gloves. The same holds true for heat protection gloves. In both cases, the greater the protection required (extreme heat or cold and more than 15 minutes of continual contact), the thicker and heavier the gloves will need to be.

Some thermal gloves are designed to be used along with others. In many meat processing applications, a cold protective thermal liner is worn under a cut protective glove or a liquid protective liner over a cut protective glove. For cold storage or freezer applications, a cold protective liner is sometimes worn under a general purpose or liquid protective glove.

In Summary

There are many different factors at play when hand protection is really taken seriously. Going through the entire cycle of analyzing your own specific needs and picking the right product may seem like a daunting task. However, making the wrong choice can prove to be an expensive mistake. And it's not just in the employees' interest. Taking the right safety measures will increase your business' efficiency, improve productivity, and help lower costs. ■

Quinn is senior director, specialty markets, Global Business Unit at Ansell. She can be reached at sharonann.quinn@ansell.com.

How to Know if a Pest Management Company is the Right Fit

Six essential questions to ask during your search in finding the best pest management provider for your facility

BY **ZIA SIDDIQI, PHD, BCE**

Editor's Note: *This is the second in a five-part series of articles that will provide a practical approach to various pest control topics.*

When you're interviewing candidates for a position at your facility, you make sure to ask plenty of questions to see if they're competent and compatible, right? And you do it because it's important to ascertain what type of quality and performance you can expect from the candidates if they are hired.

But what do you do when searching for a pest management provider? Do you simply choose the most affordable option? Do you automatically go with the most popular brand in local area? Or, do you treat the situation as you would treat an interview with a candidate for a job opening—asking the right questions to determine whether the company is a good fit for your facility?

Every pest management company is unique, offering different services and products to food processing facilities. However, there are six important questions you should ask while meeting with pest management company representatives to ensure their work will address your needs and exceed your expectations. They include the following.

1. Are your pest management solutions customized based on the customer's situation? To put it shortly, a "one-size-fits-all" solution to pest management for food processing facilities does not exist. Facility managers should understand that pest management solutions must be customized based on the size of the facility, type of pests, and severity of pest activity. If the pest management company does not customize treatment programs based on the facility's specific needs (by conducting an initial assessment), then that raises a huge red flag. Further, pest management companies should have technicians that thoroughly understand pest behavior and how to manage pest activity. This means science plays a major role in the creation of effective treatment programs. If the solution doesn't have a foundation in science, you may want to consider another pest management company.

(Continued on p. 36)

(Continued from p. 35)

2. Do your pest management programs take a proactive or reactive approach? Facility managers should remember a proactive approach to pest management is the key to establishing a safe food processing environment. By proactively performing facility maintenance procedures and implementing a sanitation regime, your facility will have already taken a large step toward preventing pest activity. Integrated Pest Management (IPM) is an approach that focuses on proactive and preventive measures, limiting conditions conducive to pest infestations. IPM also reduces the need for traditional chemical-based treatments. A true IPM program should be dynamic, rather than static. If the pest management provider only begins treating a pest infestation after it has taken root, rather than proactively working to prevent pest activity in the first place, it may be in your best interest to continue the search for a provider.

3. Do you provide documentation that details every service visit and action taken to manage pest activity? This year, the FDA announced a major change to the Food Safety Modernization Act (FSMA). A new rule under FSMA will require facilities to develop and execute written food safety plans that detail likely hazards, corrective actions, results, and more. As facility managers, it's important for you to understand that the pest management professional should be completing thorough documentation of the service visits and enforced solutions. A copy of this documentation should remain onsite at the facility at all times in case an inspector is auditing.

> Do you treat your search for a pest management provider as you would treat an interview with a candidate for a job opening?

4. Do you offer third-party audit support? Pest management plays a major role in third-party audits. In fact, up to 20 percent of the total audit score is attributed to the success of the pest management program. Along with providing thorough documentation of every service visit and corrective action, your pest management professional should work with you to ensure those documents are in proper order and presentable for auditors to review. It would also be helpful for your pest management provider to offer step-by-step assistance in regard to what you can expect from—and how you can prepare for—the third-party auditor based on complying food safety standards. For example, three common third-party audit standards for food processing facilities are Safe Quality Food (SQF) and the British Retail Consortium (BRC) under the Global Food Safety Initiative (GFSI) scheme, and the American Institute of Baking (AIB).

5. How do you guarantee your pest management professionals comply with company standards? Ensure the pest management professionals who service your facility are performing in a manner that complies with company standards. Look for a provider that monitors their pest management professional in one way or another, whether through internal performance reviews or audits. This process helps to certify that your pest management program is being implemented in the most effective and efficient way possible.

6. Will your team help to educate staff members about their role in the pest management plan? Part of building a great relationship with a pest management provider is working on establishing a true partnership. Your provider should go above and beyond routine service visits and treatments. A provider should also take the time to educate your employees about the role they play in the facility's pest management program. During your meetings with potential providers, ask if they offer staff trainings or educational materials such as tip sheets, checklists, and informational pamphlets to help your staff put pest management into perspective.

If the pest management provider can answer each of these questions affirmatively, you'll be on the right track to finding a suitable team for your facility. ■

Dr. Siddiqi is director of quality systems for Orkin, LLC. A board certified entomologist with more than 30 years in the industry, he is an acknowledged leader in the field of pest management. Dr. Siddiqi can be reached at zsiddiqi@orkin.com.

Reducing the Unique Risks in Sprouts

Best practices for sampling and microbial testing during sprout production

BY **STEPHEN GROVE, PHD**

Sprouts are considered a healthy and highly nutritious food, often eaten raw in the U.S. on salads and in sandwiches. However, sprouts have also been linked to a number of outbreaks of foodborne illness in the past two decades. According to the Center for Science in the Public Interest (CSPI, 2011), 46 outbreaks related to consumption of sprouts were recorded between 1990 and 2011, causing at least 2,500 illnesses. *Salmonella* and pathogenic *E. coli* were responsible for the majority of outbreaks, and *Listeria monocytogenes* the cause of one.

These bacterial pathogens thrive under the same conditions that are used to sprout seeds. The warm, moist and nutrient-rich conditions will promote the growth of even a small number of cells to a high level.

FDA Guidance

In the second half of the 1990s, a number of large outbreaks resulting in more than 1,000 cases of illness prompted the FDA to issue two guidance documents to the industry in 1999. The first, entitled "Guid-

(Continued on p. 38)

(Continued from p. 37)

ance for Industry – Reducing Microbial Food Safety Hazards For Sprouted Seeds," outlined preventive controls that sprout producers should undertake to minimize the risk of sprouts being a vehicle of foodborne illness (FDA, 1999a). The guidelines were largely based on recommendations provided by the National Advisory Committee on Microbiological Criteria for Foods (NACMCF, 1999), including that seeds should be grown under good agricultural practices (GAPs), sprout producers should employ good sanitation practices, seeds should be treated with an approved sanitizer to reduce the number of pathogens that may be present on the seed surface, and that spent irrigation water during sprouting should be tested from each production lot.

The second guidance document, entitled "Guidance for Industry: Sampling and Microbial Testing of Spent Irrigation Water During Sprout Production," was written specifically to guide sprout producers through the steps necessary to test the spent irrigation water for the two major pathogens of concern in raw sprouts, *Salmonella* and *E. coli* O157:H7 (FDA, 1999b).

Recommendations

Spent irrigation water is water that has flowed over and through sprouting seeds and then drained off. The array of microorganisms in this water is a good indicator of the types of microorganisms present in the sprouts. It's generally recommended that sprouters test spent irrigation water for pathogenic bacteria rather than testing the sprouts themselves, for several reasons. First, bacteria are often distributed sporadically in sprout seeds, but are generally distributed uniformly throughout spent irrigation water. Second, testing spent irrigation water is easier than sprouts because no additional steps to release microorganisms into the liquid are needed. Therefore, proper sampling and testing of spent irrigation water is important to detect bacterial pathogens that may be present in sprouts.

Many varieties of sprouts are grown around the world and in the U.S., requiring various growing times and conditions. The FDA guidance document on spent irrigation water testing was written with a focus on alfalfa and mung bean sprouts, where pathogenic bacteria, if present, are likely to be at their highest levels at or after 48 hours from the start of the sprouting process. Collection of samples for testing was therefore recommended to be performed at least 48 hours after sprouting, including any length of time that seeds are presoaked prior to irrigation.

> Testing spent irrigation water is easier than sprouts because no additional steps to release microorganisms into the liquid are needed.

Testing should be performed at an appropriate time that ensures the sprouter will obtain test results before product is shipped. A number of rapid test kits are listed in the FDA guidance and these screening tests can provide a presence or absence result for *Salmonella* and *E. coli* O157:H7 within 48 hours. Therefore, by collecting samples at least 48 hours prior to shipping product, the test result can be known to the company prior to making a decision on whether or not to ship the product.

The FDA guidance document recommends that spent irrigation water be sampled from each production lot or batch, described as "sprouts from a single lot of seed that were started at the same time in a single growing unit (i.e., a single drum or rack of trays)." Generally, 1 liter of water is recommended for sampling spent irrigation water, collected as the water leaves a drum or trays during the irrigation cycle. Pooling from different production batches is discouraged since any pathogens present may be diluted with samples that are not contaminated. In addition, if a presumptive positive is found in a pooled sample, the sprouter would need to either discard all batches represented by the pooled sample or retest each individual batch in order to determine which is/are contaminated.

Hurdles and Solutions

Other types of sprouts present a challenge in recommending a best practice for testing. Some types of sprouts are commonly irrigated for less than 48 hours, and if microbiological testing is performed, results may not be reported to the sprout producer prior to the product entering the food supply. In such a case, a sprout producer may instead sample the sprouts themselves, rather than the spent irrigation water. The concern in this case is that detecting a low level of contamination present in the sprouts is challenging.

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It's generally recommended that sprouters test spent irrigation water for pathogenic bacteria rather than testing the sprouts themselves.

The recommendations in the two FDA guidance documents, along with other resources, including documents from international scientific bodies, international regulations, training material, etc., relating to best practices for sprout safety are currently being evaluated and used to develop a core curriculum by the Sprout Safety Alliance (SSA), a public-private alliance between stakeholders from the food industry, academia, and federal, state, and local food protection agencies. The SSA was created by the FDA in cooperation with Illinois Institute of Technology's Institute for Food Safety and Health in 2012 to enhance the sprout industry's understanding and implementation of best practices for improving sprout safety. The SSA aims to develop a core curriculum and training program for stakeholders in the sprout production community for improving sprout safety and understanding the requirements outlined in the FDA Proposed Rule on Standards for Produce Safety.

Under FSMA

Sprout producers will likely need to adhere to the appropriate requirements in the Proposed Rule covering fresh produce safety under the FDA's Food Safety Modernization Act (FSMA), and in particular, in the specific section on sprouts (FDA, 2013). The proposed requirements include using a scientifically valid method to treat seeds immediately prior to sprouting in order to reduce pathogens that may be present on the seeds. The FDA also proposes that sprout producers perform environmental testing for *Listeria spp.* or *L. monocytogenes*, and test spent irrigation water or sprouts for *Salmonella* and *E. coli* O157:H7. In each case, a written sampling plan must be prepared and include considerations of when, how, where, and what to sample, and for spent irrigation water testing, how much sample to collect.

The SSA is working with sprout producers, academic researchers, and other stakeholders to develop best practices for sampling so sprout producers large and small can benchmark their current practices, and strive to improve their practices surrounding sprout safety. Mock sampling and testing plans are expected to be part of the SSA training program, in order to assist the sprout industry, and particularly the small sprout producers, with developing their own individual plans.

Raw sprouts will continue to have safety concerns due to the inherent issues surrounding their growth, which also promote the growth of any pathogenic bacteria that may be present. Testing sprout spent irrigation water for bacterial pathogens has long been known to be an effective tool, amongst others, that can be used to improve the safety of sprouts. ■

Dr. Grove is manager, industry projects/research assistant professor for the Institute for Food Safety and Health, Illinois Institute of Technology. He is also the coordinator for the Sprout Safety Alliance, www.iit.edu/ifsh/sprout_safety. Dr. Grove can be reached at sgrove@iit.edu.

REFERENCES FURNISHED UPON REQUEST

Quality

CONTRACT LABS

Handy Contract Labs: Not Just for Testing Anymore

Contract labs help fulfill many roles by serving as multi-faceted verification tools, technical resources, and partners in the quality and food safety management system

BY **VIRGINIA DEIBEL, PHD,** AND **JOSEPH D. MEYER**

The story about contract lab services used to read: "Once upon a time, contract laboratories were places where tests were run and results were generated. The end."

Today, the story is quite different. While a food manufacturer's goal is to provide quality products that meet the needs and expectations of consumers, the stakes are at an all-time high to ensure quality and safety. To aid in this goal, contract labs can play an integral part.

The specific roles for laboratories have changed and contract labs are now considered as collaborators in the manufacturer's food safety system. Contract labs play a multitude of roles in the collaboration of quality and safe food production by serving as a multi-faceted verification tools and technical resources.

The scope of how integrated the lab becomes in the manufacturing process will vary from manufacturer to manufacturer, but the following are some areas to explore as tangible benefits that can be provided.

Multi-Faceted Verification Tool

Quality and safety testing is a primary function when considering contract lab services that assist in food manufacture. Ongoing testing of finished products, equipment, plant infrastructure, and raw materials all embody a robust monitoring process to verify that a Hazard Analysis and Critical Control Points (HACCP) plan, Good Manufacturing Practices (GMPs), and prerequisite programs are functioning as designed. Tasks can include:

- Testing incoming materials against a purchase specification,
- Periodic testing of materials against baseline or historical values,
- In-process tests to ensure the process is operating within specification,
- Finished product tests against internal or external product specifications,
- Environmental testing to verify sanitation, traffic control, and GMPs are working as intended,
- Supplier/co-manufacturer qualification testing,
- New product verification,
- Process start-up,
- Change-over practices, and
- New equipment validation.

For many manufacturers, it is not practical or feasible to do all verification testing in-house. A contract lab can provide the manufacturer increased testing capability and capacity to verify that the quality and safety programs are on track. Additionally, the contract lab has the capacity to handle the larger than normal testing volumes required by these activities. Also of importance, a contract lab provides the additional benefit of providing test results viewed as being "unbiased."

Technical Resource

A contract lab can help ensure food quality and safety by providing additional technical resources to food manufacturers. These resources may come in the form of additional methods, specialized equipment, or technical knowledge. Many manufacturers either do not have an internal lab or their internal labs have limitations on their testing capabilities. For example, only one method is available to test for a specific organism or no methods are available to test for a complex group of organisms that affect quality, as may be the case with lactic acid bacteria.

Utilizing the best tools helps drive ongoing quality and safety improvements. A contract lab can provide access to methods unavailable in an internal lab due to

equipment costs, lack of scientific expertise, time constraints, or high reagent costs because of decreased volume purchasing power. Access to specialized equipment increases access to additional method options. As test methods become more specialized and sensitive, entering into new test methodology can become cost prohibitive, and upkeep costs further add to the barrier to new technology. However, the advantages are that new methods may provide increased sensitivity or specificity, which may be critical in lot disposition determinations.

Contract labs may also conduct testing that provides further information such as when routine tests results are inconclusive, presumptive, out of spec, or point to other potential concerns. This additional level of information can provide insight and direction into the root cause investigation of potential issues. Similarly, these methods may aid in verifying the effectiveness of corrective/preventative actions, when taken. Consider a *Salmonella* assay: To aid with trending or investigations, serological information is an important tool that enables a producer to know if a harborage site is present, if contamination was removed during sanitation, or if cross-contamination is occurring from one area of the plant to another.

Having a choice of methods also allows for an opportunity to readily compare methods, identify, and then choose the one that best suits the product, process, time restraints, information, and cost needs.

The area perhaps the least explored, but potentially the most valuable, is the technical knowledge that is available to the food manufacturer through the contract lab staff. Contract labs have the educational background and experience within their personnel who can assist in understanding method limitations, identifying the best method for a specific product matrix, or identifying the best method based on testing objectives. They are also a source of information on newly available methods.

The technical knowledge available in the contract lab often goes beyond methodology and may include areas such as product specific knowledge (i.e. quality defects, causes, troubleshooting, and solutions), process experience, and food safety and quality programs. Contract labs may also have access to additional knowledge networks through their external relationships. Their staff are typically exposed to a wide range of products and matrices which adds to their ability to solve analytical challenges.

A Partner in the Quality and Food Safety Management System

As a manufacturer's relationship with a contract lab matures, it can go beyond transactional and become more consultative. The contract lab can play a more active role in the manufacturer's food safety system and become an extension of the management system. In this regard, the contract lab is a collaborator. Potential types of management systems include the following.

Test result management. One example of test result management is the contract lab's direct management of test results and historical data. Online visibility, data trending, and tracking are examples of data management. This could include data compiled from multiple manufacturing locations or from multiple suppliers. The typical contract lab has an advanced data management system that can provide direct communication of results and also communication of results requiring action. For those results requiring further action, the lab may be able to provide resources to assist with those actions.

Supplier management. Contract lab integration may work directly with the food manufacturer's raw material suppliers to schedule testing and provide direct communication of results prior to release of materials for shipping. As stated above, when combined with the finished product testing, the compiled data can be used to quickly flag potential issues.

Product and process development. Contract labs can support product and process development by providing consulting or onsite resources to design a test regime, collect and test samples, perform a data review, and assist with further actions based on the results.

The contract labs of today offer a wide variety of collaborative options to help ensure the safety and quality of the foods manufacturers produce. They should be viewed as an extension of the manufacturer's own capabilities. Developing a good working relationship with shared expectations is the key. Knowing all of the capabilities that the contract lab has to offer will help maximize the benefit that a contract lab can bring to a quality and safety management system. The benefit should go well beyond "a place where tests were run and results were generated." ■

Dr. Deibel is the director of microbiology, nutritional chemistry and food safety, for Covance Inc. She can be reached at virginia.deibel@covance.com. **Meyer** is the director, microbiology, at Covance. He can be reached at joseph.meyer@covance.com.

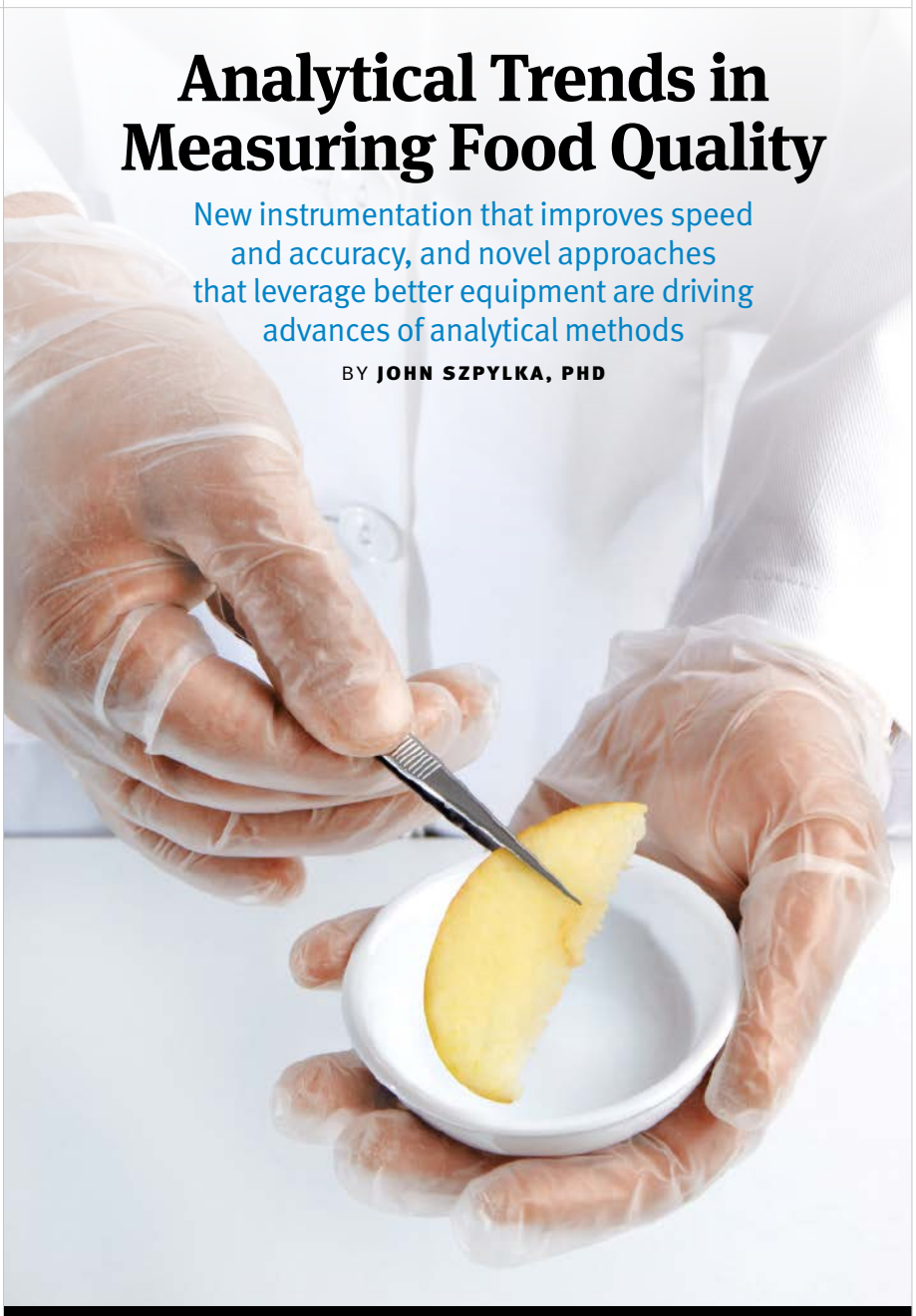
In the Lab

ADVANCES IN LAB METHODS

Analytical Trends in Measuring Food Quality

New instrumentation that improves speed and accuracy, and novel approaches that leverage better equipment are driving advances of analytical methods

BY **JOHN SZPYLKA, PHD**



As the tools of analytical measurement continue to get more sensitive, more specific, and faster, the industries using these tools must keep up with the changes. New methods of testing for food quality continue to be developed alongside improving traditional methods of analysis. All of these advancements set new standards and protocols on how the quality of foods and of their ingredients is defined and monitored. Understanding some of the general trends is needed to plan for what lies ahead.

LC-MS/MS Technology

Use of liquid chromatography-mass spectrometry/mass spectrometry (LC-MS/MS) has grown rapidly in the field of food testing. LC-MS/MS is being utilized more in food company quality and R&D divisions as a flexible alternative to traditional methods due to its high sensitivity and faster throughput.

An excellent overview on the use of LC-MS/MS to monitor for food contamination was published in the February/March 2011 issue of *Food Quality*[1] where Andre Schreiber and Art Sims highlighted the advantages of LC-MS/MS technology. Since that publication, those advantages have been further leveraged for the analysis of food nutrients.

Analytical methods which use LC-MS/MS are being rapidly developed due to the technique's high sensitivity, selectivity, accuracy, and increased availability of isotopic standards. An additional advantage is the reduced amount of clean-up required because of the mass spectrometer's high specificity. As the resolution of and software for MS detectors increase and improve, the ability of the MS detector to "filter out" potential interferences is taken advantage of by the new methods.

AOAC International has recently adopted LC-MS/MS methods for the analysis of vitamin D (AOAC 2011.11, 2011.12, 2011.13, 2012.11). Each of these methods takes advantage of the points highlighted above alongside the additional advantage of LC-MS/MS simultaneously using MS/MS to confirm the identity of the vitamins being tested. After a vitamin's parent ion is identified, two daughter ions are created by fragmenting the parent ion, and these daughters are used to confirm the identity of the vitamin. The daughter ion levels are also used to quantify both vitamin D2 and vitamin D3.

LC-MS/MS analysis of certain vitamins is complicated for vitamins which are bioactive in several forms, with some of those forms typically in low concentrations. The recently adopted method, AOAC 2011.06[2] for the measurement of total folates (vitamin B9) does quantify six forms of vitamin B9 including the common fortifying form of folic acid[3]. Research is underway to measure other vitamins present is various bioactive forms. The common

approaches include converting the different forms into one form (i.e., saponification converting the multiple forms of vitamin A into the retinol form, and conversion of multiple forms of vitamin B12 into cyanocobalamin).

UPLC and UHPLC Technology

Ultra Performance Liquid Chromatography (UPLC) and its equivalent Ultra High Performance Chromatography (UHPLC) are recently developed companions to traditional high performance liquid chromatography (HPLC). UPLC and UHPLC can separate compounds in less time than HPLC while using less solvent. This is due to the development of columns containing uniform, smaller particle sizes (in the 1.7 µm scale) which increase the column's theoretical plates, thus improving peak separation efficiency (better peak resolution). The time needed for peak separation is therefore decreased. To use these columns, higher pressures are needed to push mobile phase through the bed of smaller particle-sized stationary phase.

When this technology first appeared, a somewhat limited number of columns were available. As the efficiency and reliability of this technology was recognized, the number of columns has increased dramatically. Use of this technology is becoming more common.

The QuEChERS method is a streamlined version of extracting pesticides combined with GC-MS/MS and LC-MS/MS separation and quantification.

Advances in Methods

In the world of pesticides testing, the QuEChERS extraction is becoming more prevalent. The acronym of Quick Easy Cheap Effective Rugged Safe highlights desired method attributes by the laboratory, by the customers, and by management who sets financial budgets.

Early pesticide methods were targeted for specific pesticides. A welcome development was the development of methods which extract and quantify a broader scope of pesticides. One common example was the Luke extraction with rapid extraction followed by pesticide detection using a number of chromatographic systems with specific detectors. Confirmation of detected pesticides was performed by subsequent analysis using a mass spectrometer detector. This approach is being used less often, however, it is still available due to its versatility in testing for some matrix types.

The QuEChERS method is a streamlined version of extracting pesticides combined with GC-MS/MS and LC-MS/MS separation and quantification. This approach is very common today. The original method was developed in 2001/2002 by Michelango Anastassiades while at USDA in the laboratory of Steve Lehotay[4] and has since been standardized as AOAC 2007.01. This method has been demonstrated to reliably test for more than 300 pesticides in fruits, vegetables, and most grains. The scope of pesticides covered by the method can be expanded as needed.

(Continued on p. 44)

(Continued from p. 43)

When analyzing foods and ingredients outside the original scope, an "on-the-fly" method validation is performed. For example, if a laboratory is testing eggplant for the first time, the sample is analyzed alongside a spiked eggplant sample (matrix-match standards). Acceptable recovery of the spiked amounts demonstrates and documents the method's applicability for testing eggplant by the laboratory.

Improvements in Sensory Analysis

At one point in my career, I was a quality engineer for a yogurt company. On my first day at this new position, my boss told me to taste every type of product we make, including every product style, every flavor, and samples from all our production locations. I became quite the yogurt-tasting connoisseur, which was the intent of this exercise.

The more someone understands their products, the faster quality issues can be identified. More and more companies are asking production site personnel to taste finished products. Fully trained Sensory Panels are also becoming more common at production sites. Members of these panels receive training to calibrate their tasting of the foods with focus on identified key characteristics. For example, if a product's creaminess is recognized as a critical attribute, a commercially available product (i.e., a baby food) can be used to "remind" panel members what the desired creaminess level is.

Additional Thought

Encapsulation of nutrients to improve stability can challenge analytical methods. Traditional extraction techniques may need to be improved for use on these new ingredient forms, both on the base ingredients and on finished products. Some encapsulating agent(s) require more dedicated dispersal to safely liberate the protected nutrient. Some approaches include enzymatic digestion of the encapsulating agents (i.e., proteins, fats, starches), use of alternate solvents to break the encapsulation, adjusted heat treatments, sonication of the sample in the extraction solution, and more aggressive agitation.

In Closing

The food industry has benefited greatly from the constant improvement of the tools and processes to monitor food quality. This does require keeping abreast of what is occurring in the supporting area of analytical testing, but in the long run will result in better quality and safer foods. ■

Dr. Szpylka is the director of chemistry NA, Silliker Laboratories, a Merieux NutriSciences Co. He can be reached at john.szpylka@silliker.com.

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Serco Vertical Storing Dock Levelers directly contribute to environmental efficiency, security, and cleanliness.

Maintaining the Cold Chain: Links in Review

Summer is here as temperatures steadily rise across the U.S., so it's time to think about keeping your product cold and doing so in the most comprehensive, cost-effective manner

BY **NEIL CANAVAN**

For the most wide-ranging advice on cold chain management, a membership in the Global Cold Chain Alliance (GCCA), based in Alexandria, Va., might be a good first move. "It's critical that all parties work together to insure the maintenance of proper temperatures from the point of production to the point of the consumer," says GCCA president, Corey Rosenbusch. "It's our mission to promote that cause."

With an eight-year tenure at GCCA, and a membership encompassing stakeholders from 67 countries, Rosenbusch is conversant in the scope of the mission, the challenges, and the innovations to that end.

One growing concern is the needs of infrastructure—domestic and international.

Internationally, the concern involves the growth of the middle class in countries like China and India, and the inherent increase in demand for higher quality food products. "You've got apples that come (refrigerated) all the way from Washington state that come off a container ship and then sit in the sun because they don't have the temperature control infrastructure in place." The challenge is trying to coordinate successful export to markets where they are not quite ready to receive and distribute the product.

Domestically, there is burgeoning interest in automation due to increasing labor costs and expanded environmental regulations. "We're watching this very closely with the increased pressure, particularly here in the U.S.," says Rosenbusch. Though as yet, he observes that, unlike the European Union, the U.S. is lagging behind in the adoption of automation for cold chain management.

At the same time, Americans love their gadgets. The most important technological changes Rosenbusch has witnessed involve product tracking and warehouse management systems. "There's no paper anymore," he says. "It's all radio frequency tags [RFID]." This enables a customer to have real-time electronic data interchange regarding location and relative condition of product.

Not all the GCCA has to offer is broad in scope. For example, Rosenbusch just recently talked one of his members off a ledge after an ammonia leak (ammonia

(Continued on p. 46)

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is a commonly used refrigerant). "Leaks only happen on rare occasions, but it's a real crisis." And GCCA has a step-by-step plan in place to deal with such a crisis—removal of ammonia, evaluation of potentially exposed product, etc.

Automation, Infrastructure

Having the experience of building automated infrastructure, Gavin Sargeant, vice-president automation, Conestoga Cold Storage, Ontario, Calif., can comment on the slow uptake in the U.S. "Automation is the predominant method of cold storage in the E.U., but it's hard to get off the ground in the U.S. due to the capital expenditures," says Sargeant.

And it can be risky. "If you don't know what you're doing, even if an otherwise successful company invests in it and makes a mistake, it can be catastrophic."

Beyond capital outlay, the risk is in the initial design. For instance, if an automated cold storage facility doesn't account for product throughput you had in mind, you can't add more people and equipment to scale up. "You don't have that ability in an automated facility that's incorrectly designed—if the fundamental design of the system is incorrect, you're done."

Thus, third-party automated storage. "We determine our clients throughput needs, we design and manufacture the automated equipment, we build the buildings...they don't have the risk." And running the show is Conestoga software. "We hold our software very close to our hearts because that's key to the success of the tracking, throughput, and reliability of the system," says Sargeant.

Tech Trak

Perhaps there's been no bigger and ongoing impact on the industry than radio frequency identification (RFID). According to the just published report, "Strategic Analysis of Global RFID in Cold Chain Market," (Frost and Sullivan, Mountain View, Calif.) the estimated revenue from RFIDs in the cold chain market was $361.6 million in 2012, and this use is projected to expand by 27.5 percent through 2017.

What's driving the increase (besides simple utility)? Responding to the question via email, Nandini Bhattacharya, Frost and Sullivan analyst stated, "The

Xylem's ebro brand of data loggers offers critical visibility of the storage and transport conditions over time.

FDA mandates that value chain participants track and keep a record of the product temperature history...and they have the authority to penalize those who do not comply. This is pushing all the value chain participants to adopt and implement RFID."

This trend is not lost on Ray Caron, vice president of marketing and business development at DeltaTRAK, Pleasanton, Calif., a purveyor of RFID technology. For several years the company has been promoting the ColdTRAK system, a cloud-based application, available by subscription, for retrieving, analyzing, and sharing temperature data. The application enables viewing of trip data within minutes of the product reaching its destination.

More recently, DeltaTRAK has launched the ThermoTrace, TTI (Time and Temperature Indicator). "This combines two well understood technologies," explains Caron, those being the ubiquitous barcode, and, a bit less common, a chemical label that is physically altered by an environmental change. In this case, the chemical expands and migrates, altering the barcode. The combination of technologies results in a single-use TTI label that changes the barcode when exposed to temperatures exceeding a given threshold.

"The data can be retrieved by any barcode reader, or now, even smartphones," Caron says, and it can be integrated into any existing cold chain program.

Carrier's trailer refrigeration model 7500 from the X4 belt-driven series benefits from ecoFORWARD technology.

Reefer Gladness

In keeping with the adage, "necessity is the mother of invention," refrigerated transport (reefer) units for trucks have been recently improved. The necessity in this circumstance is being supplied by the impending deadline for compliance with the EPA's Tier IV emission standards for diesel engines; in response, the invention is a suite of technology improvements called, EcoFORWARD, launched last year by Carrier Transicold, Matawan, N.J., a provider in refrigerated transport systems.

"What started out as a compliance project turned into an opportunity for fleets and customers," says Transicold's director of marketing, David Kiefer. As Kiefer explains, rather than just tweak existing systems, why not look at compliance as a byproduct of improved performance. "We figured as long as we have to redesign the equipment, lets do it top to bottom."

The results of the extra time and effort are high-efficiency refrigeration components with smarter (2.2-liter diesel) engines, operating under the watchful eye of, and controlled by a distributed electronics "APX" system. "The computer is talking to the engine and all the other high-efficiency components to make sure it all runs optimally," Kiefer says. The APX even has a USB dock to facilitate data downloads.

EcoFORWARD technology has enabled the reduction of a unit's need of engine power by up to 20 percent, while improving cooling capacity by as much as 10 percent. Further, the units are lighter and use 24 percent less refrigerant. "Altogether, not only are you compliant with better capacity, but units consume less fuel, and that's better for the environment."

Temping

To keep track of the environment your products been living in, consider investing in a few data loggers. These small devices, like the ones from ebro, a division of Xylem Analytics, Beverly, Mass., operate wirelessly, will automatically notify the user in case of a temperature excursion, and, once uploaded, the data can be accessed from anywhere with an Internet connection.

"It's a very simple system," says Robert Teich, managing director at ebro, "You don't need extra software, it's easy to configure..." Teich acknowledges that the unit may not be for everybody—some companies lack the necessary IT infrastructure, or, alternately, it may be the case that third-party logistics are too diverse, harder to organize; in these circumstances the stand-alone version of the data logger is advised.

Either way, the technology is on the order of standard practice in Europe, says Teich (based in Ingolstadt, Germany). "It's funny, the FDA came up with this great concept of HACCP (Hazard Analysis and Critical Control Points) but had few ideas about implementing or enforcing it." Taking the regulatory lead, such policies abroad mean it's common in Germany and other countries to have data loggers within a walk-in refrigerator in stores and restaurants.

It's been Teich's observation that temperature recording in non-transport situations is often done with a handheld thermometer, with results recorded by hand. Perhaps the recently passed Food Safety Act is applying the needed pressure for change, as Teich notes an uptick in his sales. "We see more interest now in smaller stores and restaurants in the U.S. for data loggers," he says. "You always have that complete digital record, so anytime a food inspector comes you have an automated report that you can quickly produce."

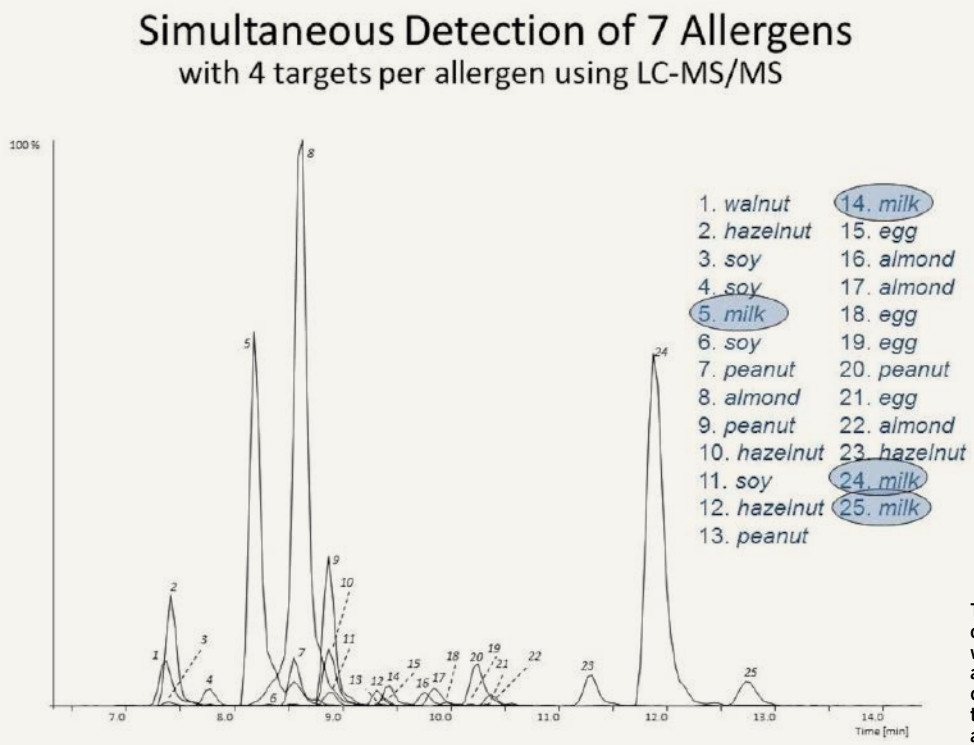
Dock Worker

All the technology in the world won't help you if someone left the door open, thus, the vertical storing dock leveler, such as those made by Dock Products Canada, Inc., Ontario. Steve Kalbfleisch, director of Canadian sales, explains, "Instead of storing a leveler in a position parallel to the floor, this one stands straight up behind the overhead motor." Among other things, this provides for a better seal than conventional levelers. "This preserves cooling and conserves energy because the overhead door comes down to the bottom of the pit as opposed to say the top of the leveler where you have all kinds of gaps."

Recently added to the standard vertical dock offering is the new Serco Thermal Guard Package that allows for truck doors to be opened from inside the building after the truck is positioned at the door, thereby retaining the thermal seal at the dock.

"People are becoming far more conscious of energy consumption," says Kalbfleisch, "so with that in mind, we're recommending the appropriate equipment for our customers to help them reach that goal." ■

Canavan is a science/medical writer based in Brooklyn, N.Y. Reach him at ncanavan@hotmail.com.



The simultaneous detection of seven allergens in one run, with each (except walnut) allergen having four peptides detected. As an example, the four peptides for milk are indicated.

The Future of Allergen Testing with Mass Spectrometry

Mass spectrometers offer accurate allergen identification while also enabling the detection of multiple allergens in a single analysis

BY **MAYBELLE COWAN-LINCOLN**

For many people, trying new foods is a delicious adventure. But for consumers with potentially fatal food allergies, it can be a dance with death, relying on incomplete product labeling and inaccurate testing methods. But a new focus for an old technology has given allergy sufferers hope that in the near future they can know how safe what they are about to eat really is.

Federal labeling regulations are in place, but they are hardly comprehensive. The Food Allergen Labeling and Consumer Protection Act of 2004 requires manufacturers to include a "contains" statement, a clear list of ingredients that are defined as allergens in the U.S. by the "big eight" list: Eggs, milk, wheat, peanuts, soy, tree nuts, fish, and crustacean shellfish. The problem arises when the allergens are not intended ingredients. If the food is made in the same facility and on the same equipment as food containing allergens, some of these potentially dangerous ingredients may wind up cross-contaminating other foods.

To warn consumers of possible cross-contamination, companies often adopt advisory statements revealing that a food was produced in a facility that also pro-

PHOTO COURTESY OF EUROFINS.

cesses allergens. But these statements are completely voluntary; they are not required by labeling laws.

Conventional Testing Tools

Warning statements cannot be a substitute for Good Manufacturing Practices. Companies are still expected to make a good faith effort to ensure foods that are not supposed to contain allergens are, in fact, allergen-free. That is where allergen testing comes in. But just how reliable are conventional testing technologies?

Typically, companies rely on two types of tests: polymerase chain reaction (PCR) and enzyme-linked immunosorbent assays (ELISA). PCR is a fast and inexpensive method to identify DNA. It amplifies, or copies, small segments of DNA until a large enough sample is grown to determine if an allergen is present. Although the method can identify the DNA of milk, peanuts, soy, walnuts, hazelnuts, fish, and crustaceans, there are several pitfalls to this method that can allow an allergen to slip through the cracks. The most notable is that PCR detects the presence of DNA, but not proteins. Egg whites and milk, significant allergens, contain little or no DNA, but high quantities of protein. Therefore, this method is not reliable for these foods.

The ELISA method, on the other hand, detects antibodies in a sample that indicate the presence of allergens, but a separate kit is required for each allergen, which can get expensive. Consequently, companies often do not test products for the presence of all possible allergens. They do a cost-effectiveness analysis and select the top one, two, or three allergens most likely to be present. Any others can go undetected.

Mass Spectrometer Advantage

A newer technology for detecting allergens is mass spectrometry (MS), a process that identifies proteins and peptides with a high level of accuracy. Unlike other methods, MS directly detects allergens by breaking them down into peptides, or short strings of amino acids that link together to form larger proteins. This platform offers several advantages over conventional detection methods.

Bert Popping, PhD, director, scientific development at Eurofins, an international analytical testing company which is known to have pioneered the use of MS for food allergen testing, explains the reliability of results by MS equipment from the way they detect peptides rather than entire protein structures. Proteins can be degraded by processing, cooking, etc., and an altered structure may not be recognized when an assay is looking for an allergen.

(Continued on p. 50)

> Another reason mass spectrometers are more accurate is they directly detect components of the allergen, unlike PCR or ELISA.

(Continued from p. 49)

However, the shorter peptides are more likely to be still intact after processing and therefore remain detectable by MS. And MS detects more than one peptide per allergen, so should one be degraded, the offending substance can still be discovered by at least one or two other peptides.

Dr. Popping sums it up by stating, "The beauty of mass spectrometry is that you are looking at much smaller sequences, so even if some part is broken away, usually you still have sufficient structure left so the peptide is detectable. And it is safer because instead of relying on finding just one target, you are looking at several."

To look at this another way, think of a protein as a building. Imagine the building being "broken down" by an explosion. If someone wanted to identify what kind of building it had been, they need only to look at the pieces. A jumble of couches, bedroom furniture, and kitchen appliances points to a residential apartment building, while desks, filing cabinets, and computer hardware indicate an office building. Similarly, the peptides that remain after the protein is broken down by MS determine what protein existed before the test.

Another reason mass spectrometers are more accurate is they directly detect components of the allergen, unlike PCR or ELISA which indirectly detect them through DNA or antibodies. This allows high-protein, low-DNA allergens like milk and egg whites to be detected. In addition, mass spectrometers can multiplex, detecting all of the big eight in one

The Smartphone: A Tool for Allergen Testing?

Mass spectrometry adapts existing technology to a new purpose. Similarly, the iTube, now in the prototype phase at time of print, turns an ordinary smartphone into a portable allergen testing lab. Currently designed to detect peanuts, this small attachment—22 mm x 67 mm x 75 mm and weighing a mere 40 grams—is a colorimeter that measures the intensity of light to determine if an allergen is present. Its inventor, Aydogan Ozcan, PhD, associate professor at UCLA, states, "Although several products that detect allergens in foods are available, they are complex and require bulky equipment, making them ill-suited for use in public settings. The iTube was developed to address these issues."

The iTube works by quantifying changes in the intensity of passing through a solution containing a possible allergen. Certain solutes absorb certain light frequencies, and peanuts absorb red, 650 nm. iTube has two small test tubes, one control and one assay. The user takes a small amount of food in question and dissolves it in a special solvent allowing it to incubate for a little more than 10 minutes. iTube passes a light through the test tubes and the smartphone camera quantifies changes in the intensity of the red light illuminating from the test and control tubes. An app on the smartphone then uses this comparison to determine if peanuts are present, even in quantities as small as 1 ppm.

The benefits of this platform for those with food allergies is obvious, but Dr. Ozcan envisions his invention becoming a valuable tool for members of the food industry that include manufacturers and restaurants, offering them fast, accurate, and cost-effective allergen testing. The public health arena and local governments can also use iTube to protect consumers and enforce regulations.

But Dr. Ozcan's vision extends beyond testing isolated samples for individual allergens. He imagines the creation of public, spatio-temporal allergen maps to provide vital information for allergen sufferers and their families.

Dr. Ozcan explains, "Our iTube platform will provide accurate and sensitive measurements of allergens, and the results could one day be uploaded to secure servers for long-term use in public health settings." Users will be able to enter a zip code into a Google maps interface to discover what allergens have been reported in which location within a given timeframe, or search for incidences by allergen type.

Thermo Scientific's Q Exactive is an example of a MS unit.

test–making them faster, easier, and less expensive to test for multiple allergens than a series of ELISA assays.

A recent study performed by Dr. Popping confirmed the reliability of the method. Seven allergens, including eggs, milk, and soy, were baked into bread and tested with PCR, ELISA, and MS. The accuracy of PCR and ELISA tests was mixed; sometimes they detected the allergens, but sometimes they did not, and they often underreported how many parts per million (ppm) were present in the sample. Conversely, MS results were unerringly accurate, detecting each allergen every time and in the correct ppm.

Mass spectrometers can multiplex, detecting all of the big eight in one test–making them faster, easier, and less expensive to test for multiple allergens.

Cost is another potential benefit of MS, especially when testing for multiple allergens. One MS test performed by a third-party lab can possibly cost a food manufacturing company more than one ELISA kit, but less than three kits. Therefore, once a company is targeting three or more allergens, MS technology provides a cost savings opportunity that becomes more efficient with each additional targeted protein.

MS Drawbacks?

There are, however, a few obstacles preventing MS units from taking their place as a first-line allergen detection method. Considered a newer platform in the food industry, it suffers from the perception that it is highly expensive and technically complicated. While it is true MS equipment requires a significant capital outlay, most testing labs already own the machines, and their technicians are well-versed in their operation. This technology has been in use for other purposes and other industries for years.

According to Dr. Popping, "When people in a community are confronted with change, it takes time for them to adapt. But I am confident that MS will take its place as a first-line detection method because we are seeing more research done and more funding dedicated to developing this technology." ■

Cowan-Lincoln is a science/technical writer based in New Jersey. She is a frequent Wiley-Blackwell contributor who has been featured in numerous publications. Reach her at mlincoln214@yahoo.com.

Food Service & Retail

EDUCATION

Jack in the Box relies on its HACCP program to help identify and monitor the preparations of its products.

Embracing HACCP

Implementation grows as retail and food service look to shore up food safety in an evolving market

BY **ANDY TENG**

Produce and agricultural manufacturers and processors have long embraced Hazard Analysis and Critical Control Points (HACCP) principles since they were first developed in the 1960s. For those producing meats and poultry, seafood, juices, and a few other high-risk categories, following a HACCP plan isn't just a good practice; it's required under federal regulations. But as only one link in the farm-to-fork food safety continuum, manufacturers and processors alone cannot protect consumers from foodborne illnesses.

Retailers and food service providers also play an important role in ensuring food safety, but most are exempted from FDA and USDA HACCP requirements even though they deliver finished products into the hands of consumers. Regulated by state and local authorities, this important segment of the continuum is increasingly turning to HACCP in response to business trends, greater awareness of potential risks, and regulatory changes at the state level, industry observers say. While broader HACCP adoption may eventually help improve food safety in stores and restaurants by providing them a time-tested framework, some observers also say it's difficult to measure the net impact on consumer safety and the benefits to businesses that embrace it.

"Clearly people are moving in this direction if they haven't already," states Robert Gravani, a professor of food science at Cornell University in Ithaca, N.Y. "Most people want to raise the bar; they're not going to want to do just the minimum."

A faculty member at Cornell's department of food science, Gravani teaches HACCP principles to businesses through

the university's extension program. While anecdotal, there is evidence to show that more companies are expressing an interest in how HACCP can improve food safety at their stores and restaurants, he says. This rise, he points out, stems from the fact that many retailers offer a growing menu of fresh and prepared foods—through a traditional salad bar, a hot food stand, or even a sushi bar. For example, a visit to a Whole Foods supermarket is akin to a stop at a food court because it offers a variety of traditional and ethnic foods.

"Today the number of freshly prepared foods and menu items are just absolutely astounding and tremendous. There are eat-in restaurants within retail stores. There are a lot of foods available for carry out in a variety of places, so it makes great sense to apply the HACCP principles to the preparation and services of these foods," Gravani points out.

This shift among retailers and concerns about the growing number of foodborne illnesses have the industry reviewing and stepping up their practices. After all, there is cause for concern. According to the Centers for Disease Control's FoodNet, which tracks foodborne illnesses across the U.S., the number of confirmed cases rose sharply last year in two categories: *Campylobacter* and *Vibrio*. Most alarming was that the incidences of *Campylobacter* infection rose to the highest level since 2000 even as the rate of infection for STEC O157, *Salmonella*, and other major food-related illnesses remained unchanged. With high-profile outbreaks becoming a regular occurrence, many companies are concerned for their customers and their brands.

HACCP At A Glance

While HACCP is a way of life for many processors and manufacturers, those in food service and retail are less enlightened. That's because the U.S. Food Code makes it a voluntary exercise for most retailers; however, the FDA has encouraged participation by issuing a HACCP manual for retail businesses entitled *Managing Food Safety: A Manual for the Voluntary Use of HACCP Principles for Operators of Food Service and Retail Establishments*. In this document, the agency does urge companies to "take a proactive role in ensuring that the food served or sold in your establishment is safe" by developing a HACCP plan.

HACCP can be intimidating to smaller retailers and food service operators, some observers note, because it's perceived as overly complex. Many of these organizations lack internal resources or knowledge and so stay away. But as some trainers point out, HACCP offers a rigorous approach to food safety that isn't necessarily burdensome. They simply need to adhere to its seven principles:

As convenience stores have expanded their food selection, the potential for problems rises without proper training and protocols.

(Continued on p. 54)

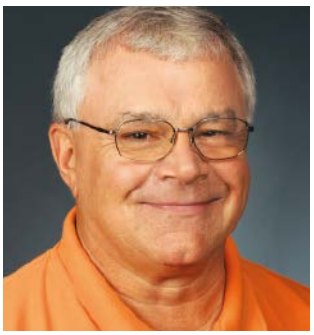
(Continued from p. 53)

- Perform a Hazard Analysis,
- Identify Critical Control Points (CCPs),
- Determine the Critical Limits,
- Establish Procedures to Monitor CCPs,
- Establish Corrective Actions,
- Establish Verification Procedures, and
- Establish a Record Keeping System.

While the system was originally developed by Pillsbury in conjunction with NASA and the U.S. Army to ensure food safety for astronauts, its principles are suitable for the broader industry. By following them, organizations can prevent rather than just react to problems in their food safety programs. It is mandatory for seafood, meat and poultry, fresh-cut produce, juice, and some specialty producers to develop and implement a HACCP plan, but retail and food service establishments such as restaurants, grocery stores, prisons, health care facilities, child and adult care centers, convenience stores, and others are exempted from federal requirements. However, a growing number of businesses are embracing some or all of these principles as part of their overall safety and quality programs because of HACCP's proven effectiveness.

Expanded Food Offerings

One such organization is the Cenex brand of convenience stores, which is owned by CHS, Inc. Two years ago, the company certified a number of its employees in HACCP to enhance its food safety program. Since then, the company has expanded its services beyond Cenex stores to other food service operators, including Wendy's and Dairy Queen as well as school districts and others. Bob Gumatz, manager of retail solutions, explains that the company decided to become HACCP-certified as a way to maintain quality and food safety throughout its Cenex locations, which are owned and operated by co-ops and independent dealers in 22 states. About 80 percent of the stores offer food items such as fresh sandwiches and salads and roller grill items. Some sell fried chicken, pizza, and other hot foods. The company this year will offer take-home dinner items in some locations.



"Certainly a lot of our most engaged, fully committed clients embrace it."

—**BOB GUMATZ**, *manager of retail solutions, CHS, Inc.*

Gumatz says by investing in a HACCP program, the company wanted to ensure the Cenex brand maintained the highest safety culture. With foodborne incidents on the rise, CHS management sought to make sure one incident doesn't end up tarnishing the entire brand. Additionally, as convenience stores have expanded their food selection, the potential for problems rises without proper training and protocols.

"If someone at a Cenex store in Wisconsin ate food and got sick and that got publicized, don't you think people in Washington State or Montana are going to drive by their Cenex store and say, 'Isn't that the place where people got sick eating their food. Let's go across the street,'" poses Gumatz. "We don't want to react. We are being proactive."

In working with various companies, Gumatz says the level of HACCP understanding among retail and food service businesses and state and local inspectors varies widely. Typically, large corporations with a dedicated safety staff are well-versed in HACCP principles, but others had trouble with even the acronym. His experience with health inspectors is similar, with some states actively promoting a HACCP approach in the retail and food service segment while others strictly abiding by the Food Code (see sidebar). The disparity in knowledge is reflected in the commitment that different organizations make to food safety and quality.

"Certainly a lot of our most engaged, fully committed clients embrace it. They want it, and they understand what it means for food quality and safety. We also have people on the other end of the spectrum who jump on the bandwagon because everyone else is doing it," he adds.

For HACCP to yield results, operators must commit and adhere to a well-deliberated process, Gumatz says. They must understand that in retail and food service, HACCP may require businesses to simplify their offerings. For instance, Gumatz's biggest client offers more than 350 menu items—which can certainly make implementation unwieldy. Furthermore, this segment of the industry poses particular challenges because of its wide variety of products, its types of operations, and its organization sizes. Retailers and food service establishments can range from those with a simple single store to the national chains that operate thousands of facilities across the country.

For larger chains, economy of scale affords them the resources to embrace HACCP early on. For San Diego-based Jack in the Box, HACCP has been part of its food safety

The Cenex brand of convenience stores certified employees in HACCP to ensure the brand maintained the highest safety culture.

HACCP at State Level: Colorado Enacts Regulations for High-Risk Foods

While most food service and retailers are exempt under the U.S. Food Code from having a HACCP plan, some local and state authorities now mandate its implementation for specific products. For example, Colorado as of March 1 began requiring HACCP for high-risk foods processed by modified atmospheric packaging, sous vide, or cook-chill methods. In some instances, preapproval from state or local inspectors are required; in others, the plan must be made available upon inspection.

Nicole Grisham, the direct service compliance and LAP coordinator within the Division of Environmental Health & Sustainability at the Colorado Department of Public Health and Environment, says the new rules are part of the state's risk-based approach to ensuring food safety. In requiring HACCP for these foods, regulators want to minimize the potential for outbreaks. With this segment of the food industry increasingly broadening its offerings, especially in products at high risk of contamination, Colorado wants to make sure those businesses at least have good operating procedures in place.

One reason for concern is the state's passage of the Colorado Cottage Foods Act last year, which made it easier for small, home-based producers to sell products. Grisham says while it was a boom for the cottage food industry, some of those producers have "pushed the envelope" of what they can sell, creating safety hazards in some instances. The act "has really encouraged people to push that envelope and start expanding and doing unique things that fall under specialized processes," she notes.

While the state's HACCP mandate is one way to ensure producers follow good practices, Grisham also laments that most small and even some midsized companies don't understand it and how to comply. To help, the state offers annual training courses for regulators also open to industry.

program for years, and the company requires all of its food manufacturers to have their own plans in place, explains Ann Marie McNamara, the company's division vice president of food safety and regulatory compliance. With more than 2,500 restaurants in the chain, Jack in the Box relies on its HACCP program among others to help identify and monitor the preparations of its products.

McNamara explains HACCP is pervasive throughout its restaurant operations and all employees are trained to adhere to its principles and held accountable. "Every job has critical control points associated with it, so we train each employee in the steps important to producing safe food," she says.

McNamara notes that even though food processing and manufacturing are different from food service and retail, HACCP principles are universally applicable. As long as organizations make the effort to effectively design and adhere to best practices and monitor and verify their processes, they can achieve the desired results regardless of the type of products they make or the size of their operations, she adds.

As food service providers and retailers continue to evolve and broaden their offerings, and as the industry and regulators continue to grapple with a growing number of foodborne illnesses, initiatives such as HACCP will likely gain adopters seeking a proven and effective method of food safety assurance. ■

Teng is a freelance writer and former interim editor of Food Quality & Safety magazine based in New Jersey. He can be reached at andy@andyteng.com.

Advertiser Directory

Fresh Approaches to Food Safety Training for Grocers

Technology training platforms allow grocery employees to develop a sense of commitment toward achieving proper safety policies, procedures, and behaviors

BY **LAURA DUNN NELSON**

Managing risk and exposure is one of the most important responsibilities of every grocery owner or operator. One department that deserves special scrutiny because of the extent of human contact with food on a daily basis is the deli. Risks to public health are numerous due to the potential for food contamination and the spread of bacteria. Employees are prohibited from touching food with bare hands, but that does not guarantee there will be thorough hand washing when employees are juggling customer demands, experiencing equipment challenges, or both.

While managers understand the need for training employees about the genuine risks to health and safety that can result from oversights, employees do no always act according to the training they have been given or retain the information they've learned. That would appear to be the case based on results from a FDA study, "Trend Analysis on Report on the Occurrence of Foodborne Illness Risk Factors in Selected Institutional Foodservice, Restaurant, and Retail Food Store Facility Types." The lengthy FDA report tracks trends from 1998 to 2008 in all the facilities listed in the title. The findings for retail groceries, particularly those with delis, hot food bars, and fresh seafood counters, are somewhat disturbing. Nearly 57 percent were out of compliance due to improper holding in terms of time and temperature, and a surprising 26 percent for what the FDA describes as "poor personal hygiene." The figures aren't much better in the other departments. In the meat and poultry departments, 35 percent failed to comply due to improper holding and 19 percent were found to be non-compliant for hygiene. For the seafood departments, improper holding was only slightly improved with 34 percent non-compliant for time and temperature holding and nearly 9 percent for hygiene. These figures have

to be viewed as less than satisfactory and in need of improvement. Grocers who recognize the seriousness of this situation should start by looking at the one requirement where most shortcomings can be traced—the lack of effective training.

Food Safety Pitfalls

Food handling is one training discipline that deserves examination. According to the Center for Disease Control (CDC), improper food handling is the cause of 97 percent of food poisoning incidents. Many of these foodborne illness outbreaks have been traced to food manufacturers and processors, but that does not eliminate risk at the retail grocery level. The CDC warns that vegetables and fruits can become contaminated during storage—a point of concern to anyone selling fresh produce or deli meats. The CDC attributes other incidents to improper disinfecting of food preparation surfaces and cross contamination, all of which require training in proper handling and contamination avoidance. Another subject of obvious concern to the CDC as well as the FDA is inadequate hand-washing—an issue that is widespread.

Cross contamination in salad bars from such allergens as seafood, shellfish, and peanuts is another public health risk for grocers. "You have to train employees to be aware that they can't have one salad close enough to contaminate another salad," says Scott Esqueda, assistant vice president of Argo Insurance—U.S. Grocery and Retail, Portland, Ore. "They have to be trained to place the salad in another section of the case so that there is no chance of cross contamination." The insurance executive also emphasizes the need for ongoing training in two other areas: Accurate time and temperatures for heated food and personal hygiene. "I think everybody could do more training," Esqueda says.

Whether the retail business is part of a grocery store chain or an independent store, training is often limited and not fully understood. One reason may be because the employees are overwhelmed with responsibilities and they do not completely absorb the concepts of proper hygiene and food safety. Similarly, food handlers at a deli or meat counter may not always recognize the risk posed from touching a cell phone even though their hands may be covered. An article in the April 2010 issue of *Progressive Grocer* notes that a national survey of best practices in retail groceries found that a glaring reason for low performance management scores was inadequate training. "Specific comments on the survey...described a lack of training for themselves and especially for management," the article reports. It also finds a "correlation" between the low performance management scores and "how well they score in overall operations and profits."

Whether the retail business is part of a grocery store chain or an independent store, training is often limited and not fully understood.

A study conducted by the University of Kentucky in 2004, but still relevant today, establishes a correlation between training and employee turnover in the grocery industry. "Grocery stores with lower levels of training (less than 20 hours per year) experienced higher voluntary turnover than those with higher levels of training," the study states. It also notes a "weak but negative relationship" between voluntary turnover rates and store performance, efficiency, and safety.

The study reports average turnover rates at more than 43 percent and part-time employee turnover significantly higher at 58 percent. These turnover rates present yet another challenge for maintaining consistency of knowledge throughout the staff. Stores with high turnover rates may find training requirements "slipping through the cracks" because of some ongoing personnel changes.

Another issue to consider is the methodology used to conduct training, which many stores have not changed in more than a decade. Training may include miscellaneous paperwork in the form of sign-in sheets, spreadsheets, and the occasional PowerPoint presentation. In addition, the documentation of training, if it exists at all, may be inadequate and incomplete. As the time-consuming paperwork piles up, training organization tends to erode, particularly when it comes to proof of comprehension. Verification of knowledge is difficult to substantiate especially if a simple passing grade on an examination is considered acceptable. Training is supposed to positively influence employee behavior, but that is unlikely when there is no way of ensuring that all food safety issues associated with handling are completely understood and applied every day on the job, particularly when the training is inconsistent.

Many retail grocers, who are quite aware of these deficiencies, have turned to a modern training technology to improve their employees' knowledge and comprehension.

Training Technologies and Retail Grocers

Technology training platforms have been developed specifically for retail groceries, regardless of size. These platforms are designed to be interactive and engaging. Employees do not merely listen to a one-sided lecture; they use the platform to interact and respond to questions throughout the training session. Courses cover the gamut of food safety issues associated with everyday operations, including understanding cross contamination and how to avoid it, preventing the spread of foodborne illnesses, hygiene and hand-washing,

(Continued on p. 58)

(Continued from p. 57)

sanitation, importance of time and temperatures, and equipment cleaning. Since retail food involves many departments with varying training needs, the platform is designed to be flexible to accommodate both single-employee and group training. Employees trained in groups can respond by using a remote control and the system gives the instructor immediate feedback on how many employees answered correctly and incorrectly. When the latter occurs, the platform and/or the instructor can make sure the concept is understood. For those stores with employees for whom English is a second language, the platforms offer multi-lingual presentations as well.

The technology reduces (if not eliminates) nearly all of the paperwork associated with previous training methods. All defensible records from every training session are electronically stored and easily accessible for instructors and management, a valuable tool not only for proving comprehension of food handling safety but also for future employee performance reviews. Technology platforms save time previously lost due to searches, reviews, and cross referencing of extensive paperwork.

Why is this so important? Consider the amount of paperwork necessary to document training and comprehension for each individual employee without training technology. For example, a store with 50 employees, each having undergone five training sessions, would have to correlate a minimum of 250 separate pieces of paper—a time consuming, labor-intensive process that falls far short of efficiency. Today's technology eliminates all of the paperwork and time to process it through instantaneous storage and all records are easily accessible. Most important, the data confirms actual comprehension of all key learning objectives.

The value of technology as a food safety training tool has not been lost on Topco Associates. This major grocery aggregator with 52 member-owners located in Elk Grove Village, Ill., opted to improve its employee training for all of its members. "Some of our members have relied heavily on verbalized one-on-one training and you can't expect too much from that," says Howard Popoola, Topco vice president of quality assurance. "There has to be standardization of training and the platform allows us to do that."

According to Popoola, the training technology platform rectifies a previous problem with grocery employee training—information overload. "The employee used to be required to watch video after video and it was counterproductive," Popoola says.

> Cross contamination in salad bars from such allergens as seafood, shellfish, and peanuts is another public health risk for grocers.

The Topco executive reports that response to the platform from supervisors and employees is overwhelmingly positive. "It's very specific to what we do and our members who have used it, love it," he says. "They especially like the fact that all their current training courses can be used within the platform, which preserves the investment they have made over many years."

Another factor that corroborates the importance of thorough training and validation of comprehension is risk. The cost of risk to retailers nationwide is $21 billion according to a December 2011 article in *Risk Management*. It identifies liability as the second highest operational expense. Only workers compensation is higher. While these figures apply to all retail operations, the message they convey is clear. Grocers should consider food safety training every bit as important as the other steps they take to alleviate risks and the litigation that is bound to follow if they don't. "You should factor what the costs would be if a foodborne illness would be traced to your store," Topco's Popoola says.

Most retail grocers constantly fight the battle of low margins, which is all the more reason to consider the positive impact that training technology can have on cost reduction as well as food safety. Through an interactive training module, workers can learn, for instance, how to reject produce that doesn't meet standards and greatly reduce the potential for waste, spoilage, and the costs associated with both. Studies have shown operations that engage their employees also lessen the amount and frequency of turnover, which is why there is so much emphasis on the interactive component of training. It turns the employees into active participants rather than disengaged and bored listeners who probably will neither retain nor apply the information.

Store owners and managers should not assume that training has been successfully completed because an employee has signed an attendance document or barely passed a test. Training has to be presented, repeated, and updated so that employees can develop a sense of commitment to recognize and avoid cross contamination, maintain cleanliness of hands and equipment, and promote a safe workplace. ■

Dunn Nelson, director of industry relations for Alchemy Systems, LP, has more than 25 years' experience in food safety and quality control programs for foodservice and retail operations. She can be reached at laura.nelson@alchemysystems.com.

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Mass Appeal: What's Hot in Contract Lab Services

More contract labs are working with mass spectrometry as they feel the pressure of providing quicker and more efficient results

By **Gina Shaw**

MASS SPECTROMETRY HAS ASSUMED AN ESSENtial role in ensuring food quality and safety—so much so that last year's Asilomar Conference, hosted by the American Society for Mass Spectrometry, focused its agenda on mass spec in food safety and quality. Topics included LC/Q-TOF Mass Spectrometry in detection of peanut and tree nut allergens in processed and unprocessed foods; UHPLC/high resolution MS in analysis of food contaminants; and the use of LC/QTOF-MS for identification of unknown contaminants for food defense.

Many of the contract laboratories working with the food industry today are focusing on doing as much as possible with combined liquid chromatography/mass spectrometry (LC/MS) for its lightning-fast speed combined with powerful sensitivity, says Christie Brewe, laboratory and quality manager with Romer Labs, which operates four fully accredited laboratories in the U.S., Austria, Singapore, and the U.K.

"A lot of what we do is mycotoxin-based, and we are trying to go beyond what's regulated worldwide to look at other mycotoxins with synergistic effects, and getting those to mass spec," says Brewe.

As the Asilomar conference demonstrated, many labs are working to move food allergen testing into LC/MS as well, although most food allergen testing remains PCR- and ELISA-based at the moment.

GMO (genetically modified organism) detection and quantification is also in high demand. ELISA assays and strip tests are sometimes used in GMO detection, but the current gold standard for industry worldwide is PCR-based GMO detection. Mass spectrometry could dramatically enhance a lab's ability to quantify minute concentrations of GMO proteins, and it's currently under investigation for this purpose but it's not yet in common use at most contract labs.

For more information on contract labs, see "HandyContract Labs: Not Just for Testing Anymore," page 40. It explores how today's contract labs are offering a wide variety of collaborative options to ensure the safety and quality of the foods manufacturers produce. ■

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.

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Gliadin and Sesame Tests

According to Neogen, the new rapid lateral flow tests for gliadin (gluten) and sesame provide results in just five minutes after extraction. The Reveal 3-D for Gliadin R5 test detects as little as 5 ppm of gliadin (10 ppm gluten) on environmental surfaces and in rinses. The test kit is in a sensitive format and conforms to influential Codex Alimentarius guidelines. Reveal 3-D for Sesame also detects as little as 5 ppm of sesame in rinses and on environmental surfaces. Accurate results aid in cleaning validations or verification of existing procedures to prevent cross-contamination of sesame within manufacturing facilities. **Neogen Corp., 800-234-5333, www.neogen.com.**

Big Six STEC Controls

Six non-O157 serogroups of Shiga-toxin producing *Escherichia coli* (STEC) strains have been added to Microbiologics' line of ready-to-use QC microorganism products. The six new STEC strains are the same six STEC serogroups the USDA and the FSIS recently classified as adulterants in non-intact raw beef. The STEC strains are initially offered in qualitative KWIK-STIK and LYFO DISK formats along with two pre-packaged QC Microorganism Sets; one set includes the Big 6 STEC strains and the other includes Big 6 STEC strains plus serogroup O157. **Microbiologics, Inc., 800-599-2847, www.microbiologics.com.**

Compact, Easy-To-Use Titrators

EasyPlus is a compact and simple titrator specifically designed for basic requirements and first time users of automatic titrators in the food and chemical industries. Previous models have focused on advanced automation solutions, flexible method structures, and secure networking software. EasyPlus focuses specifically on accurately automating routine titrations. The interface is modeled on the familiar app format. New operators already know and understand this interface style, making familiarization and operation quick and easy. iTitrate guidance leads operators through setup and method programming step-by-step. The EasyPlus also features 15 different operating languages. **METTLER TOLEDO, 800-638-8537, www.mt.com.**

Extraction of Mycotoxins

ISOLUTE Myco SPE columns are used for the "catch and release" cleanup of mycotoxins from food matrices prior to analysis by LC-MS/MS. The ISOLUTE Myco sorbent is a proprietary polymeric phase optimized for the extraction of a broad spectrum of mycotoxins from a wide range of foodstuffs, enabling chemists to utilize a single SPE product to extract all relevant mycotoxins from an individual foodstuff. Using a single, easy-to-use sample preparation product, along with optimized matrix specific application notes, users are able to prepare diverse samples for analysis by LC-MS/MS. The coupling of a dedicated polymer based sorbent with LC-MS/MS analysis also saves time since more samples can be processed each day. **Biotage, 704-654-4900, www.biotage.com.**

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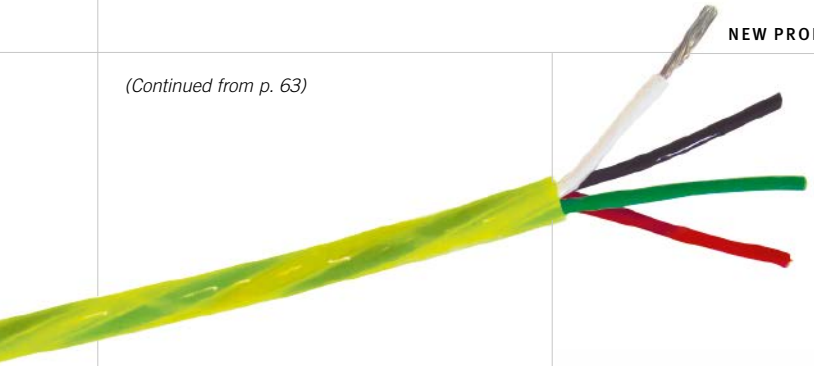

Antimicrobial Cable

According to the company, the DEFENDER antimicrobial cable jacket eliminates greater than 99 percent of bacteria (e.g. *E. coli, Salmonella*) and fungus (e.g. Aspergillus) within 24 hours of exposure. The cable contains a silver ion based antimicrobial additive commonly used in many consumer packaged goods. Adding this to the cable jacket during the manufacturing process provides long-term broad-spectrum protection from bacteria, mold, and fungus. Protection is continuous and doesn't transfer to skin or other surfaces. The bright green jacket allows for easy visual inspection during required check-ups for cleanliness. It's ideal for wash down areas, canning or bottling process lines, and conveyor systems in the food and beverage industry. **TPC Wire & Cable Corp., 888-286-0785, www.tpcwire.com.**

Thermogravimetric Analyzer

The TGA701 Thermogravimetric Analyzer determines weight loss as a function of temperature in a controlled environment. Moisture and ash are determined in various foods, feeds, meats, oilseeds, and pet foods. Complying with AOAC, AACC, and ASTM-approved methodology, the TGA701 replaces traditional analytical techniques that require vacuum ovens, muffle furnaces, or microwave ovens. Sample carousel allows 19 samples to be analyzed simultaneously. **LECO Corp., 269-985-5496, www.leco.com.**

Smart Wireless HACCP

The Checkit wireless food safety monitoring solution is a fully-digital and automated system that eliminates the need for paper-based manual checks and time-consuming report generation. Smart wireless sensors ensure 24/7 monitoring of temperature, humidity, and the door status for hot/cold food storage equipment in food service areas, while flexible handheld units collect food temperature and hygiene data at the press of a button to reduce the risk of human error. All data is time-stamped and downloaded to a centralized database, which automatically generates food safety compliance reports along with a full audit trail. It also sends alerts to PCs, tablets, or smartphones if there is a problem. **Elektron Technology, 760-343-3650, www.checkit.net.**

Testing for T-2 and HT-2

The new AgraQuant ELISA test kit for T2 and HT2-toxin has high cross reactivity between both toxins (>90%). Calibrants used in this test kit are from 25 to 500 ppb sum of T-2 and HT-2 toxin and are therefore in line with the requirements set in the European Commission's recently published document 2013/165/EU, which recommends maximum levels for the sum of T-2 and HT-2 toxin in various food and feed matrices. **Romer Labs, 636-583-8600, www.romerlabs.com.**

In Other Product News

bioMérieux's VIDAS UP Salmonella (SPT), an automated test for the detection of *Salmonella* species, has been granted Official Methods of Analysis approval by AOAC on a wide variety of food products and environmental samples. The scope of this approval also includes 375 gram samples.

Alchemy Systems has been awarded a patent from the U.S. Patent and Trademark Office for its "Multimedia Training System and Apparatus." The patent specifically covers the Audience Response System for the interactive training program called SISTEM (Standard Industry Skills Training and Education Media).

DuPont Nutrition & Health's DuPont BAX System assay for detecting *Salmonella* in a variety of food types has been recognized as AOAC Official Method of Analysis 2013.02. This molecular-based method uses PCR technology and real-time detection.

Neogen Corp. now offers a raw meat species identification testing service for customers in North America at its laboratories in Lansing, Mich. The service uses Neogen assays to detect adulteration at as little as 1 percent of mislabeled horse, cow, pig, poultry, or sheep meat. Results are available within 48 hours of the sample receipt.

InstantLabs Medical Diagnostics Corp.'s Listeria Species Food Safety Kit has received AOAC Performance Tested Methods certification (PTM #041304) for environmental and food matrices. The Hunter system is a real-time PCR platform designed to be used at the point of need.

Events

JULY

13-16

IFT Annual Meeting & Food Expo
Chicago, Ill.
Visit www.ift.org
or call 312-782-8424.

AUGUST

20-22

Penn State Fundamentals of HACCP
University Park, Pa.
Visit www.foodscience.psu.edu/workshops.

25-28

AOAC's Annual Meeting & Exposition
Chicago, Ill.
Visit www.aoac.org
or call 301-924-7077 x 170.

SEPTEMBER

10-12

Penn State HACCP for Meat and Poultry Processors
West Chester, Pa.
Visit www.foodscience.psu.edu/workshops.

18-19

2013 HACCP Certification Course
Dallas, Texas.
Visit www.food-safetynet.com
or email info@FSNS.com.

18-20

BRC Global Standard for Food Safety Implementation
Columbus, Ohio.
Visit www.food-safetynet.com
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OCTOBER

16-18

BRC Global Standard for Food Safety Implementation
Fresno, Calif.
Visit www.food-safetynet.com
or email info@FSNS.com.

Trade Show Preview

IAFP 2013 Travels to Charlotte

Annual meeting centers around the protection of the worldwide food supply

The International Association for Food Protection (IAFP) annual meeting is set to take place July 28, 2013 to July 31, 2013 in Charlotte, N.C. This food safety show always attracts a broad mix of attendees and this year will prove no different. Attendees will include professionals in quality control, processing operations, regulatory inspections, food safety consulting, risk assessment, research and development, microbiological research, plant management, technical services, and HACCP management.

Educational sessions will be dedicated to timely coverage of key issues and cater to multiple experience levels. With a reputation for high-quality content, the annual meeting features technical papers, posters, and symposia detailing information on a variety of topics related to food safety. The meeting will also showcase more than 140 companies demonstrating the latest products and technologies in the Exhibit Hall. (*Food Quality & Safety* magazine will also be in attendance!)

IAFP 2013 begins Sunday evening, July 28, with the Opening Session featuring the Ivan Parkin Lecture, followed by the Cheese and Wine Reception held in the Exhibit Hall. This year's honored lecturer is David W.K. Acheson from Leavitt Partners. Monday morning starts three days of sessions with over 800 presentations including 42 symposia, 11 roundtable sessions, 128 technical presentations, and more than 500 poster presentations. A sample of symposia topics include: Linking Pests and Pathogens of Food Safety; Sanitation Stories: Tall But True; Benefits of Food Safety Beyond Saving Lives; and Farm to Fork Cantaloupe Risks and Interventions. The Ninth Annual John H. Silliker Lecture will be presented on Wednesday afternoon, featuring Dane Bernard from Keystone Foods LLC. For additional educational opportunities, IAFP 2013 will present four pre-meeting workshops on July 26 and July 27.

Online registration and program information are available on the association's website. Visit www.foodprotection.org or email info@foodprotection.org for additional details. The IAFP is a non-profit educational association comprised of food protection professionals. ■

Innovators

IN FOOD QUALITY & SAFETY

Gail Borden Jr. 'Got Milk'

BY **LORI VALIGRA**

The mid-1800s were a time of great migration, when people from the East Coast crossed the Great Plains in search of a better life, and more specifically, California gold. Traveling in covered "prairie schooners" proved to be hazardous both physically and in keeping food from spoiling. Gail Borden Jr. (1801-1874), a New England businessman and inventor who transplanted to Texas, turned his attention to developing condensed, portable food that didn't spoil.

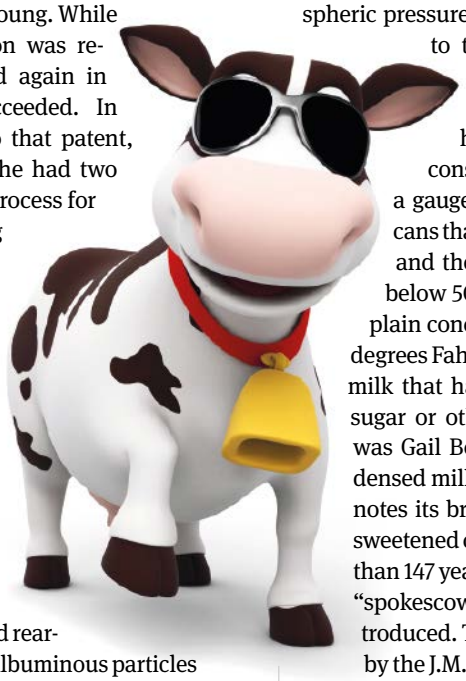
His first attempt was a "meat biscuit," dehydrated meat compounded with flour, that would not spoil. But it also was reported to be unpalatable. Though the U.S. Army endorsed it in 1850, Borden had to abandon efforts to market it when he ran out of money. Around the same time, he had begun experimenting with a process for condensing milk.

While milk is a staple and nutritious drink today, at the time it was risky to consume. Cow milk was ridden with bacteria, and if it wasn't consumed within several hours in the summer, it spoiled in the heat, causing milk poison or milk sickness. Borden, who had been a farmer, leveraged his experience in drying foods to try to make milk safer.

"He knew milk to be the most perfect single article of food—the only one, in fact, which when fed alone, will sustain life, and yet the most perishable and the most difficult to get to the large cities in its original purity and freshness," Ollie E. Reed, chief of the USDA's Bureau of Dairying from 1928 to1953, wrote about Borden.

Reed wrote that Borden didn't know about germ theory, but he had learned from the meat biscuit experience that preventing decomposition was a key. There had been many previous attempts to solidify milk or find a suitable substitute for it, but Borden wanted to make something better, according to Reed.

Borden's first patent filing in 1853 was for an evaporation process done in a vacuum in an effort to protect the milk from air, much in the way a cow transfers milk to its nursing young. While that application was refused, he tried again in 1856 and succeeded. In the abstract to that patent, Borden wrote he had two inventions: a process for concentrating and preserving milk by coagulating and rearranging the albuminous particles in combination with the evaporation of the fluid *in vacuo*; and the preparatory coagulating and rearranging of the albuminous particles done as part of making concentrated or condensed milk.



In describing the rationale for the process, Borden wrote, "All organic substances are injuriously affected by the atmosphere, and are liable to reaction among their constituent elements; hence the deterioration of milk is greatly influenced and accelerated, though not wholly caused, by exposure to air."

He continued, "This demonstrates that the less milk is suffered to be acted upon by the external air, the better its condition... and has led me to perform the concentration, which is one object of my invention, in such a manner as to exclude the milk as much as possible from contact with the atmosphere as it is being concentrated."

The process involved a preliminary heating of the milk as soon as possible after milking the cows until its albuminous particles coagulated. This kept the vacuum heating vessel from being coated with extra albumin. Borden recommended in his patent abstract preheating in tin, brass, or copper cans placed in a bath of boiling water from 150 to 200 degrees Fahrenheit, depending on whether the end result is plain condensed milk or preserved milk. He then recommended straining the milk into a metal reservoir with a steam-jacket, into which the milk was brought to the boiling point and then drawn into the vacuum-boiler (to prevent air contamination) using atmospheric pressure through a pipe leading to the pan. The milk was then evaporated and concentrated by superheating it, checking its consistency regularly with a gauge, transferring it into tin cans that usually held 40 quarts, and then cooling it with ice to below 50 degrees Fahrenheit for plain concentrated milk and to 56 degrees Fahrenheit for concentrated milk that has been combined with sugar or other extracts. The result was Gail Borden Eagle Brand condensed milk. Eagle Brand's website notes its brand was the top selling sweetened condensed milk for more than 147 years. In 1938, now-famous "spokescow" Elsie the Cow was introduced. The brand is now owned by the J.M. Smucker Co.

While popular worldwide now, the new condensed milk was met with a lukewarm reception initially, as consumers were accustomed to watered-down milk. When it became known in the late 1850s that New York cows used for fresh milk were being fed distillery mash, Borden's product took off and was boosted in 1861 when the Union Army bought it for field rations. Unlike with his meat biscuit, Borden was able to make a fortune from the success of his condensed milk. ■

Valigra is a writer based in Cambridge, Mass. Reach her at lvaligra@gmail.com.

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Ask us about our 24-hr environmental solutions for *Salmonella* and *Listeria*!

An innovative food pathogen detection solution that is:

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- RapidChek® SELECT™ phage-based enrichment systems
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