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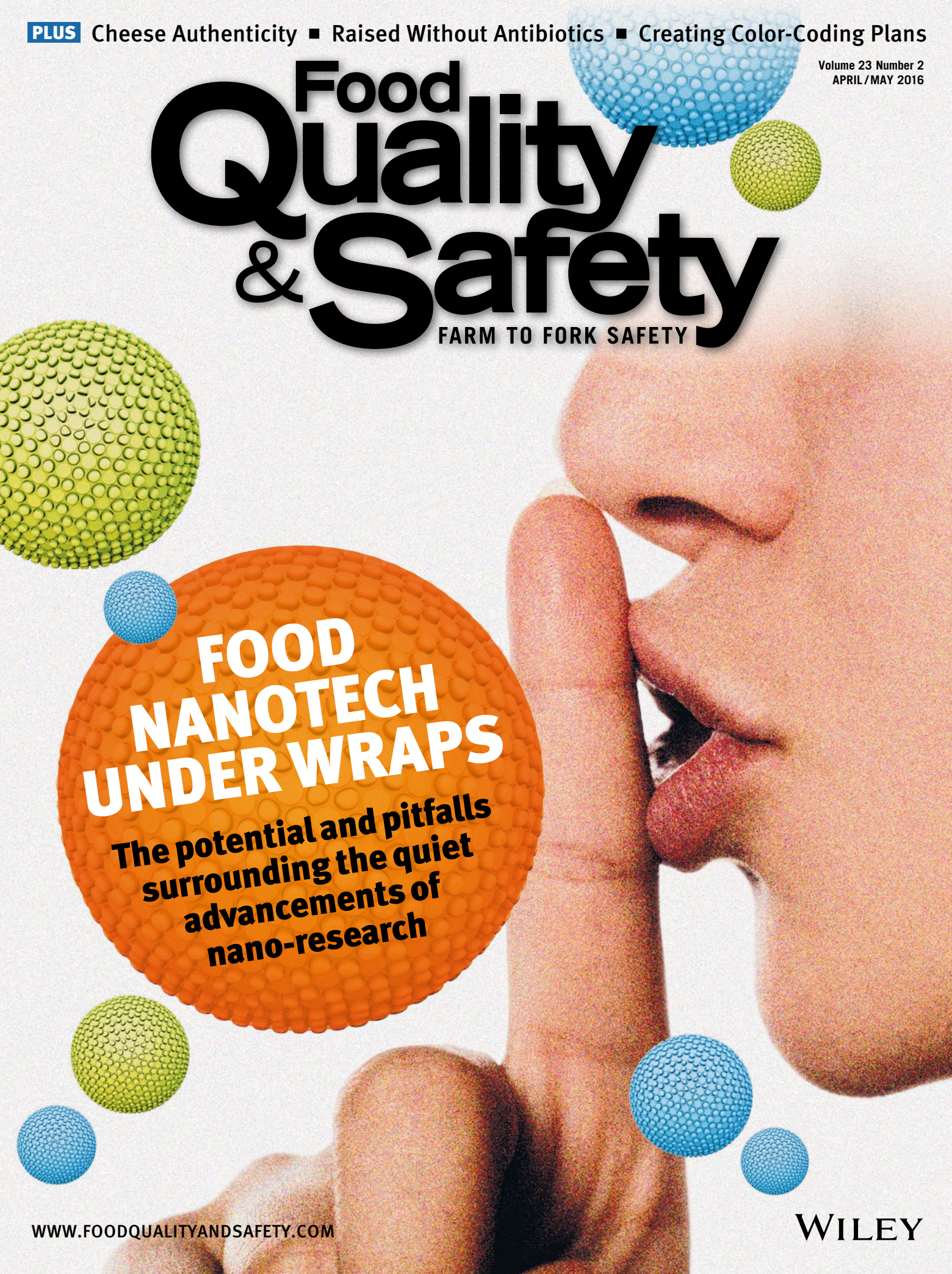
Volume 23 Number 2
APRIL/MAY 2016

Food Quality & Safety

FARM TO FORK SAFETY



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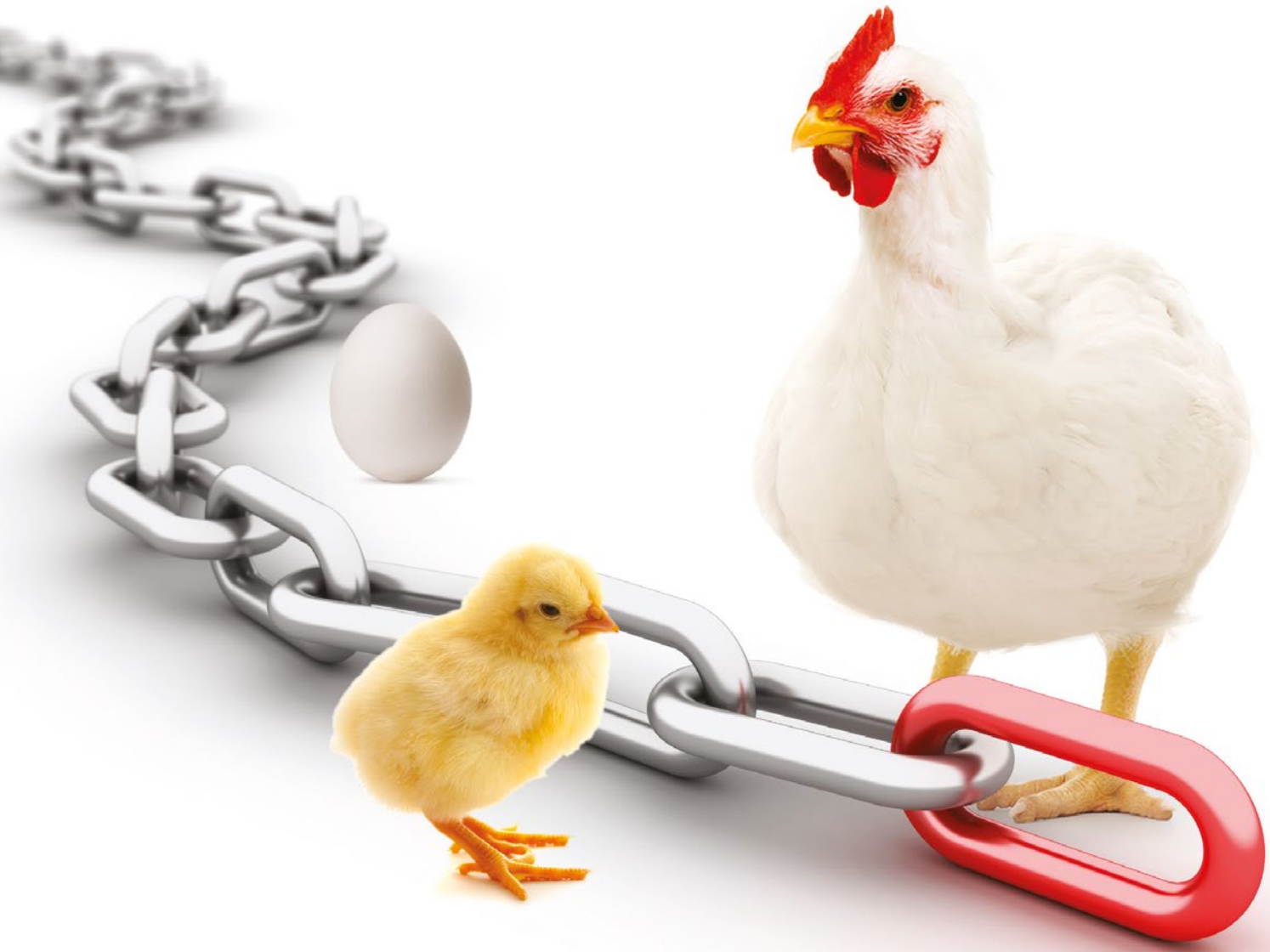

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From The Editor

As Vermont's July deadline looms near for manufacturers to label all food items sold in the state that are made with GMOs, General Mills announced in mid-March that it will start labeling genetically modified ingredients for its products across the country—not simply for just one state. This move comes after federal legislation on GMO labeling stalled in Congress, leaving many food manufacturers uncertain about the future of their product labels. Opposed to state-by-state legislation, companies like General Mills are choosing to use one packaging label for the whole country that discloses GMO ingredients.

Campbell Soup Co. became the first major company back in January to announce it will to start labeling all its U.S. products for presence of GMOs. The company also opposes a patchwork of state labeling laws, which it believes would be incomplete, impractical, and create unnecessary confusion for consumers.

Although FDA has said the genetically modified ingredients on the market are safe, GMO labeling efforts are stemming directly from consumer demand. According to Mintel's "Free-From Food Trends U.S. 2015" report, nearly three in five consumers rank GMO-free as one of the top five free-from claims they seek; a quarter put it in the top two.

The report also mentions that if the debate in congressional halls continue with no decision on a GMO labeling bill, other states' legislators may take the Vermont legislation as a template for their own labeling efforts.

This is something the Grocery Manufacturers Association has publicly opposed. According to a recent statement from the organization, "...Vermont's looming labeling mandate is a serious problem for businesses. Food companies are being forced to make decisions on how to comply and having to spend millions of dollars. One small state's law is setting labeling standards for consumers across the country."

In fact, more than 10 states have passed similar laws to Vermont but several of these states put a clause in their bills that they would not go into effect unless Vermont's bill goes in to effect.

Regardless, some form of GMO labeling will be a reality for food manufacturers either before or on Vermont's July 1 deadline. It will be interesting to see in the next few months if manufacturers and consumer advocacy groups can work together and agree on one national GMO label.

Marian Zboraj
Editor

Food Quality & Safety
FARM TO FORK SAFETY

EXECUTIVE EDITOR/PUBLISHER Lisa Dionne, ldionne@wiley.com
SENIOR ACCOUNT MANAGER Ken Potuznik, kpotuzni@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
MANAGER, DIGITAL MEDIA & STRATEGY Jason Carris, jcarris@wiley.com

Advertising Sales Director
Stephen Jezzard
350 Main Street
Malden, MA 02148-5089
(781) 388-8532
sjezzard@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 kpotuzni@wiley.com

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NEWS & NOTES

The Farm-to-Barrel Trend

As reported by Reuters, craft brewers are responding to the demand for local foods by turning to local farmers, foragers, and fauna to source their ingredients—from persimmons and pumpkins to hops and wild yeast. The "plow-to-pint" movement is giving beer an identity more tied to an area's soil, climate, and terrain, or terroir—much like wine. In addition, new laws in a number of states—including New York, Maryland, and Virginia—support the use of local ingredients and make it easier for farm-based breweries to expand and serve locally sourced beer. This local-ingredient trend has attracted many different names, including farm-to-keg, farm-to-barrel, plow-to-pint, and ground-to-glass.

Reducing Acrylamide

The U.S. FDA issues final guidance to help growers, manufacturers, and food service operators take steps to reduce levels of acrylamide in certain foods. Acrylamide is a chemical that may form in certain foods during high-temperature cooking, such as frying, roasting, and baking. The National Toxicology Program characterizes the substance as "reasonably anticipated to be a human carcinogen." Guidance's focus is on raw materials, processing practices, and ingredients pertaining to potato-based foods (such as french fries and potato chips), cereal-based foods (such as cookies, crackers, breakfast cereals, and toasted bread), and coffee—all sources of acrylamide exposure.

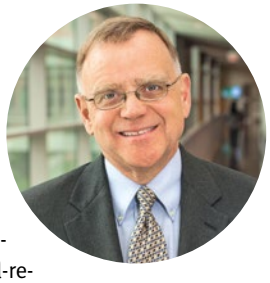
Salmonella and *Campylobacter* Prevention Efforts

USDA's FSIS finalizes new federal standards to reduce *Salmonella* and *Campylobacter* in ground chicken and turkey products, as well as in raw chicken breasts, legs, and wings. Based on scientific risk assessments, FSIS estimates that implementation of these standards will lead to an average of 50,000 prevented illnesses annually. FSIS has also updated its microbial testing schedule at poultry facilities and will soon begin posting more information online about individual companies' food safety performance.

GFSI and UNIDO Focus on Capacity Building

The United Nations Industrial Development Organization (UNIDO) and GFSI are expanding a long-term collaboration into a formal strategic partnership for large-scale capacity building programs. UNIDO is giving attention to food safety as a key thematic area in its inclusive and sustainable industrial development initiative where partnership with the private sector is a key instrument. It has incorporated this cooperation with GFSI into the UNIDO Terms of Reference recently announced by Li Yong, UNIDO's director general. Both entities will jointly dedicate and mobilize resources to scale up food safety capacity building in priority regions. This partnership builds on the collaborations between GFSI and UNIDO since 2009, and follows the achievements made under the recent sustainable supplier development project implemented in Malaysia thanks to UNIDO and AEON, also based on GFSI Global Markets.

FDA's Michael Taylor Leaves Agency



Michael Taylor, U.S. FDA's deputy commissioner for foods and veterinary medicine, is leaving the agency on June 1, 2016. Taylor joined FDA in July 2009 and was named to this position in 2010. Since that time, he has led the implementation of FDA's FSMA and guided nutrition-related initiatives to reduce the risk factors for chronic disease and other adverse diet-related outcomes. He has also overseen the move to eliminate the use of certain antibiotics that can contribute to the development of antimicrobial-resistant bacteria. Taylor plans to continue working in the food safety arena, focusing on settings where people lack regular access to sufficient, nutritious, and safe food. Dr. Stephen Ostroff will step into the role following Taylor's departure. Dr. Ostroff led the FDA as acting commissioner until the recent confirmation of Dr. Robert Califf as FDA commissioner.

Business Briefs

NSF International acquires **Euro Consultants Group,** a food safety and quality service company based in Wavre, Belgium.

CSA On-Site, LLC, enters into an exclusive agreement to design and build On-Site Testing Laboratories for **Mérieux NutriSciences** customers in North America.

AIB International's Leatherhead, U.K. office has relocated to office spaces near the Leatherhead Town Center.

FSMA Update

Augur for the Laboratory

What the future holds if FDA's proposed rule on the lab accreditation and model lab standards provision within FSMA comes to fruition | BY **ROBIN E. STOMBLER**

Laboratories, are you ready? Five rules implementing the Food Safety Modernization Act (FSMA) are already in effect, and two additional, final regulations are anticipated in the coming months. While the specific rule for laboratory accreditation and model laboratory standards has not yet been promulgated, the rules issued to date foreshadow what laboratories will need to know.

On Jan. 26, 2016, the latest final rules on produce safety, accreditation of third-party certification bodies, and the Foreign Supplier Verification Program (FSVP) went into effect. Each one of these rules addresses laboratory testing in some capacity. A common refrain is that the agency is developing a proposed rule to implement laboratory accreditation and model laboratory standards as outlined in the law. Yet, these three rules take other actions of which laboratories should be aware. Outlined below are five tips for how conscientious laboratories should prepare.

1. Get Accredited

The FDA states, "For a regulatory audit, (when) sampling and analysis is conducted, the accredited third-party certification body must use a laboratory accredited in accordance with ISO/IEC 17025:2005 or another laboratory accreditation standard that provides at least a similar level of assurance in the validity and reliability of sampling methodologies, analytical methodologies, and analytical results." While waiting for the laboratory rule, the FDA, at its own initiative, has displayed a preference for laboratories accredited to the ISO 17025 standard, or equivalent. According to the International Organization for Standardization, ISO 17025 indicates general quality, administrative, and technical requirements for laboratories to competently perform testing, regardless of the number of personnel they employ or the extent of the scope of testing.

In addition to documenting that a laboratory is accredited, the FDA will require accredited third-party certification bodies to maintain laboratory testing records and results. Laboratory analyses performed in or used by a food facility must be accounted for in a regulatory audit. Within 45 days of completing a regulatory audit, accredited third-party certification bodies must transmit such information in their report to the FDA and to its recognized accreditation body.

In the FSVP final rule, FDA offered that importers may benefit from using accredited laboratories and that laboratories might consider making their certificates of accreditation available. The agency stopped short in mandating these benefits in this regulation in anticipation of a future laboratory rule.

2. Watch for More Transparency

The FDA will post to its website a list of all recognized accreditation bodies and accredited third-party certification bodies. The business names, contact information, and scope of services will be indexed and searchable. Accredited third-party certification bodies are required to maintain on their websites a timely list of entities to which it has issued food or facility certifications.

If accreditation of a certification body is suspended, withdrawn, or reduced in scope, this information too will be posted and maintained on the FDA website and by the recognized accreditation body. While this public posting is not specific to laboratories, it provides a strong sign of what may be required of laboratory accreditation bodies in the future.

3. Laboratory Data is Important

Importers are now required to retain documentation of each sampling and testing of a food. The specifics of this documentation are spelled out in the FSVP final rule. As might be expected, the food tested must be identified, including, if appropriate, the lot number. The number of samples tested must be recorded. The test conducted, analytical method(s) used, and the results of the testing must

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also be documented. In addition to noting the test report date, written accounts must record the date on which the test was performed. If a hazard was detected, actions taken to correct the problem must be noted. Laboratories should know that information identifying the laboratory conducting the testing and whether the testing was conducted by a qualified individual will also be collected and retained.

> Laboratory analyses performed in or used by a food facility must be accounted for in a regulatory audit.

These data elements are often considered standard information on laboratory testing reports. Current FSMA final rules uphold the need for this data.

4. Know the Definition of a Pathogen

While this point may seem obvious to laboratory professionals, the FSMA final rules have aligned the definitions of a pathogen into one. The rules consider a pathogen to be a microorganism of public health significance. Those microorganisms incorporate yeast, molds, bacteria, viruses, protozoa, and microscopic parasites and include species that are pathogens.

5. Follow Established Methods and Guidelines

The final rules reference laboratory methods and guidelines. For example, in the produce safety final rule, the FDA concludes that the environment, rather than spent sprout irrigation water, should be monitored for *Listeria monocytogenes*. Methods and procedures in the *USDA Microbiology Laboratory Guidebook*, the *Bacteriological Analytical Manual*, and those used in the FDA's compliance activities should be followed for testing for this purpose. The agency will allow other scientifically valid methods, at least equivalent in accuracy, sensitivity, and precision, to be used.

Importantly, the agency has noted that the results of testing not conducted "in accordance with methodologies and procedures designed to ensure valid and accurate results" may not be relied upon.

Good to Know

The final rules repeatedly note that the FDA is developing a proposed rule to implement the laboratory accreditation and model laboratory standards provision within FSMA. With references to laboratory testing woven throughout the final FSMA rules issued to date, food laboratories would be well served to address the quality, accuracy, and reliability of their testing now. ■

Stombler is president of Auburn Health Strategies and director of the Food Laboratory Alliance. Reach her at Rstombler@auburnstrat.com.

To-Do List for FSVP Compliance

Rule requires food importers to verify that foreign suppliers are producing food in a manner that meets U.S. safety standards

BY **BRANDON HENNING**

In September 2015, the CDC announced an investigation into an outbreak of *Salmonella* infections linked to imported cucumbers from Mexico. Since then, the infection has spread to 39 states affecting 888 people. To its credit, Andrew and Williamson Fresh Produce has issued two voluntary recalls as a result of the investigation, but this is a great case of why the FDA has passed section 301 of the Food Safety Modernization Act (FSMA) regulation, the Foreign Supplier Verification Program (FSVP).

According to the FDA, 15 percent of the U.S. food supply, including nearly 50 percent of fresh fruit and 20 percent of fresh vegetables, is imported. Therefore, establishing a preventative process to keep Americans protected from foreign foodborne illnesses, like the *Salmonella* outbreak caused by cucumbers from Mexico, is critical.

The FSVP, an important part of FSMA, is the FDA's solution to address this issue. FSVP requires that importers perform varying levels of risk-based activities to verify that food imported into the U.S. has been handled in a manner that meets applicable U.S. safety standards. The goal is to proactively catch imports that could potentially be contaminated before they enter the U.S.

Under FSVP, importers will be faced with enormous responsibility, which will be challenging for companies who do not have experience managing suppliers to the necessary detail required by law. Importers will now be responsible for ensuring that the foreign suppliers they are working with meet the same safe food handling and production standards required for food handling and manufacturing within the U.S. This includes:

- Determining known or reasonably foreseeable hazards with each food;
- Evaluating the risk posed by a food, based on the hazard analysis, and the foreign supplier's performance;
- Approving suppliers and determining appropriate supplier verification activities; and
- Conducting corrective actions.

Tips on Complying

The following is a recommended to-do list for companies needing to comply with FSVP.

1. Establish a global catalog of all the suppliers, supplier sites, importers, and importer sites you receive ingredients from:

- Food and beverage companies will need to know where the food or ingredients they are importing are actually produced. This will be a challenge for organizations that simply capture the broker or the parent company of the imported product, as that will not give the level of visibility required when it comes time to do a risk assessment or audit of the actual manufacturing or handling site.

2. Organize all of the food safety documents and certifications required from suppliers and importers:

- One of the easiest way to ensure compliance is to make sure all supplier and importer certifications, as well as the key documents sent with each shipment (certificate of analysis, lab results, safe handling) are easily accessible during an FDA audit. Leveraging a supplier document control solution as part of a quality management system can greatly help here.

3. Perform regular supplier and importer risk assessments.

4. Schedule auditing of supplier sites and importer sites:

- Based on the results of the risk assessment, determine if an audit of the importer manufacturing or handling site is required. Be sure to keep record of the audits performed and the status of any corrective actions that were sent to the supplier as result of the audit. This will significantly ease the burden of responding to an FDA audit, as well as reduce the risk of shipments being delayed in customs.

5. Remain in continuous communication with suppliers and importers to stay up to date on incident follow-up, corrective action, supplier document requests, and specification changes:

- Ideally, this would be accomplished through a supplier quality management portal, reducing the risk of lost communication often found when interaction with the supplier is typically done via phone and email.

6. Implement a system that provides alerts and notifications when a supplier or importer is out of specification or behind on action requests:

- This system should also ensure that audit programs and any follow-ups are being executed in a timely manner, and if they are not, that all parties involved are notified.

7. Leverage data for supplier and importer analysis:

- Utilize reporting and analytics to monitor supplier performance and to determine if the safety programs put in place are effective. ■

Henning is director of industry solutions at Sparta Systems. Reach him at brandon.henning@spartasystems.com.

Industry Insights

How Henry Ford, 3D Printing, and Other Industries Changed Food Manufacturing

Although the food industry may appear established, there are always lessons to be learned from other industries that can propel food businesses forward | BY **KATIE MOORE**

History is filled with examples of how new inventions have revolutionized manufacturing industries. For instance, food and beverage industry analysts often talk about three waves of technology-driven revolution. The first of these waves occurred in the 1980s, when manufacturing resource planning systems arrived to automate order processing and bill paying. Before this era, products were entirely mechanical and business processes were manual. The second part of the food manufacturing revolution arrived with the explosion of the Internet in the 1990s. The Internet allowed different enterprise functions to be more closely coordinated and interconnected with the outside world—suppliers and customers could be reached across the world, allowing companies to integrate their supply chains on a global scale.

And today, the food manufacturing industry is riding the third wave of the Industrial Internet and the Internet of Things (IoT). Sensors, processors, software, and Internet connectivity are now part of the actual manufactured product, as well as an integral part of its production. Add this capability to the introduction of cloud computing, where data is stored on servers around the globe and accessed from any Internet-capable computing device, and you now have a world in which product performance, location, maintenance, and status data are stored and analyzed in the cloud. These cloud-based solutions are not only more powerful, nimble, and reliable but also less expensive and more mobile-ready, allowing instant access to big data insights from anywhere at any time.

Although the food industry may appear established and built-out, there are always lessons to be learned from other industries that can propel food manufacturers forward. Leveraging technology and key learnings from other industries and deploying them in the food production space need to continue to be prevalent. With that in mind, here are some examples of how the food manufacturing industry is improving thanks to technology originated from other industries.

Automotive

At the beginning of the 20th century, the automobile was only attainable to the very wealthy. Enter Henry Ford who changed the industry by developing an assembly line that increased the efficiency of manufacturing and decreased its cost. Prior to the introduction of the assembly line, cars were individually crafted by teams of skilled workmen—a slow and expensive procedure. The assembly line reversed the process and instead of workers going to the car, the car came to the worker, automating the same task over and over again.

Automation technology has long been a staple of food production, and as it is used more and more in the food production industry, the cost to install Industrial Internet workflows is decreasing, making

the technology more accessible for manufacturers. This technology can help improve efficiencies across a plant by merging worker responsibilities, and increasing speed of production while reducing product deficiencies.

The technology behind 3D printing could allow food manufacturers to bring complexity and variety to consumers at a low cost.

Another benefit that automation technology brought to both workers in the car assembly lines and now food production is added safety. There are several hazardous jobs within a manufacturing plant, such as manually moving heavy materials to load them into processing machines and operating certain equipment, which can cause serious injury if workers aren't careful. Automation technology and digitizing the work process can help ensure the right process is followed and the right steps happen in the correct order. That way, necessary steps to ensure employee safety are not inadvertently bypassed, and employees are free to monitor machines and keep the workflow processes moving forward.

Television

In the 1950s, televisions became more affordable and quickly rose as the entertainment of choice across homes in America. As television sales skyrocketed, suddenly families were gathering around the TV set for dinner, and soon came the advent of pre-packaged, frozen, TV dinners. Not only did television change how Americans consumed their food, it also brought about a change in how Americans thought about food.

Food manufacturers could now directly reach consumers through television and advertising, and promotion became pivotal to the marketing of the American food supply. Television remains the most widely used advertising medium for food manufacturers because it can reach large audiences and instill brand name recognition. Much television advertising is also aimed toward people who do not read newspapers, such as children.

Television allowed food manufacturers to directly influence consumers and the industry quickly learned that whenever consumer tastes and preferences shifted, food manufactures must respond to the demand. In 2013, for example, consumers placed a high-value on healthier food alternatives. To respond to the demand, food manufacturers were forced to find innovative ways to create healthier products or risk losing sales to competitors. This included everything from changing formulas in their products to achieve a healthier output, refitting equipment and factory lines, and heading back to the test kitchen to create new recipes that gave consumers both higher nutritional values and more flavorful taste.

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Big Data

The IoT continues to permeate the minds of today's technology decision makers in all areas of business. With the recent estimates of the IoT and Industrial Internet financial impact being in the trillions of dollars, the big data they produce is getting exponentially larger in volume and data analytics is becoming increasingly important and complex.

Automation technology has helped food manufacturers leverage the data they collect differently. Organizations can now analyze the output of Industrial Internet data into actionable information to help food manufacturers gain better plant insights and improve processes. For instance, using big data and advanced analytics, manufacturers are able to view product quality and delivery accuracy in real time, making trade-offs on which suppliers receive the most time-sensitive orders. Qualifying metrics now becomes the priority over measuring product delivery schedule performance alone.

Using sensors on all machinery in a food production plant also provides operations managers with immediate data and visibility into how each piece of equipment is operating. Having advanced analytics of the machine data captured shows quality, performance, and training variances by each machine and its operators. This is invaluable in streamlining workflows in a food manufacturing plant, and is becoming increasingly commonplace.

For instance, I recently worked on a team with a customer to put in place a workflow system to leverage and capture big data to improve overall efficiency. Management knows that data is king, but data is really only as good as the processes that are in place to use it. On the flipside, if a food manufacturer doesn't have a standard process in place for getting connected, getting insights, or optimizing data—its data will just sit without a purpose.

Retail

Throughout the years, retailers have utilized technology to become more nimble, tracking inventory better, and adopting real-time supply chain methods that keep the right items in stock at the right price. Some retailers are even bumping it up a notch, using multiple technologies to detect and record everything from traffic patterns on their shop floor to optimizing shoppers' mobile devices on store WiFi in order to track behavior and send relevant coupons their way.

Retailers now leverage the copious amounts of data produced by these technology interactions to improve and personalize customers' in-store experiences. Using sensors to track customers' paths through a store, for example, can help managers improve store layout and merchandise placement strategies. In addition, online marketplaces like Amazon, which are not confined to inventory within the four-walls of traditional stores, can use similar merchandise strategies to "suggest" a larger variety of items to its customers.

> Not only did television change how Americans consumed their food, it also brought about a change in how Americans thought about food.

The customization of consumer products in the retail industry has also led to services such as Amazon Fresh, where shoppers order their groceries online and have them directly delivered to their residence, taking out the need to visit a brick-and-mortar supermarket completely. Food manufacturers are mimicking this personalized approach and providing workers with the ability to customize food production to match in-place infrastructure. One supplier customer was able to eliminate its end customer's inventory carrying costs and, on average, 10 percent of the inventory held onsite. Ultimately, this allows food manufacturers to maintain a just-in-time strategy that increases efficiency and decreases waste by receiving goods only as they are needed in the production process, thereby reducing inventory costs.

3D Printing

The use of 3D printers has the potential to revolutionize the way food is manufactured within the next 10 to 20 years, impacting everything from how military personnel get food on the battlefield to how long it takes to get a meal from the computer to your table, according to the IFT15 Symposium: Where Science Feeds Innovation.

Prices of 3D printers has been steadily declining, from more than $500,000 in the 1980s to less than $1,000 today for a personal-sized device, making them increasingly available to consumers and manufacturers. Although they are not widely used in food manufacturing yet, their general availability is fueling research into how they can be used to personalize foods (based on dietary needs or allergies) and speed delivery of food to consumers.

The technology behind 3D printing could allow food manufacturers to bring complexity and variety to consumers at a low cost. Traditional manufacturing is built on mass production of the same item, but with a 3D printer, it takes as much time and money to produce a complex, customized product that appeals to one person as it does to make a simple, routine product that would be appealing to a large group.

Conclusion

From the wisdom of Henry Ford in the 20th century to cutting-edge 3D technology, food manufacturers have successfully leveraged key innovations from other industries. The Industrial Internet is the newest wave of innovation and connected devices aren't just changing the way consumers live, work, and play—they're dramatically reshaping entire industries.

In order to thrive, food manufacturers need to continue to deploy technology from other industries to remain competitive. Food manufacturers have learned it is imperative not only to benchmark themselves against other food and beverage companies, but also other manufacturers in other industries. I heard from one company that it has moved from considering itself a beer manufacturer to a technology company that happens to produce beer—this is the kind of new mentality that needs to be embraced. The food manufacturers best positioned for the future are the ones experimenting now with ways to use intelligent, connected devices to offer new services, reshape experiences, and enter new markets by creating digital ecosystems. ■

Moore is the industry marketing manager for GE Digital. Reach her at Katie.Moore@ge.com.

Across The Nation

Gone to Carolina

'Can't you see the sunshine' of outstanding Tarheel State food safety programs?

BY **LINDA L. LEAKE, MS**

Editor's Note: *This is the second installment of a year-long series that highlights the food safety initiatives, programs, and activities implemented in certain U.S. states.*

"In my mind I'm gone to Carolina," croons James Taylor at virtually all of his concerts. While the iconic singer songwriter may not get to spend time in the state where he grew up as often as he would like, those that live in and visit North Carolina can routinely experience what might be called, under Taylor's influence, the pleasant and comforting moonshine of good and safe eats. ("Can't you just feel the moonshine?" Taylor sings soothingly.)

From the mountains to the sea, under the sun by day and the moon by night, North Carolina shines in an exemplary way relative to its food safety and food protection and defense infrastructure, according to Anita MacMullan, food administrator of the North Carolina Department of Agriculture and Consumer Services (NCDA&CS) Food and Drug Protection Division (FDPD).

"The FDPD stands out by demonstrating a deep commitment to quality and maintaining strong relationships with federal, state, and local regulatory partners," says MacMullan, who oversees North Carolina's food regulatory program. "The NCDA&CS constantly seeks ways to innovate, improve efficiency, increase effectiveness, and be at the forefront of new food safety and defense initiatives."

Through Fire and Rain: Radiant Regulatory Rays

MacMullan believes the strengths of the FDPD relative to food safety oversight and defense capabilities can be found in the Division's continuous involvement in new programs and initiatives designed to strengthen capacities and capabilities surrounding public health protection.

"Due to the strength of our leadership and commitment to excellence in all endeavors, the FDPD has become a leader among state programs in establishing and sustaining new programs and initiatives to improve our regulatory oversight and defense capabilities," she says.

That's a big deal, since there's an inventory of more than 13,000 food firms subject to inspection in North Carolina. "Of that, approximately 1,900 are manufacturing firms, with the remainder consisting of retail operations such as grocery stores, home processors, retail frozen desserts, and other industry types," MacMullan mentions. "In the manufacturing firm category we include bakeries, milling operations, seafood processors, wholesale frozen desserts, beverage bottlers, prepared salads, sauces, snack foods, and warehouses."

The FDPD was one of five state regulatory programs that piloted the first version of the Manufactured Food Regulatory Program Standards (MFRPS) in 2007.

Developed by FDA, along with selected state program managers, the MFRPS are an optional set of standards that can be used by the states (if they so choose) as a guide for continuous improvement for state food manufacturing programs.

"The concept of applying standards to regulatory programs was new at that time and pilot states did this work without the benefit of additional funding or other means of assistance," MacMullan points out.

MacMullan is quick to extol what she believes are some of the key achievements of the FDPD's MFRPS involvement. These include developing a comprehensive database to manage inspection, sampling, and compliance information; increasing training to field and compliance staff; creating procedures and policies to bring uniformity and consistency to MFRPS; establishing an audit program to assess the performance of North Carolina's regulatory program, leveraging Rapid Response Team (RRT) expertise in response activities; and ISO/IEC 17025 accreditation of the FDPD laboratory.

In 2008, the FDPD was in the first group of state programs that received funding from FDA under the RRT cooperative agreement. This cooperative agreement provided resources to build emer-

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gency response capacity and capability and to implement MFRPS.

"In collaboration with other RRT states, our program participated in the development of the national *RRT Manual of Best Practices* and continues to contribute to national emergency response activities," MacMullan relates. "Our RRT has been involved in training our own staff on emergency response activities, including the use of an Incident Command System, as well as collaborating with other states on similar training and table top exercises to ensure that we have the skills necessary to address food emergencies in our state."

Laboratory Capabilities

MacMullan boasts that the FDPD's laboratory becoming ISO/IEC 17025 accredited in 2010 was an accomplishment that not many state agricultural laboratories had achieved at that time. "Having an ISO accredited laboratory sends a very strong message to regulated industry and regulatory partners about our commitment to accurate, defensible data," she emphasizes. "Additionally, accreditation allows for greater utility of our laboratory data for public health protection.

"Our laboratory also participates in the Food Emergency Response Network (FERN), a nationally integrated lab system to provide surge capacity testing during food emergencies or foodborne illness outbreaks," MacMullan continues. "By participating in FERN, our laboratory stays current on new methodologies and procedures for food testing. Participating in FERN, along with being an ISO accredited lab, places our laboratory in an elite group of state and national laboratories that conduct critical food testing."

The FDPD staff serves on the Produce Safety Alliance, the Food Safety Preventive Controls Alliance, the FDA sponsored Partnership for Food Protection, and other working groups focused on advancing an integrated food safety system. "In collaboration with the National Association of State Departments of Agriculture and FDA, the NCDA&CS has been at the forefront of developing a model operational plan for state implementation of the Food Safety Modernization Act (FSMA) Produce Safety Rule," MacMullan adds. "The FDPD is also a member of the North Carolina Fresh Produce Safety Task Force and works with task force members on issues related to produce production."

The NCDA&CS is a founding member of the North Carolina Food Safety and Defense Task Force (FSDTF), a multi-agency, multi-stakeholder partnership created to better protect North Carolina's food supply. Created in 2003 by a Governor's executive order, the FSDTF brings together federal, state, and local regulatory agencies; academia; agriculture; industry; consumer groups; law enforcement; and other technical experts to improve the safety and security of the state's food supply.

How Sweet It Is: Industry at the Table

"A strength we have in North Carolina is that industry has a strong voice when it comes to food safety issues," says Stephen Tracey, CP-FS, CFS, the food safety manager for Salisbury, North Carolina-based Delhaize America-Food Lion and chair of the state's FSDTF executive committee.

Regulatory agencies, including the NCDA&CS and state public health officials, have invited North Carolina food industry representatives to serve on various relevant committees and councils over the years, Tracey points out.

"Industry being invited to the table has been an important way we have mutually enhanced communications among our organizations," Tracey emphasizes. "The end result is that we have a strong food safety culture in our state. With all of us working together, regulatory officials understand that food industry representatives want to do the right thing for customers and industry leaders understand that regulators are protecting public health."

Research, Extension, Education Powerhouse

"North Carolina is one of the most agriculturally diverse states in the country, and our food safety efforts reflect that diversity," says Lee-Ann Jaykus, PhD, a William Neal Reynolds Distinguished Professor in the Department of Food, Bioprocessing, and Nutrition Sciences (FBNS) at North Carolina State University (NCSU), Raleigh.

According to Dr. Jaykus, an impressive and inspirational list of food safety research, extension, and educational activities spearheaded by NCSU are not only unique to the Tarheel State, but wildly significant nationally and internationally.

"Relative to research, NCSU faculty and collaborators are conducting basic science research on the biology of *Salmonella*, *Campylobacter*, and *Listeria monocytogenes*," she begins. "There is also myriad applied food safety research at NCSU covering the commodities of red meat, poultry, fresh produce, and seafood."

In 2011, NCSU received a landmark $25 million grant from USDA's National Institute of Food and Agriculture (NIFA) to study human noroviruses across the food supply chain.

Norovirus is the most common cause of acute gastroenteritis in the U.S., according to the CDC. Each year, it reportedly causes 19 million to 21 million illnesses and contributes to 56,000 to 71,000 hospitalizations and 570 to 800 deaths nationwide. Norovirus is also the most common cause of foodborne disease outbreaks in the U.S.

You've Got a Friend: NoroCORE

Under Dr. Jaykus's expert leadership as scientific director, what has become the iconic USDA-NIFA Food Virology Collaborative (NoroCORE—Norovirus Collaborative for Outreach, Research, and Education) consists of a team of more than 30 collaborators from academia (representing 15 universities), industry, and government. The team's mission is to increase understanding of foodborne viruses; educate producers, processors, and food handlers on safe handling and preparation of food; and develop control and management strategies to reduce food contamination before and after harvesting. The ultimate goal is to design effective control measures and reduce the number of virus-caused foodborne illnesses.

Dr. Jaykus is proud to boast about NoroCORE's accomplishments to date.

"Basic science research has led to better understanding of the biology of noroviruses," she relates. "We have produced several 'designer' molecules that can be used to better diagnose disease and detect norovirus in foods and the environment. And we have collected epidemiological data that refines estimates of the burden of norovirus disease in the U.S."

Moreover, the NoroCORE scientists have identified several technologies and

tools, including copper, aerosolized hydrogen peroxide, and pulsed light, that are showing promise in inactivating human noroviruses on surfaces and foods. They have also produced a reagent exchange and comprehensive literature database that supports investigators and facilitates collaboration.

"We have trained more than 20 graduate students who now have specific expertise in food virology," Dr. Jaykus says. "We have provided significant extension and outreach to several sectors, including, among others, food service and grocery; sanitation and hygiene; testing and test kit manufacturing companies; molluscan shellfish and fresh produce industries; the cruise ship industry; and environmental and public health professionals. Besides all of that, our public outreach endeavors feature novel messaging that includes fact sheets, infographics, animations, and various social media campaigns."

Many other accomplishments are expected by the completion of the NoroCORE project in 2017, Dr. Jaykus emphasizes.

Extension and Education

In support of the FSMA, NCSU offers a strong extension and outreach program to fresh produce growers and packers, with an emphasis on small farmers. "A vegetable fermentation lab on campus sponsored by the USDA Agricultural Research Service conducts basic and applied research, and significant outreach, to this group of stakeholders," Dr. Jaykus notes.

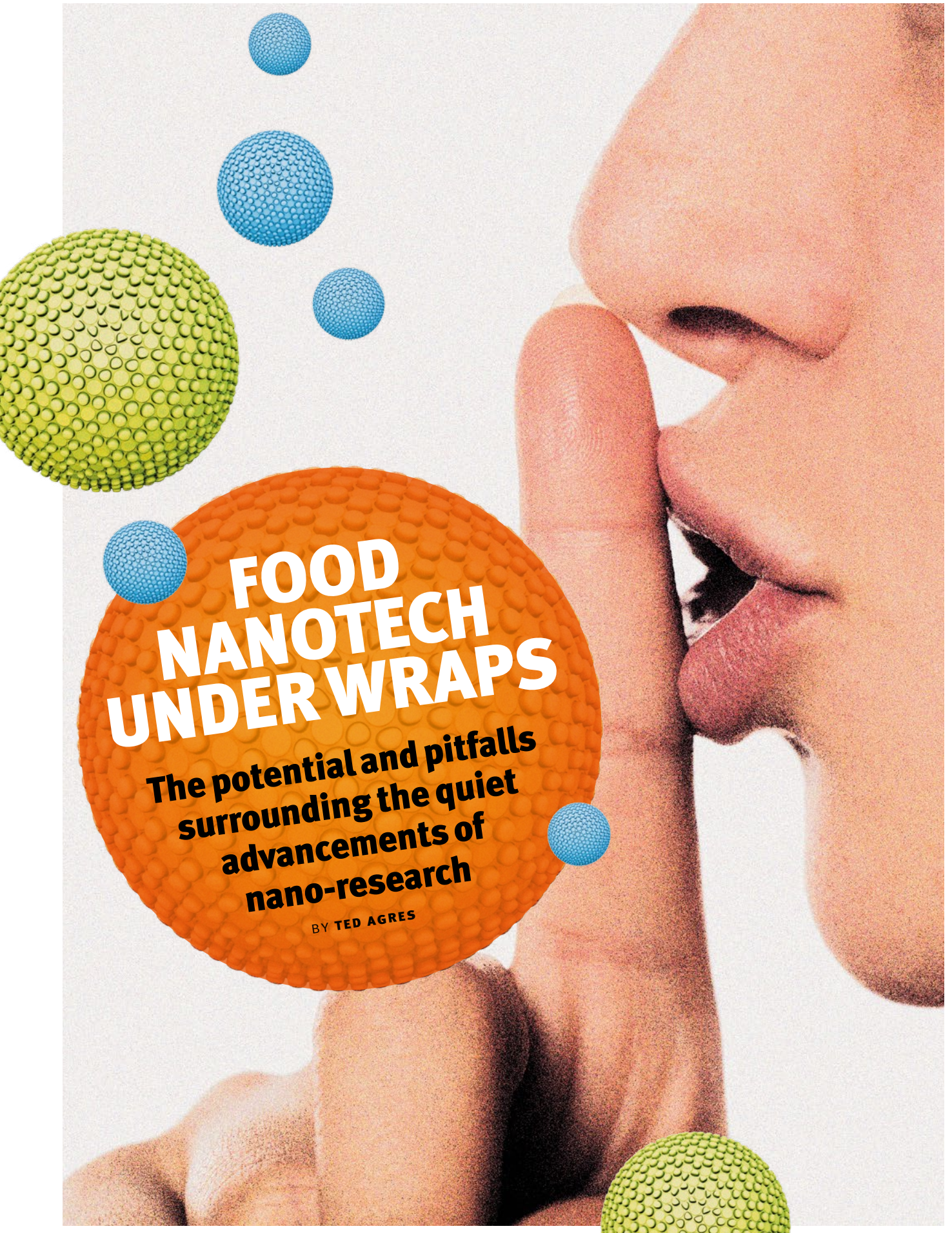
"NCSU offers a food entrepreneurial program that supports small food businesses in product development and safety," she says. "Our department provides expertise in microbiological risk assessment. And we offer strong outreach to consumers and other entities, including food service, schools, and farmers markets, with an emphasis on promoting food safety through the use of training and social media."

The FBNS offers one of the only graduate minors in food safety in the country. Novel distance education college credit courses, certificate programs, workshops, and training opportunities, with a focus on the food industry, cover Good Manufacturing Practices, sanitation, and Hazard Analysis and Critical Control Points programs to start the list. Not surprisingly, there's an online course on norovirus, which is geared for industry and the regulatory community.

"Some participants of the NoroCORE team are even putting together an online food virology curriculum geared to graduate students," Dr. Jaykus adds. "It's an opportunity to learn all they ever wanted to know about vomiting and diarrhea!" ■

Leake, doing business as Food Safey Ink, is a food safety consultant, auditor, and award-winning journalist based in Wilmington, N.C. Reach her at LLLeake@aol.com.

Is your state newsworthy? Your input regarding what states should be featured in this series is welcomed! Send a brief note highlighting what you believe is great relative to food safety/protection in any state, touching on public health, regulatory, academia, and/or industry components. Send recommendations to Linda L. Leake at LLLeake@aol.com. Hurry, there are only four more states to be featured in this year-long series!–*FQ&S*



FOOD NANOTECH UNDER WRAPS

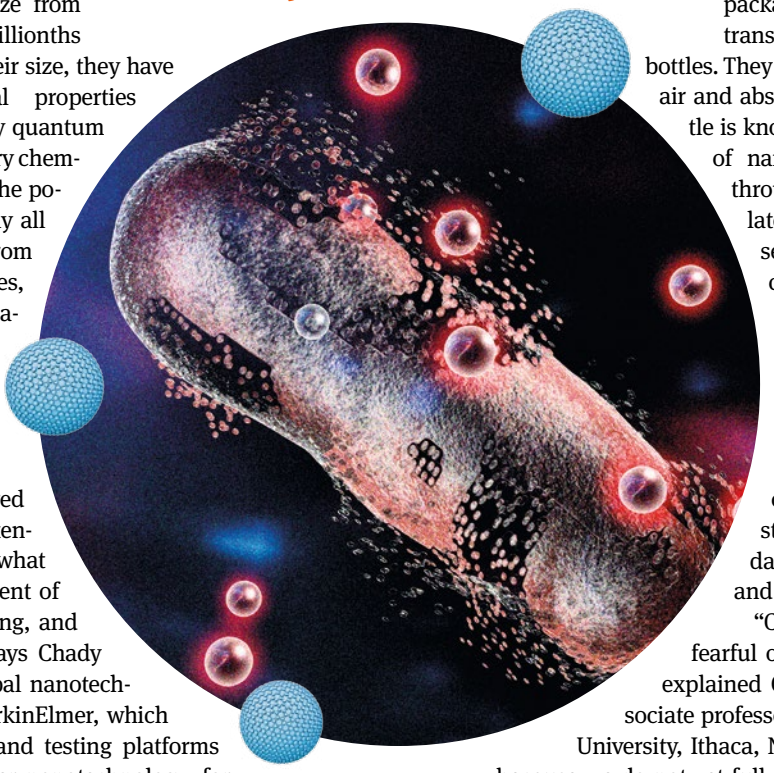
The potential and pitfalls surrounding the quiet advancements of nano-research

BY **TED AGRES**

While most major food companies publicly steer clear of nanotechnology, a large number of food and food-related items—including brand-name cereals, candy, cheese, chocolate, mayonnaise, plastic storage containers, and bottles—contain nanomaterials, added mainly to enhance color or extend shelf life. In fact, food nanotech, or the use of nanomaterials in food and food-related products, has been quietly growing over the past decade despite consumer mistrust and a lack of definitive knowledge over possible health harms.

Critics say that until the health effects are established, nanomaterials should be banned from foods or at least be strictly regulated.

Nanomaterials are engineered substances ranging in size from 1 to 100 nanometers (billionths of a meter). Because of their size, they have unique physico-chemical properties that are governed more by quantum mechanics than by ordinary chemistry. Food nanotech has the potential to enhance virtually all stages of production, from growing (nano-pesticides, nano-fertilizers), to preparation (nano-nutrients, nano-flavors), to packaging (nanofilms, nanosenor-enabled containers).



"For food and food-related science, engineered nanomaterials have the potential to transform how and what we eat through development of longer-lasting, better tasting, and safer, healthier foods," says Chady Stephan, manager of global nanotechnology applications at PerkinElmer, which manufactures analytical and testing platforms for nanomaterials. Polymer nanotechnology, for example, "can provide new food packaging materials with improved mechanical barrier with antimicrobial properties together with nano-sensors for tracing and monitoring the condition of food during transport and storage," Stephan tells *Food Quality & Safety*.

Critics say that until the health effects are established, nanomaterials should be banned from foods or at least be strictly regulated. "Scientists agree that nanomaterials create novel risks that require new forms of toxicity testing. But very little testing and regulation of these new products exists, and consumers have almost no information," says Jaydee Hanson, senior policy analyst at the Center for Food Safety.

Until a few years ago, Kraft Foods, Nestle, H.J. Heinz, Unilever, and other major food companies were enthusiastically pursuing food nanotech R&D, anticipating such innovations as nanoparticle emulsifiers to make food textures smoother and more uniform, nanoparticle colors and flavors to enhance appeal and taste, nanofilms and nanosensor-enabled "smart packaging" to detect, signal, and even prevent spoilage, and nanotech-enabled food contact surfaces to repel bacteria (see "Examples of Food Nanotech Applications" sidebar, p. 24). But instead of responding positively, consumers have grown wary about the safety of nanotechnology. Most major food companies have halted their food nanotech programs or are keeping them tightly under wraps.

Chief among the health concerns is that nanomaterials in food can easily pass through biological barriers including cell membranes and cell nuclei. Nanoparticles can leach out of packaging material, such as transparent films, containers, and bottles. They can also be inhaled from the air and absorbed through the skin. Little is known about the health effects of nanomaterials as they move through the body and accumulate in tissues and organs. Research has found that some common nanomaterials, including nano-titanium dioxide (a whitening agent) and nano-silver (an anti-bacterial), can cause cellular dysfunction, including the over-production of reactive oxygen species and oxidative stress, a precursor to cellular damage, neurological disease, and cancer.

"Consumers are skeptical, even fearful of nanotechnology in food," explained Carmen I. Moraru, PhD, associate professor of food science at Cornell University, Ithaca, N.Y. "This is understandable because we do not yet fully understand the interaction of nanoscale matter with the human body—very important when nanostructures are ingested," she said during a presentation at the Cornell Institute for Food Systems Industry Partnership Program.

Despite the concerns, scores of researchers in the U.S. and worldwide are actively pursuing nanotechnology to enhance food quality and safety. They focus on two main areas: antimicrobial food packaging and food surface materials, and nanosensors capable of detecting minute levels of foodborne pathogens and toxins quickly and inexpensively.

Nanomaterials in Food Surfaces and Packaging

Dr. Moraru and her Cornell colleagues, working jointly with researchers at Rensselaer Polytechnic Institute, Troy, N.Y., have used an electrochemical process called anodization to create nanoscale

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pores on metal food surfaces that prevent bacteria from sticking. The nanopores become endowed with an electrical charge and surface energy that repel bacteria and prevent biofouling and biofilm formation. The pores can be as small as 15 nanometers (a sheet of paper is about 100,000 nanometers thick). In laboratory tests, nanopores in aluminum prevented *E. coli* O157:H7 and *Listeria monocytogenes* surrogates from attaching to the metal's surface.

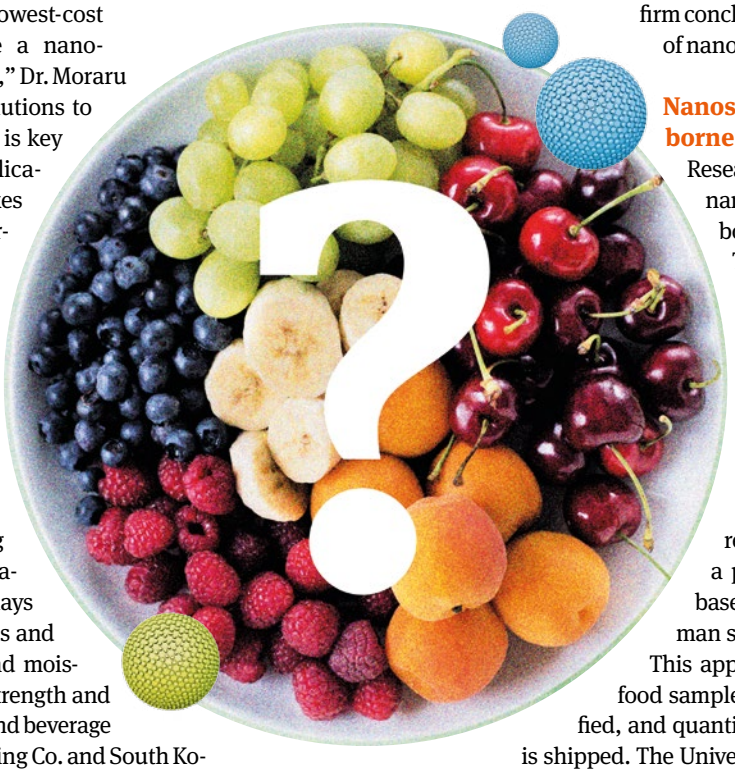
"It's probably one of the lowest-cost possibilities to manufacture a nanostructure on a metallic surface," Dr. Moraru said, noting that low-cost solutions to limiting bacterial attachment is key to nanofood processing applications. "The food industry makes products with low profit margins," she explained. "Unless a technology is affordable, it doesn't stand the chance of being practically applied."

Already widely commercialized are nanocomposites in food packaging to extend product shelf life. These include nano-silver, nanoclay (naturally occurring fine-grained silicates), and nano-zinc, among others. Nanoclays are fabricated into plastic films and coatings to strengthen gas and moisture barriers and to increase strength and toughness. Several large beer and beverage makers, including Miller Brewing Co. and South Korea's Hite Brewery, have been using nanoclay composites in their plastic bottles to create high-oxygen barrier packaging that keeps beer fresh for six months and longer.

Nano-silver is strongly anti-microbial, capable of killing more than 650 disease-causing pathogens within six minutes of contact time. As such, nano-silver is widely used in medical applications including catheters and for dressing wounds. Nano-silver has also been added to a variety of plastic food packaging and storage containers to inhibit the growth of mold and fungus. In 2014, however, the EPA banned nano-silver from food storage containers because the application had not been properly tested and registered. Nano-silver in food packaging has also been banned in many European countries. Nevertheless, such containers remain commercially available in South Korea, China, Taiwan, and other countries. Other non-food U.S. nano-silver products include socks, sportswear, laundry detergents, and deodorants.

While nano-silver is widely suspected of causing health harms, other nanomaterials, such as nano-titanium dioxide and nano-silica, continue to be used in food. Titanium dioxide is commonly used to increase the whiteness or brighten the color of numerous products including toothpaste, candy, mayonnaise, cheese, cake frostings, and yogurt. While FDA considers conventional titanium dioxide to be safe, the health effects of its nano-sized particles remain unclear. Food companies whose products have been found to contain nano-titanium dioxide deny adding the particles and suggest that they occur naturally. Nano-silica is widely used as an anti-caking agent in powdered food products and in cosmetics and skin care. The European Commission's Scientific Committee on Consumer Safety found "inadequate and insufficient" evidence to draw any firm conclusion for or against the safety of nano-silica in cosmetics.

Researchers are also developing nanosensors to detect foodborne pathogens and toxins.



Nanosensors to Detect Foodborne Pathogens

Researchers are also developing nanosensors to detect foodborne pathogens and toxins. The USDA's National Institute of Food and Agriculture (NIFA) last year awarded $3.8 million in grants to support nanofood R&D in food safety, food security, nutrition, and environmental protection. The University of Massachusetts in Amherst received $444,200 to develop a pathogen detection platform based on surface-enhanced Raman scattering, or SERS, mapping. This approach permits bacteria from food samples to be concentrated, identified, and quantified before any food product is shipped. The University of Georgia in Athens received nearly $500,000 to develop bio-nanocomposite-based electrochemical sensors that can detect fungal pathogens in selected crops.

"Advances in nanotechnology help secure a healthy food supply by enabling cost-effective methods for the early detection of insects, diseases, and other contaminants; improve plant and animal breeding; and create high value-added products of nano-biomaterials for food and non-food applications," says Sonny Ramaswamy, PhD, director at NIFA.

One important goal for nanotech sensors is to detect foodborne pathogens rapidly and inexpensively. Conventional detection methods such as microscopy and nucleic acid- and immunoassay-based techniques can require large samples, long incubation times, or the need to prepare cultures. Newer techniques including polymerase chain reaction, or PCR, and other molecular diagnostic methods require undamaged DNA and reagents and rely on experienced technicians, making the overall cost high enough to limit wide-scale use.

Nanosensors may be able to overcome many of these limitations. Researchers at Technische Universität München in Germany,

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for example, are developing disposable carbon nanotube-based gas sensors that can be sprayed onto the surfaces of clear plastic packaging film. The nanosensors gauge product freshness by detecting small changes in carbon dioxide and other gases.

Laboratory nanosensors are being constructed from nano-gold, nano-silver, magnetic nanoparticles, and quantum dots. In a recently published technical overview of nanosensors, B. Stephen Inbaraj and B.H. Chen, food science researchers at Taiwan's Fe Jen Catholic University, describe a "quartz-crystal microbalance DNA sensor" to detect *E. coli*; a reusable immunosensor based on gold nanoparticles to detect *Salmonella*; and the addition of "superparamagnetic nanoparticles" coated with antibodies to detect *Listeria monocytogenes* using a high-transition temperature superconducting quantum interference device, or SQUID. Such nanosensors "provide advantages of rapid, sensitive, and user-friendly detection, enabling portability for in-field application," Inbaraj and Chen write.

Nanoparticles can leach out of packaging material, such as transparent films, containers, and bottles.

Examples of Food Nanotech Applications

Food processing:

- Nanoscale coatings to prevent biofouling (bacterial contamination) of food contact surfaces
- Nanoparticles to selectively bind and remove pathogens and chemicals
- Nanoencapsulation, nanoemulsions, and nanoparticles to improve the bioavailability of nutraceuticals and deliver flavor enhancers
- Nanotubes and nanoparticles as gelation and viscosifying agents

Food packaging:

- Biodegradable nanosensors for temperature, moisture, and time monitoring
- Nanoclays and nanofilms as barrier materials to prevent spoilage
- Nanosilver and other nanoparticle surface coatings with antibacterial properties
- Fluorescent nanoparticles with attached antibodies to detect chemicals and foodborne pathogens
- Silicate nanoparticles to create lighter, stronger, and heat-resistant films

Agriculture:

- Nanocapsules to deliver pesticides, fertilizers, and other agrichemicals
- Nanosensors to detect animal and plant pathogens
- Nanosensors to monitor soil conditions, crop growth

Sources: Nanowerk, industry news releases.

Nanofood Safety Concerns

Last year the Center for Food Safety unveiled a searchable online database of about 300 different food and food-related products found to contain more than 40 different types of nanomaterials. The products included an array of brand-name candies, breakfast cereals, seasonings, mayonnaise, as well as baby bottles and plastic storage containers. Nano-silver and titanium dioxide were the two largest categories, followed by nano-encapsulation and nano-silica.

"The FDA is failing to prevent nano-laced foods from being sold," says the Center for Food Safety's Hanson. "Our food safety agency should demand that these products be taken off the market, as companies are using food additives and food contact materials not approved at the nano scale."

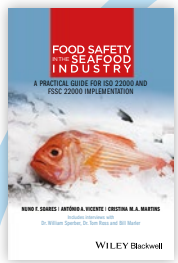
After several years of deliberation, in June 2014 FDA issued industry guidance documents on nanotechnology in food. The agency said it will consider nanomaterials to be like any other food additive. While noting nanotechnology was not "intrinsically benign or harmful," its use could warrant new or additional food safety evaluations. "For food ingredients and food-contact materials, we will examine nanotechnology products for safety using our pre-existing regulatory frameworks, on a case-by-case basis," explains Marianna Naum, PhD, FDA spokesperson. "This requires that valid scientific data must demonstrate...that there is a reasonable certainty of no harm from the proposed use of the substance under its intended conditions of use," she tells *Food Quality & Safety* magazine.

Late last year, the European Commission decided to go further and published a final novel foods regulation specifying that engineered nanomaterials will require prior authorization before being used in food, with safety being assessed by the European Food Safety Authority. Food company applicants must demonstrate that they have used the most recent methods to test engineered nanomaterials. Food items containing nanomaterials will be required to disclose that information on the label.

While the regulatory science remains in flux, the genie is clearly out of the bottle. Only time and further testing will clarify the ultimate risks and rewards of food nanotechnology. ■

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

Latest Titles in Food Safety

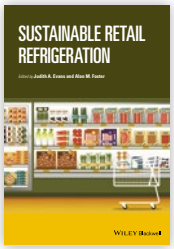


Food Safety in the Seafood Industry: A Practical Guide for ISO 22000 and FSSC 22000 Implementation

Nuno F. Soares, António A. Vicente, Cristina M. A. Martins

ISBN: 978-1-118-96507-8 • Paperback • 200 pages • March 2016

Written in an accessible and succinct style, this book implementation brings together in one volume key information for those wanting to implement ISO 22000 or FSSC 22000 in the seafood manufacturing industry.



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Judith A. Evans, Alan M. Foster

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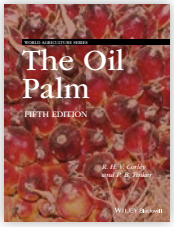

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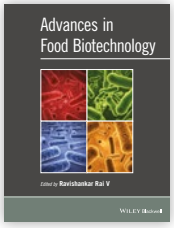

Advances in Food Biotechnology

Ravishankar Rai V

ISBN: 978-1-118-86455-5 • Hardcover • 752 pages • December 2015

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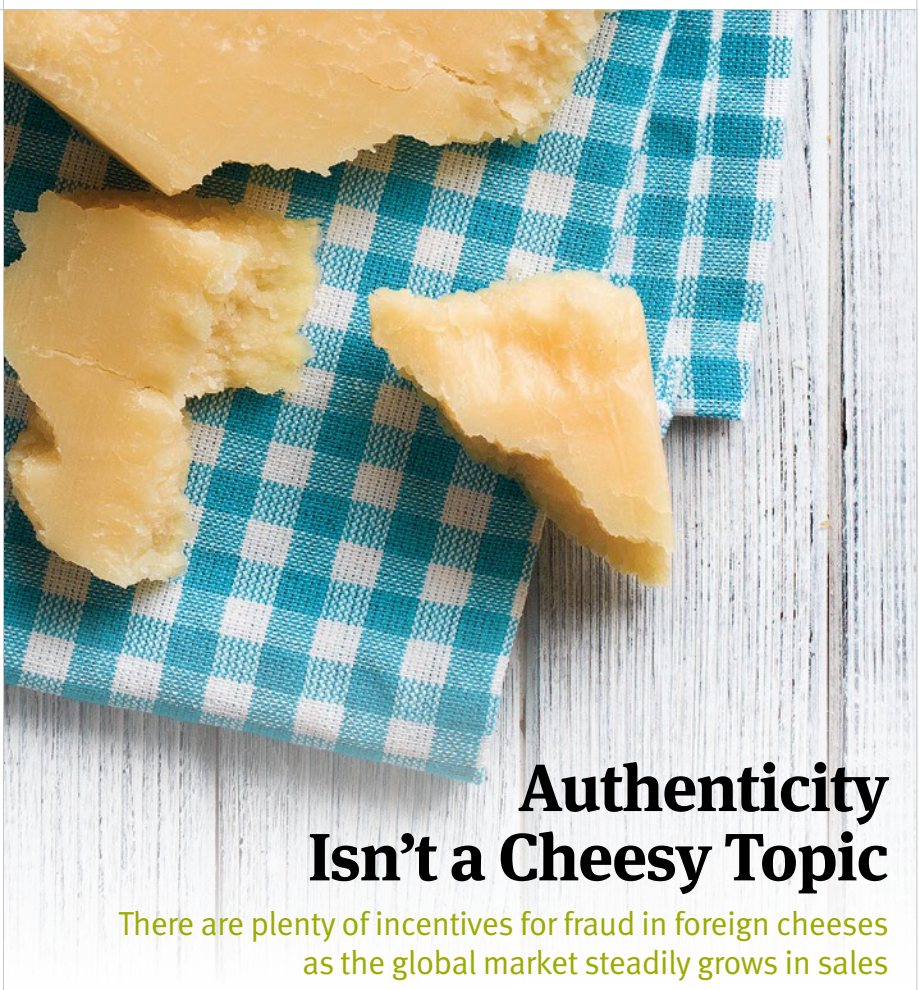

Authenticity Isn't a Cheesy Topic

There are plenty of incentives for fraud in foreign cheeses as the global market steadily grows in sales

BY **BERT POPPING** AND **EMILIANO DE DOMINICIS**

Nobody really knows when cheese making started. Several myths describe how cheese making originated with one of the most popular legends dating back 4,000 years ago. It describes an Arab trader who had to cross the desert and he carried milk in a pouch made from a sheep's stomach. Since there was rennet in the lining of the pouch, and with the heat generated by the sun, the milk separated into whey and curd. When he tasted the whey in the evening, he found that it satisfied his thirst, and the curd his hunger.

According to recent findings by the research group of Richard Evershed from the University of Bristol, cheese making dates back to the Neolithic period, much before the Arab trader story. His group found traces of dairy fat in ancient ceramic fragments, supposedly used as cheese-strainers, in Poland, which suggest that people have been making cheese in Europe for up to 7,500 years.

However, some of the cheeses we know today, like Gouda, Parmesan, and Cheddar, have their beginning in the Middle Ages.

The mass production of rennet is said to have started around 1860 and industrial cheese production followed in the 20th century.

Types of Cheeses

Considering that cheese is made from a single ingredient, milk, how is it possible to have so many different types of this product? There are many factors affecting cheese making, from the milk source and its quality to several factors involved during production.

How many varieties of cheeses are being produced? This is a difficult question to answer. Cheese can be classified using different criteria. Such as milk source (e.g. cows, goat, sheep, or buffalo milk), softness degree (soft, semi-soft, semi-hard, and hard), by geography (country or region), production method, curing or ripening duration, fat content, etc. According to the International Dairy Federation, there are 500 types of cheese. Sandine and Elliker mention 1,000 and the website Cheese.com references more than 1,700 different cheeses.

The Global Cheese Market

As previously mentioned, large scale industrial production of cheese emerged in the 19th century and exhibited breath-taking growth. By the end of the 19th century, the industry was reported to have produced 98 million kilogram (kg) of cheese per year and by end of the 20th century, it was already 10 times as much. It is estimated that in the U.S., about 30 percent of all milk goes into cheese production. And the global cheese market is estimated to have a value of U.S. $80 billion and will reach U.S. $105 billion in three years from now, with a healthy growth of a CAGR of 4.4 percent.

Specifically for Parmigiano Reggiano, the production of cheese wheels levels around 3.3 million per year, limited by the geographic region in which it can be produced and the amount of milk coming from that region. Based on the sales price of approximately U.S. $18/kg at a major Italian supermarket (price on Jan. 16, 2016) and the average weight of a cheese wheel of 38 kg, this results in a total U.S. $2.2 billion sales value—which gives plenty of incentive for fraud.

What is Food Fraud

Food fraud encompasses two aspects: the deliberate misrepresentation of a product, e.g. a champagne label on a bottle that contains sparkling wine from a region

other than the French Champagne; and the deliberate modification of a product, e.g. by dilution, addition, or replacement of an expensive ingredient with a cheap one.

Although not the oldest business in the world, food fraud is not far from it. In 1820, the first book on food adulteration (and methods of detection) was written by Fredrick Accum, a German chemist living in London. The subtitle on the cover features cheese as a product of adulteration. The chapter on cheese adulteration is titled "Poisonous Cheese" and discusses the addition of red lead to annatto for coloring. Today, the addition of red lead is less likely, however, a look at the USP Food Fraud Database reveals that other adulterants are being used.

Fraudulent practices affecting milk include dilution with water to increase the volume, in conjunction with melamine to increase the apparent protein content. Although the main purpose of adulteration practices is solely economic, some cases also pose a safety risk to consumers. For example, the instance of melamine added to milk caused the death of several children in China when used in infant formula.

Premium milks from buffalo, sheep, or goat are frequently mixed with less expensive cows milk. In some countries, cows' milk is more expensive and mixtures with goat and sheep milk have been reported.

Other typical adulteration includes the use of reconstituted milk powder instead of fresh milk, as well as the addition of detergent, urea, formaldehyde, hydrogen peroxide, salt, potato starch, and hydrolyzed leather. Some compounds are approved to use within legal limits, and beyond this point they may be consider adulterants, such as cellulose used as an additive to prevent clumping of the product, including grated cheese.

The USP Food Fraud Database carries no less than 474 entries on milk and milk products for the years 2000 to 2015, and milk adulteration is the second most frequently reported issue. This is in stark contrast to the European Rapid Alert System for Food and Feed database called RASFF. This database contains only 30 entries in the same timeframe when queried for product category "milk and milk products" and hazard category "adulteration/fraud." None of them list the Risk Decision as "serious." Interestingly, melamine does not even appear in the query results, even when querying the RASFF database using only the criteria "milk and milk products" under category and "serious" under Risk Decision. This is due to the fact that although the database contains 337 entries on melamine, only four notifications relate to melamine in milk, and in all cases the Risk Decision is "undecided." This indicates that the RASFF portal does not provide a good representation of food fraud cases when only searched in the hazard category "adulteration/fraud," a definition that should be revised by the European Authorities. It also does not correlate with the report provided to the European Parliament in 2014 on food fraud. This report lists milk and milk products, including cheese, as fourth most frequently adulterated product category.

With regards to the misrepresentation of products, Europe has created legislation to protect premium food products.

In its latest regulation EC 1151/2012, superseding the earlier regulation EC 510/2006 on quality schemes for agricultural

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products and foodstuffs, the European Commission clearly defines in article 12 the use of the PDO (Protected Designated Origin) label. Currently 600 products carry the PDO label, of which 186 are cheeses, 49 are from Italy.

The remainder of this article will focus on Parmigiano Reggiano cheese, one of the most popular PDOs, which was first registered in 1996. The region in which it is produced is limited to Parma, Reggio Emilia, Modena, and parts of the provinces of Mantua and Bologna, on the plains, hills, and mountains between the rivers Po and Reno. Cattle, which milk is used for the production of Parmigiano, cannot be fed silage or fermented feeds, and no additives or preservatives can be used. It was apparently Benedictine monks who started producing this cheese. Today's production of a wheel requires 600 liters of milk. The resulting cheese wheel is left to dry and forms a natural, edible crust. The minimum maturation time is 12 months, longer than many similar cheeses.

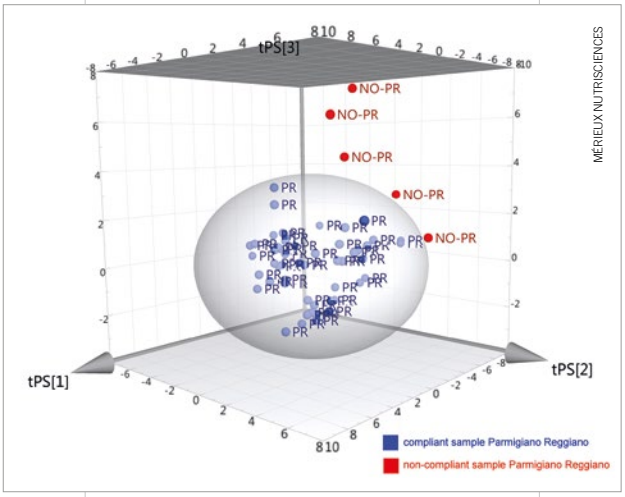
To protect PDO products, like Parmigiano Reggiano cheese, the European Commission has bilateral agreements with some countries. There is no such agreement with the U.S., which is why one can find generic products on the market labeled Parmesan, Champagne, Camembert, etc. that do not have their origins in Europe.

Common Approaches to Detect Food Fraud

The forms of adulteration like dilution with water, skimming, or removal of fat and addition of fluid skim milk can be detected from specific gravity and fat content. Immunological technologies and polymerase chain reaction, or PCR, can be used to determine a blend of milks (e.g. cows' milk in goat) and results are expressed as approximate content (percentage). The addition of cows' milk can also be detected by the presence of ß-carotene, which is absent in goat milk. There are other technologies that have been or are still being used for the detection of adulteration of milk and cheese.

Today, routine checks for incoming materials are often done by near infrared spectroscopy (NIR) or fourier transform infrared spectrometry, or FTIR. These are useful techniques as they assess profiles instead of single parameters. NIR technology focuses mainly on three major chemical entities: C-H, N-H, O-H, and C-O-H, representing sugar, water, protein, and fat. This is insufficient to identify all adulterants or changes unrelated to any of these structures.

Figure 1.



Novel Methods of Detection

Nowadays, cases of fraud tend to be substantially more sophisticated, and scientists are behind some of them. In many instances, fraudsters take advantage of the limitation of detection methods or by the fact that many compounds are not normally associated with foods and therefore are not looked for. Melamine is a very good example: In order to perform this fraud and keep it covered, it is important to understand that one of the quality parameters for milk, protein content, is not measured directly. Instead, it is assessed by methods (Kjeldahl and Dumas), which determine nitrogen content. Such methods do not only determine nitrogen in the protein structure, but also nitrogen in other compounds present in the sample. Therefore, more nitrogen does not necessarily translate into more protein and thus higher quality.

Since many fraudsters target methods of analysis, it is critical to develop new strategies to counteract. One good option is the use of novel technologies that allow the simultaneous assessment of a wide range of different variables, which in their entirety, are difficult to fool.

Among the novel technologies worth mentioning is the combination of high-resolution mass spectrometry with sophisticated multivariate statistical analysis. The data generated by the mass spectrometric analysis are processed by software that generates a three dimensional model (see Figure 1), which looks like a sphere. A key precondition for developing these models is to have a certain number of reference samples known to be authentic. The non-targeted approach that Mérieux NutriSciences has developed to verify the authenticity of Parmigiano Reggiano was built on one reference sample provided by the Parmigiano Reggiano Consortium.

After the model has been built, unknown samples are analyzed and compared with the multi-variable model. The model will distinguish samples that are compliant (authentic Parmigiano Reggiano) from those which are not. If not, there is a high probability that a sample is adulterated or mislabeled.

In case of the Parmigiano Reggiano model, the high-resolution non-targeted mass spectrometry in conjunction with statistics already provided a good prediction rate. This could be further improved by assessing additional targeted variables, e.g. compound only present in silage feed. This approach yielded a 100 percent prediction rate when tested on blind samples sent by the Parmigiano Reggiano Consortium.

The principle of this non-targeted approach can easily be transferred to other premium products as long as reference materials are available. In the case of extra virgin olive oil, not only the country and region could be predicted, but also the year of the olive harvest.

The work demonstrates that older and costly approaches do not always lead to better or more accurate results. The novel non-targeted approach, based on numerous examples, can result in ideal prediction of adulterated or mislabeled sample. ■

Popping, is chief scientific officer at Mérieux NutriSciences Corp. Reach him at bert.popping@mxns.com. And **de Dominicis** is head of research and development at Mérieux NutriSciences in Italy. Reach him at emiliano.de.dominicis@mxns.com.

Testing

ANTIBIOTICS

Entering the 'Raised Without Antibiotics' Market

Analytical methods that monitor for unintended presence of antibiotics help ensure the quality of meat products

BY **DELLE HERRERA** AND **JOSEPH KREBS, PHD**

Consumer demand for meat raised without antibiotics (RWA) has grown by 25 percent over three years, and shows every sign of continuing to accelerate, driven by consumer concerns about human health, animal welfare, and environmental stewardship. Despite an overall decrease in U.S. per capita meat consumption, sales of meat and poultry raised without antibiotics have steadily increased over the same three-year period.

According to surveys conducted by *Consumer Reports*, 72 percent of consumers are very concerned or extremely concerned about the widespread use of antibiotics in food products, listing the fear of rising antibiotic resistance and the proliferation of multi-drug resistant superbugs as a top reason. Heavy selective pressures imposed on bacterial populations by antibiotic overuse have been shown to favor the spread of drug-resistant bacterial strains, which thrive in such conditions. These selective pressures are widespread, with approximately 80 percent of the antibiotics sold in the U.S. being administered to animals raised for food, including hogs, cattle, chickens, and turkeys. This large-scale antibiotic use kills susceptible bacteria, leaving behind only drug-resistant bacteria, which reproduce and give rise to a growing population of antibiotic-resistant superbugs. These superbugs then spread through air, soil, water, and contaminated meat, resulting in untreatable infections in human patients. Multi-drug resistant *E. coli* infections seen in humans have been linked directly to contaminated poultry, and hospitals have seen an increase in untreatable, fatal, bacterial infections as widespread agricultural antibiotic use favors the population growth of bacterial strains resistant to even last-line antibiotics. Resistant bacteria transfer the resistance trait across species by plasmids, small bits of DNA that can be transferred to different types of bacteria. For example, the *mcr*-1 gene, which confers resistance to the last-line antibiotic colistin, has been found in *E. coli*, *Klebsiella*, and *Pseudomonas* species, all common sources of infection.

> Rapid test methods can be simpler, less expensive, and more portable than instrument-based detection methods.

In addition to public health concerns, customers in search of meat viewed as humanely raised seek meat from animals raised without antibiotics, often viewing prophylactic antibiotic use as a necessity that arises from crowded factory farm conditions.

Labeling It

Consumers in search of meat raised without antibiotics depend on labels such as the USDA No Antibiotics Added label to

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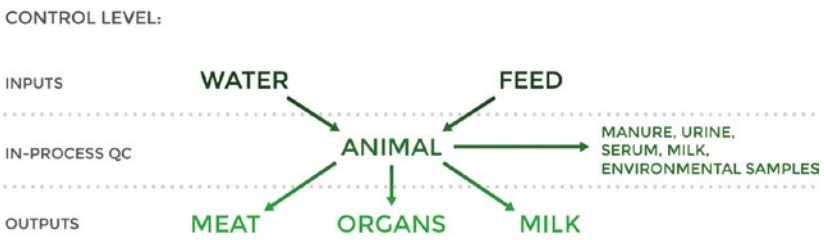
ensure the quality of their meat. The USDA No Antibiotics Added label verifies that an animal was not given antibiotics, in any form, at any time during its lifespan. To apply for such labeling, producers submit documentation to the USDA, providing a brief description of the raising of the animals from birth to harvest. Documentation of raising practices should include segregation protocols and procedures for dealing with sick animals, complete feed formulation presented in common language or copies of feed tags, and a signed affidavit on company letterhead verifying all claims on the label are true. Information regarding antibiotic usage is self-reported by the producers, placing the responsibility on farm facilities to ensure animals are raised without antibiotics.

Additionally, for poultry, the USDA verifies that poultry products were not derived from eggs or poultry that were injected or otherwise treated with antibiotics. The USDA also monitors methods of verifying these claims. If the animals were purchased from another producer, the USDA requires a copy of the incoming purchase label bearing the claim that the animals were raised without antibiotics, or a copy of the letter from the USDA Food Safety and Inspection Service to the original producer, accepting their supporting documentation for the raised without antibiotics claim, as well as the in-house segregation protocol from the time the meat is received until shipping of the final product. The USDA also accepts copies of certificates from third-party certification agencies.

Efforts in Reducing Antibiotics

Together with the USDA, the CDC and the FDA have testified before Congress that there is a definitive link between routine nontherapeutic use of antibiotics in food animal production and the rising tide of antibiotic resistance in humans. The FDA, which regulates veterinary use of antibiotics, has issued best practice guidelines that include the voluntary withdrawal of production use of new medically important veterinary antibiotics. FDA recommends that antibiotics be used in food-producing animals only under veterinary determination of medical necessity and utility, and that drug sponsors voluntarily revise the conditions of use of their medically important new antimicrobial animal drugs to reflect the need for the professional oversight of a licensed veterinarian. This would mean a change from over-the-counter to veterinary feed directive status for medicated feed products and from over-the-counter to prescription status for medicated drinking water products.

Figure 1.



Internationally, at this year's World Economic Forum in Davos, Switzerland, more than 80 companies, including international pharmaceutical, biotech, diagnostic, and generic drug companies, have signed a declaration supporting continued work to reduce unnecessary and inappropriate use of antibiotics in both human medicine and in livestock, in order to preserve the long-term effectiveness of existing antibiotic drugs. These signatories commit themselves to the principle that such stewardship is essential to slow the rise of multidrug-resistant bacteria.

In response to growing consumer demand, many large-scale buyers are sourcing meat partially or exclusively from facilities which raise animals without antibiotics, including Whole Foods, Trader Joe's, Publix, Stop & Shop, and Shaw's grocery stores. Major restaurant chains, including Chipotle, Panera, McDonald's, and Wendy's, also feature, as a selling point, meat products derived from animals raised without antibiotics. Chick-fil-A, the largest U.S. chicken chain by domestic sales volume, has committed itself to serve only 100 percent antibiotic-free chicken by the year 2019.

Producers of meat and poultry raised without antibiotics enjoy a market advantage over their conventional counterparts, as demand for meat raised without antibiotics continues to increase even as overall U.S. market size for meat products shrinks. Traditionally, increased cost has been a concern for large-scale producers, but a *Consumer Reports* survey finds that more than 60 percent of consumers would be willing to pay at least $0.05 per pound more for meat raised without antibiotics, with 40 percent willing to pay $1 or more per pound. Additionally, actual transition costs are predicted to be very low. Denmark has nationally phased out the routine use of antibiotics in animal feed, and a World Health Organization analysis of pre- and post-ban poultry prices found no changes in net cost because the increased feed cost was offset by the cost savings of not purchasing growth-promoting antibiotics. The National Research Council estimates that if U.S. producers eliminated all non-therapeutic antibiotic use in meat production, the price increase would be as little as a dollar a month per person, far below the threshold *Consumer Reports* found customers are willing to pay.

A Change in Process

The transition from traditional to RWA methods requires significant changes to fundamental production processes. Fixed transition costs predominantly arise from the initial investments of modifying poultry houses, improving ventilation systems, and the adoption of more advanced vaccination technologies, as factors in reducing incidences of infections that would otherwise require antibiotics. A study of the removal of growth-promoting antibiotics from the feed of broiler chickens showed no reports of field outbreaks of dermatitis, necrotic enteritis, or dysbacteriosis. This finding was consistent with the finding of no significant differences in septicemia or inflammatory process in the plant with birds not fed these antibiotics compared to those given antibiotics. Total farm condemnations were not affected by removal of growth-promoting antibiotics. During such transition periods from the regular use of medicated feed, or other growth-pro-

moting or prophylactic antibiotic products, to a process of raising animals without antibiotics, antibiotic-testing kits and consulting services can be particularly helpful to ensure the integrity of the production process and aid in smoothing the transition.

Vigilant monitoring of production materials and processes in the supply chain is essential to ensure product quality and integrity, both during and after the transition period. Quality testing at various control points along the production process is essential (see Figure 1, p. 30). This testing is highly critical to confirm the effective use of procedures and materials at each step. Essential testing measures include routine analysis of feed and drinking water supplies given to the animals to ensure that medicated feed or water stocks are not fed to RWA animals. This is especially important during the initial RWA conversion period, where both medicated and non-medicated materials are being stored and used on the same premises. Testing of feed supplies can be augmented by downstream "in-process" testing of flock/herd biofluids (such as blood and mucus), waste products (manure, urine), or environmental samples (soil, waste water). Lastly, since RWA labeling requirements apply to the final state of the meat and food products themselves, QC testing of food product outputs ensures that the final product conforms to labeling requirements.

Analytical Methods

A wide variety of powerful analytical testing methods have been developed to detect antibiotic contamination in the food production process. These methods can be classified into two broad categories—instrument-based (chromatographic) laboratory methods and rapid test methods.

Instrument-based methods, such as high performance liquid chromatography (HPLC), gas chromatography/mass spectrometry (GC-MS), liquid chromatography-mass spectrometry (LC-MS), and capillary electrophoresis, are highly accurate and reproducible techniques, but these techniques have several limitations which impede their usefulness for routine testing of RWA feedstocks and facilities. For instance, these methods require expensive instruments. These instruments must reside in a specialized laboratory and be maintained and operated by a highly skilled analyst. The expense of performing instrument-based antibiotic tests renders them impractical for routine high-throughput analysis of RWA processes. However, they are ideal methods for the secondary confirmation of contaminated samples.

Rapid test methods can be simpler, less expensive, and more portable than instrument-based detection methods. As such, they are ideal for the needs of typical RWA food producers to monitor the quality of their supply chains. Rapid antibiotic tests fall into two categories—microbiological tests and immunoassays. These tests differ in their basic underlying principle: Microbiological tests detect functional activity of antibiotics, while immunoassays detect antibiotics through their specific chemical structures. Microbiological tests, such as Bioo Scientific's MaxSignal Total Antibiotics Test Kit (#1023-03), can be simple and highly versatile. A sample is applied to a small vial that houses dormant natural bacterial spores. When heated, spores in vials lacking antibiotics will grow and divide, triggering activation of a colored growth indicator (negative result); in contrast, no color change is observed in vials containing antibiotics (positive result), since the antibiotics prevent spore growth. Microbiological tests are highly generalized and detect a wide variety of antibiotic types.

The other type of rapid antibiotic test kit, the immunoassay, is divided into two categories—enzyme-linked immunosorbent assays, or ELISAs, and lateral flow strip tests. Immunoassays generally use an antibody to recognize and bind antibiotics within the test sample. Unlike microbiological methods, immunoassays are highly specific to a particular antibiotic class. In spite of this limitation, immunoassays (particularly lateral flow tests) are frequently the preferred method for routine farm-based testing because of their speed and simplicity. This is especially true for routine quality control testing in RWA facilities where the antibiotic type of the potential contaminants (previously or currently used in the same facility) is known. Immunoassays possess the flexibility to detect antibiotics in many types of samples found in the RWA facility, including feed, water, serum, urine, manure, wastewater, liver, and meat.

Rapid testing and instrument-based assays are well suited to perform complementary roles in QC protocols for RWA facilities. Rapid testing methods are simple and inexpensive, and can be used onsite to quickly screen test samples for contamination, while putative positive samples can be subsequently confirmed by a third-party lab using instrument-based techniques. ■

Herrera is a marketing associate at Bioo Scientific. Reach her at dherrera@biooscientific.com.
Dr. Krebs is vice president of Product Development and Quality Assurance at Bioo Scientific. Reach him at jkrebs@biooscientific.com.

REFERENCES FURNISHED UPON REQUEST

Importance of DNA in Seafood Authentication

Next-generation DNA sequencing can determine authenticity and speciation to reduce the risk of food fraud

BY **DANICA HARBAUGH REYNAUD, PHD**

DNA testing of food products and ingredients is the most accurate way to identify and authenticate species, detect contaminants or adulterants, and verify label claims. It can help prevent food fraud and may help meet upcoming NOAA traceability regulations for seafood importers. This article discusses how DNA testing can help supply chain and seafood authenticity; the differences in chemical, DNA barcode, and next-generation sequencing (NGS) testing; DNA testing specific to seafood; and DNA testing as part of quality control.

As the global food supply chain becomes increasingly complex and fragmented, the challenges of safeguarding the food supply also increase. One of these challenges is protecting against food fraud and misrepresentation. Food fraud is a growing problem worldwide, costing over $49 billion annually. Economic pressure to provide cheaper food products has contributed to the fraud issue. For example, Alaskan pollock being substituted for cod and steelhead trout for salmon, which causes increasingly savvy consumers to look for third-party verification of label claims.

To ensure their products are accurately identified and labeled, and contain only what is listed on the ingredient list, food companies are turning to DNA testing of products and ingredients.

Authenticity Specific to Seafood

According to the U.S. FDA, fresh fish offered in restaurants and retail stores is not always labeled correctly. A lower-cost fish such as tilapia might be labeled as a higher-value fish such as grouper. In other cases, the same fish may be marketed under different regional names or an uncommon fish name may be changed to something more familiar to consumers, even though the common name is a different genus and species (such as lingcod labeled as cod).

To encourage consistent fish labeling, the FDA developed a list of recognized seafood names that companies may use. The FDA also created a single, laboratory-validated method of generating DNA barcodes for the identification of fish for regulatory compliance. This means one set of universally accepted barcode IDs is available for companies to test any seafood.

Under the Federal Food, Drug, and Cosmetic Act, seafood must be labeled truthfully and not mislead consumers. Products that don't comply are considered misbranded, which can result in FDA regulatory action such as a civil money penalty, no-sale order, seizure, and/or injunction. The law applies to components, packaging, and finished products, so all companies involved in handling fish—manufacturers, packers, distributors, and retailers—are responsible for assuring that they are not dealing in adulterated or misbranded products.

How DNA Testing Can Help

Being able to prove that what is on the label is what is in the product is beneficial for producers, suppliers, retailers, and consumers. It helps producers know that the ingredients they are paying for is what they are receiving.

Testing using an independent lab allows labeling ingredients and finished products as third-party DNA authenticated, which also increases consumer acceptance and allows differentiating products from competitors. In addition, authenticated food and food ingredients reduce the risk of adverse events caused by unidentified ingredients, of litigation, and of regulatory action.

DNA Testing in a Nutshell (or Lobster Shell)

DNA is the genetic code contained in cells of plants, animals, bacteria, and fungi. Parts of DNA can identify a specific individual (as in forensic or medical DNA), a broad group (such as fish), or a specific genus and species (such as tilapia).

DNA testing is appropriate for virtually any material that contains DNA in a wide range of fresh and processed products. The more processed a product is, the smaller or more fragmented the DNA samples available for extraction are. Examples from least to most processed seafood products include fresh fish (like a whole salmon or a tilapia fillet), mixed ingredients (like crab cakes), liquid extract (like fish oil), and dried extracts (like fishmeal).

If the material to be tested never contained cells or if no cell fragments remain in a product (e.g. they were removed through filtration, exposed to extremely high heat, or highly chemically processed), alternative methods to DNA are necessary, and may include chemical or other analytical tests.

Chemical Testing vs. DNA Testing

While chemical testing can provide information about the specific chemical components both in products that contain DNA and those that do not, chemical testing requires having an idea of what the product is. If you think you have salmon, you can run a chemical test to see if it's salmon—the result is a yes or no. Chemical testing can also identify a known ingredient and its quantity. For example, you can test if the product contains caffeine and if so, how much. Chemical testing isn't highly specific like DNA testing; many different organisms have identical chemical components. For instance, caffeine is found in numerous plants, such as coffee and tea, so it is not useful for species identification.

DNA testing provides the most definitive and specific identification available today. It can identify expected and unexpected adulterants, contaminants, substitutes, and allergens. DNA testing does not require *a priori* knowledge of what is supposed to be in the product. For instance, it can identify a completely unknown or mislabeled product; this is important for testing samples from the marketplace that often are misbranded.

Barcoding vs. NGS

DNA barcoding uses one standard genomic region (or gene sequence) to identify a species, similar to how UPC codes identify products when read by barcode scanners. It was developed to identify distinct groups of animals, such as fish versus chicken. NGS can also use the single gene region but sequence it thousands of times from a single sample. It can also detect and identify allergens, fillers, and contaminants.

Both barcode and NGS methods can:

- Be used for living, fresh, or dried raw material with little or no processing;
- Place unknown or mislabeled species into general categories (tuna or salmon);
- Detect large amounts of adulterants (rice or soy); and
- Identify animal and plant DNA.

DNA barcoding and NGS differ in the use of primers. (A primer is a strand of short nucleic acid sequences, generally about 20 base pairs, that is the basis of DNA replication; it is explained in more detail further along in this section.) DNA barcoding uses a single set of universal primers. NSF's NGS method uses validated universal primers and species-specific primers.

NSF uses a proprietary process called specific, targeted NGS that can identify more than 10,000 species of botanicals, animals, fungi, and bacteria in raw ingredients and finished products. These tests can differentiate between the most closely related and most difficult species to identify, including plant hybrids and complex mixtures. Batches can be sampled from any starting material.

NSF's methods can also detect and identify allergens, fillers, and contaminants. Additionally, NSF also offers two proprietary genetically modified organism (GMO) screens, which can be used on finished processed seafood products to verify label claims. These tests screen for the top 10 GMO species and the 10 most common GMO events or elements.

Expected and unexpected contaminants can be detected whether they are in high and or very low abundance (down to a few molecules of DNA). NGS testing also provides relative ratios of DNA sequences to assess extent of adulteration.

NSF's technique was developed to work with old, degraded DNA pieces, or very small fragments of DNA. The method uses targeted DNA primers to identify species through a polymerase chain reaction, or PCR, technique that amplifies DNA segments of interest, or those segments that uniquely identify a species. Primers are like a probe that is made specifically to target a particular species to allow replication of DNA. To develop primers capable of identifying species in processed and degraded products, NSF scientists reverse engineered these primers from known DNA sequences of the target species.

Creating primers requires advanced knowledge of the biology, evolutionary history, and DNA of the target and closely related species. NSF developed specific primers using a proprietary database of thousands of validated DNA reference sequences obtained from museum specimens through partnerships with academic institutions and botanical gardens. NSF sequenced the source DNA of these specimens and determined which regions of the genome (genes) are unique identifiers for each target species of interest. Next, NSF designed primer sets to amplify the specific gene region of interest to use in NGS.

Identification for Seafood

DNA barcode methods are appropriate for testing and identifying seafood and meat because a single gene region can be used to differentiate and ID a wide range of different animal species. The U.S. FDA has validated a single gene region or barcode, and created specific guidelines for the DNA barcode testing of seafood. Plant species, on the other hand, have more than one gene region critical for identification, and due to hybridization, one plant genus can contain thousands of species, whereas most animal (mammal and fish) genera contain only a few species in comparison.

Unlike DNA barcoding, however, NSF's NGS can use the single gene region and sequence it many thousands of times from a single sample. Therefore, instead of identifying a single species in a material—which would be appropriate for a whole fish fillet—NGS can identify all elements of processed or ground products (like crab cake or fishmeal), including fillers (such as soy protein, rice flower, and maltodextrin), binder starches, contaminants, undeclared additives, and any other animal species.

DNA Testing in Quality Control

Integrating DNA testing as a standard of quality control can help food companies create a "first line of defense" against adulteration and fraud. Testing all or sample lots of incoming raw materials ensures they are the correct species and free from harmful adulterants, and can also help companies verify suppliers.

The cost of DNA testing is comparable to other analytical testing methods, but is more accurate at detecting adulteration. DNA tests identify over 25 percent of routine samples as adulterated or substituted, most commonly by unexpected species and by closely related species not detected by other testing methods.

In addition, DNA testing assures that finished products are "pure" by screening for the presence of labeled ingredients and absence of allergens, fillers, and GMOs. The best way to ensure products are pure is to test raw ingredients, but knowing what is on the shelf is also important. ■

Dr. Reynaud is global director of scientific innovation for NSF International and co-founder of NSF Authen-Technologies. She is a botanical taxonomist and geneticist with over 15 years of DNA testing experience. Reach her at dreynaud@nsf.org.

In The Lab

SOFTWARE

An Ounce of Prevention for Food Safety Labs

A laboratory information management system can yield a greater solution for common problems that put labs at odds with productivity | BY **TRISH MEEK**

Over $93 billion a year. That, according to a new Ohio State University study published in the Journal of Food Protection, is the estimated cost of foodborne illness in the U.S. alone. This doesn't look at the cost to industry, but rather it considers the cost to treat those affected by these illnesses.

What concerns those in the food industry most about staggering estimates like this is the increased scrutiny it brings from policy makers. In fact, the author of the study, Robert Sharff, hopes that his data, which looks at foodborne illness on a state-by-state basis, will "give policymakers a tool to determine whether a particular intervention they're using makes sense."

Increasing pressure from regulators is only part of the story for the food industry. According to "Food Safety in a Globalized World," a study done by global reinsurer Swiss Re, "52 percent of all food recalls cost affected U.S. companies more than $10 million each and losses of more than $100 million are possible." These estimates exclude any costs of reputational damage, so the ultimate number is much larger.

The significant costs of recalls and more onerous regulatory oversight are enough to justify even greater rigor for labs operating inside food manufacturers. But there's an obvious drawback to thinking only about recalls and other risks when outfitting and running a food industry lab—this is, after all, a for-profit business. Labs must balance their critical safety net role with a business imperative to drive higher and higher productivity and eke out larger margins wherever possible.

From a food safety and quality standpoint, there are many fail points within a typical food manufacturer that must be understood and closely tracked. This can quickly become overwhelming, and many labs soon become known for their bottlenecks instead of their benefits. From the way they accept raw materials to batch release speed, labs can have an outsized influence on production speed and efficiency.

The potential for labs to disrupt manufacturing productivity can put them squarely in management's crosshairs, which is why it's so important to leave nothing to chance, even the smallest process step. Yes, there's significant pressure to meet regulatory requirements, such as ISO 22000 and Hazard Analysis and Critical Control Points, and the specter of a recall is ever-present, but the answer isn't to slow operations to a more manageable crawl. That simply isn't an option.

The modern food industry lab must cast a wider net when it comes to safety and quality fail points, but technology can ensure that this happens with increasing alacrity. This isn't accomplished by relaxing standards and letting more pass by. In fact, it's quite the opposite: the best approach is to break down all the fail points, account for them in software and manage as if even the most insignificant problem could snowball into a costly issue.

While there are many places that labs could begin as they look for common fail points, three isolated common areas where an ounce of prevention could yield a pound of cure are inventory, standard operation procedures (SOPs), and traceability. These areas may seem obvious, but few labs approach them with the rigor believed is necessary, so let's explore them in greater detail.

Inventory

Culture media, reagents, and even vials for gas chromatographs—just some of the everyday items in a food lab that often go out of stock. But why? Most labs operate fairly routinely, running the same workflow test after test with a normal cadence. It shouldn't be difficult to manage rotating stock with that information at your fingertips.

The problem is that it's not always at the fingertips. Inventory may not even be tracked electronically, so what looks to be in stock may actually be unavailable.

This isn't something you want to learn as the product team is eagerly awaiting your approval to release a batch. Perhaps the batch is held, which stalls production altogether, or batches move through but eventually need to be discarded. In either case, a seemingly mundane issue—can't/don't track inventory in real time—jeopardizes productivity, and, in this case, blame falls squarely on the lab.

Inventory can be easily tracked and proactively replenished, but it requires commitment and technology that is capable of supporting high-throughput testing. A laboratory information management system (LIMS) can not only track inventory as it's used, it can also be programmed to generate alerts that warn of waning stock levels. Knowing that a reagent is almost out of stock seems trivial until hours into the latest stoppage when you realize how valuable that information would have been two days ago.

SOPs

In writing about its most recent "Reportable Food Registry" annual report (2014), the FDA observed that "The most important lesson learned from this analysis of food allergen recalls and reportable foods is that many of these recalls were caused by simple problems and could have been easily avoided." It advocated for regular reviews of processes, from raw material acceptance to packaging, to identify procedural changes that could help avoid future recall problems.

Nowhere are SOPs more important than in the lab. Increasingly, labs are going a step further, relying on electronic SOPs (ESOPs) as a defense against risk. Productivity also hangs in the balance, and inconsistency can lead to costly delays that erode trust that must exist between labs and the larger manufacturing enterprise.

But creating ESOPs is only part of the story and a LIMS, such as Thermo Fisher Scientific's SampleManager, can simplify this process, defining stepwise workflows along with technical corrective actions to ensure consistency and adherence to protocol. Beyond the discipline offered by software such as LIMS, labs must consider many things as they develop ESOPs including thoroughness, standardization, distribution, user compliance and, as the FDA assessment indicates, learnings.

This last consideration, learnings, reflects the fact that SOPs must always be part of a feedback loop. Yes, SOPs are standard, but regulations change and processes are updated—as this happens, the lab must reassess its procedures and then roll out changes effectively. With a LIMS, this happens rapidly and thoroughly with little if any disruption to production. In fact, there may even be opportunities to further streamline laboratory procedures by proactively identifying productivity gains through software.

Aiding proactive discovery in labs is statistical quality control (SQC), a capability that is now standard in some LIMS. With SQC, technicians can detect nonconformance trending before it reaches pre-defined thresholds. This gives labs real-time monitoring capability that relies on statistical algorithms: The lab is observing data trends while the analysis is running, not weeks later.

Think of this as a failsafe for SOPs, another way to catch errors that can cost thousands before they become productivity issues. If data goes out of spec—something that may be impossible for a human to detect—the LIMS can provide warning. The technician is able to address the issue proactively, and this could mean the difference between a rapid batch clearing result or a costly delay in production.

Result Traceability

Nothing can grind a lab to a halt faster than having to defend a result. Was there something wrong with the consumables or instrument? What was the source of the sample? Was the analyst recently certified on the gas chromatography? These are just some of the questions that must be answered if a result is questioned. Until that happens, productivity will likely suffer.

Without a documented and unbroken chain between data and sample, a result is indefensible, it's that simple. From barcoding through final reporting, each step must be recorded (according to SOPs) in a manner that makes it easy to trace the pathway of a sample. Now multiply this by hundreds, if not thousands of samples, and it's clear how onerous this process can be.

When a lab is holding up a batch release, for example, so much must fall into place for it to quickly test and confirm results according to strict formulation and safety parameters. If it still relies on paper-based systems, excessive time is likely required. Even if it has mostly automated data entry, it still must adhere to guidelines that if not codified in software will also require valuable time. And within a food manufacturer, time is always associated in some way with margin.

Without an integrated informatics solution, adhering to these procedures, defending the quality of the data, and making it usable would be nearly impossible. This is why data management through software isn't just about reporting for auditing purposes. It's about accelerating results delivery so that production can continue uninterrupted and efficiently, making the lab a demonstrable driver for higher productivity and margin, not an impediment.

Small Steps Create Big Changes

There are many fail points within a typical food manufacturer, and labs are a critical line of defense to ensure failure doesn't occur. But this can thrust them into a position of productivity impediment instead of driver. When it comes to product quality and consumer safety, some bottlenecks are inevitable, almost necessary. After all, regulation seeks to control certain points that are known to engender risk. But management doesn't want to hear that control must always equal productivity drain and revenue loss.

From the way they accept raw materials to batch release speed, labs can make demonstrable contributions to productivity and profitability. But only if they accept the notion that ounces of prevention—with data as the measure—can add up to pounds of cure, which in this case would equal more efficient operations and higher profits.

When a lab disrupts manufacturing, it should be to increase productivity, not impede it, and with LIMS and some added discipline this is possible. When this happens, a lab may still be in management's crosshairs, but this time it will be for all the right reasons. ■

Meek is director of product strategy and senior marketing manager for informatics and chromatography software for Thermo Fisher Scientific. She has been with Thermo Fisher in product management, product marketing, sales, and support of software solutions for the past 17 years. Reach her at trish.meek@thermofisher.com.

Moisture Analysis in Real Time

Obtaining fast and accurate assay results with moisture analyzers

BY **REBECCA CESSNA**

It is hardly surprising to see so many different analysis tools when you walk into a food or beverage manufacturing/distribution plant. Food and beverage companies are held to a variety of high quality standards, but the stakes continue to rise. With the press covering food issues and outbreaks of bacteria, analysis not only keeps customers healthy, it also prevents the company from losing a substantial amount of money.

Unfortunately, it is not good enough to have a reliable form of analysis; it is also important to obtain results faster. The industry is changing, and the way a company analyzes its product should change with it. A solution to these evolving industry standards is to collect and act on reliable moisture readings in real time. The right moisture analyzer will not only reduce test times but also give a company the peace of mind knowing its results will continue to match its certified method.

Moisture analysis is conventionally done using a vacuum or air oven and a balance. The test is usually determined by an accredited test procedure, such as the one approved by AOAC International, which publishes standardized, chemical analysis methods designed to increase confidence in the results of chemical and microbiologic analyses.

The sample is weighed to a specified amount and allowed to dry in the oven according to procedure. Depending on the test, the oven can take as little as 1 hour, or as long as 18 hours. Some tests also require the operator to check the sample once an hour until a constant weight is reached. These tests not only take up a great deal of time, they may also cause many product quality issues. Many times the plant will not be able to run the tests as often as stipulated, due to time pressure, and once a result is in, the product may already have been packaged and ready for distribution. This leads to a loss of product and supplies, not to mention the time wasted by operators. It also limits the point at which the plant can test the product. With the long test times, a plant cannot make quick changes to the procedure to avoid wasted time or to increase efficiency. By checking the product at key times in the procedure, the plant can then create more of their quality products and decrease production times and costs.

A moisture analyzer can be programmed to closely match a reference test but takes minutes rather than hours. There are various types of moisture analyzers, but each contains a weighing system and a heating source, which heats the sample for the duration of testing while the weighing system detects weight loss. The typical test heats the sample more efficiently, creating faster sample testing times. Most analyzers allow the user to change temperature, weight, and endpoint criteria settings, which allow the operator to create a test that matches the reference procedure. The machine does the weighing, which eliminates some of the human error seen in reference testing. A moisture analyzer allows the operator to achieve real-time analysis on the product. This not only reduces test times, but saves a company from excess waste, while increasing productivity on the line. ■

Cessna is applications specialist at Sartorius Corp. Reach her at rebecca.cessna@sartorius.com.

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Dos And Don'ts of a Color-Coding Plan

Proactive steps for instituting a color scheme as part of Good Manufacturing Practices

BY **BOB SERFAS**

R.S. QUALITY PRODUCTS

What's the correct way to implement a color-coding plan in your facility? Here are some quick tips to consider when creating a plan and the necessary steps to allow for company-wide adoption, consistency, and compliance.

Do

Research. As a general rule, smarter managers are better managers. Whether you are in a position of quality assurance, research and development, or plant operations, it is important to keep up to date on industry news and best practices. Fortunately, there is a good deal of information already out there for those thinking about implementing color coding. Most distributor sites have a resource center containing compiled literature related to their products.

Know the rules you're being asked to play by. FDA regulations for food safety are lengthy but they're there for a reason. It's advisable to jump in and reread these every once in a while to stay up to speed on what inspectors will be looking for when constructing your plan.

Ask the experts. When in doubt, producers and distributors of color coding are a great resource. Most will be happy to answer questions and even help you develop a color-coding plan. They know what has worked well in the past and what you need to plan for depending on your plant's needs.

Keep it simple. A color-coding plan works best when it is as simple as possible. If your plant only requires two colors of tools, don't implement a third just because you can. Keeping it simple helps everyone understand the plan and stick to it.

Select colors that will accommodate all needed products. When selecting colors, it's tempting to pick exciting colors like pink. Oftentimes companies also want to pick the colors of their branding. This is fine to do as long as you are able to get all of the necessary tools in that color. Sometimes you'll find that for less common colors, you won't be able to find every product necessary for your color-coding plan. In that case, it's better to switch to a more common color so you can get everything you need.

Plan for the worst. When developing your color-coding plan, be a negative Nancy—think of every possible scenario that could cause a contamination or recall. Oftentimes, this helps you identify your most pressing needs. Then you can switch back to an optimistic mindset and come up with ways to prevent these things from happening.

Fully carry out plan. A color-coded plan will not work without being fully implemented. You need to color code all of the tools possible according to plan. And you shouldn't skimp on things like color coding the racks that the tools hang on. If you want people to follow procedure, they need to be able to follow it in all aspects of their daily job. If only some tools are color coded and others are not, procedures vary and may not be carried out properly.

Evaluate success of plan. Sometimes a color-coding plan is implemented perfectly the first time. Oftentimes, however, this is not the case. Plan to set aside time about every six months for the first two years to see how the plan is working. If any issues are identified, consider modifying your plan. In addition, after major changes occur at a plant, you should revisit your color-coding plan to see if the way it currently exists still makes sense for the needs of the plant.

Don't

Leave all decision making to management team. This is an item that is commonly overlooked by executives. Managers and workers in plants have very different perspectives when it comes to planning for color coding. If one party is overlooked, the other can miss out on important insights that may be key further along the line. Taking the time to invite everyone to the planning table ensures that this doesn't happen, allowing the plan to be the best it can be—saving time and money in the long run.

Implement without proper communication to employees. Once a plan is in place, it is important to let everyone know about it. This sounds common sense but it's a step that's missed all the time. You simply cannot expect a plan to be followed if everyone involved doesn't know and fully understand the plan. Take the time to explain procedure plans and answer any and all questions to ensure proper follow through.

Assume that all employees can read posters. This point builds on the last point. Communicating the plan prior to implementing is absolutely vital. Simply posting a poster with instructions is not enough. Especially considering employees that may not have English as their first language or are not literally competent. Proper training needs to accompany visual cues such as posters that detail the color-coding plan. ■

Serfas is founder and executive of R.S. Quality Products. Reach him at rserfas@rsquality.com.

TOP, BOTTOM: Examples of color-coded products for manufacturing plants.

Never Refuse to Reuse

Guidelines and best practices for the safe handling of reusable containers throughout the food supply chain

BY **TIM DEBUS**

There is a longstanding and remarkable history to the reuse of transport packaging in carrying and delivering farm harvests, food ingredients, fresh and processed foods, and beverages for human consumption. From the ubiquitous milk crates to bread trays, from liquid shipping bins to ready-to-display produce containers, reusable packaging has been used for generations around the world to transport dairy, meats, seafood, fruits and vegetables, grains, and other food staples. Billions of reusable packaging products are used each year in North America alone to bring fresh and nutritious foods safely from growing regions to consumers.

More growers, retailers, and other users in the food supply chain are adopting reusable transport packaging because it can provide superior performance and product protection, lower supply chain system costs, and reduce the environmental impact of packaging, among other benefits. And the global governmental policy emphasis on a low-carbon economy and a growing ecologically-conscious public will likely encourage further expansion of reusable packaging in food applications. As an example, the market research firm Mintel published its "Global Packaging Trends for 2016," suggesting that consumers will increasingly turn to "reusable and repurposable packaging," citing 63 percent of U.S. consumers believing this to be a "key purchasing driver."

With the continued growth of reusable packaging applications in the food supply chain and with greater attention on food safety compliance following the implementation of the Food Safety Modernization Act, leading suppliers and users of reusable packaging took action to strengthen the established record of safe use with these products. In 2014, the industry's trade organization—the Reusable Packaging Association (RPA)—formed a Food Safety Working Group to document a uniform set of standards and best practices for the handling and cleaning of reusable containers for use with food, including fresh produce, meat, eggs, and other perishables items.

The Food Safety Working Group consisted of retailers, grower-shippers, manufacturers, industry associations, and packaging suppliers for broad representation and coverage of the food supply chain. The group spent a year thoroughly reviewing and researching performance criteria, potential points of failure, best practices, and industry regulations. Key references and guidance came from established food safety models and resources such as Hazard Analysis and Critical Control Points (HACCP), Good Manufacturing Processes (GMPs), the Global Food Safety Initiative (GFSI), and the U.S. FDA's codes for food contact substances and packaging.

In March 2015, the RPA group completed its initial project and issued the document, "Guidelines and Best Practices for the Safe Use of Returnable Containers in Food Supply Chains." These science-based recommended protocols encompass the washing, handling, storing, packing, labeling, displaying, and collecting of reusable containers.

RPA's guidelines examine nine activities of the supply chain, encompassing the touch points for the reusable packaging and addressing areas for cleaning and monitoring. Activities include: maintenance and surveillance of food safety programs, food defense through secure operations, sanitation during washing, product protection during transport, proper receiving methods, product storage protection, sound return practices, compliance to use instructions, and effective testing protocols.

The guidelines extend to all users in the supply chain, including suppliers of the reusable packaging, growers and packers of the food product, and retail operations that distribute and handle the packaging.

Guidelines for Retailers

For retailers, the handling practices of reusable containers are important to ensure the integrity of the next use phase in the food distribution system. This is counter to the mindset and approach for one-way packaging in which disposal for waste or recycling is the end activity. For reusable packaging, there is not an end activity, but rather a return process to prepare and re-position the container for a new use in a continuous cycle.

Many retailers who are experienced in reusable containers educate and train employees down to the store level on the proper handling techniques and re-

REUSABLE PACKAGING ASSOCIATION

quirements. Retailers understand that effective and timely handling of reusable containers contributes to the whole cycle of performance, which benefits the retail operations and ultimately leads to greater customer satisfaction. Suppliers of reusable packaging often assist in this training by providing poster instructions for display in store backrooms.

The RPA guidelines document the best practices at retail. A significant component of the recommendations addresses practices to limit preventable contamination of used containers. Employees of retail stores should remove any trash from the used containers and fold them following their use. When storing used containers, retailers should reserve a single pallet footprint in the backroom where the containers can be stacked in a uniform and interlocking manner. The containers should be stored in a secured area where they are free from tampering as well as exposure from accidental contaminants.

Another important area for proper handling at retail is the compliance to labeling of the containers. As the use of adhesive labels has become more prevalent in the supply chain, the RPA created a task force to test and establish standards for adhesive labels with the goals of improving food safety, minimizing damage to the container and wash equipment, reducing the cost of labels and residue removal, and increasing label removal quality and efficiency. It is recommended that no additional labels or stickers are added to the containers beyond the legal product label that was affixed at time of packing and accompanies the container through the entire supply chain.

Once the containers have been used, folded, and stacked on the pallet for return, the single pallet should be filled and wrapped tightly when the total height reaches 72 inches, or a height designated by the RPC provider, to maximize loading and transport efficiency. Any broken containers should be separated and stacked on a separate pallet and marked as broken.

Retailers should notify their container provider when they have more than one pallet ready for return. Many retailers have scheduled weekly pickups. Regular store pickups and relocation of the reusable packaging to points of collection by the container suppliers will ensure timely and effective reuse. Also, all used containers need to be returned to the provider for sanitation—they should never be reused at the retail store.

Guidelines for Packaging Suppliers

The reusable packaging industry in North America follows rigorous cleaning and testing methods and deploys advanced industrial washing operations that meet or exceed regulations established by U.S. and Canadian government agencies, where applicable. Commercial cleaning operations involve multifaceted steps and techniques in preparing a container for reuse. Factors such as heat, detergents and sanitizers, water pressure, and the time and sequence in which they occur, play a critical role in cleaning.

The most detailed and numerous RPA guidelines affect suppliers who also provide the cleaning service. Critical control points in the wash process are temperature control and chemical concentration of the cleaning and sanitizing agents. The wash process should follow GMPs. These GMPs cover equipment, utensils, water, plumbing, waste, and physical facilities. When combined with proper employee hygiene and food defense practices, these GMPs form the core of a sound wash operation.

One of the more noteworthy best practices is the adoption of a comprehensive microbiological sanitation and testing regime that covers human and plant pathogens in all aspects. This includes digitally dosing and controlling detergents and sanitizers. Thresholds and parts per million (ppm) should strictly follow chemical manufacturer guidelines for food and food contact materials. Redundant electronic and manual processes should ensure these parameters are always correct.

The guidelines also provide uniform testing and surveillance practices to ensure the quality and food safety of a company's sanitation processes. Practices include: systems check log, titration log, surface swab tests, process validation, and preoperational environmental inspection release. The RPA recommends that testing occur hourly, daily, monthly, and quarterly in order to record and monitor a statistically significant sample size representative of the entire production.

Suppliers of the reusable containers should adhere to HACCP procedures to control biological, chemical, and physical hazards in the production process. It is further suggested that companies maintain a trained and qualified individual to monitor compliance with HACCP program.

What's Next?

The reusable packaging industry takes food safety seriously, striving to incorporate the most advanced systems and technologies to deliver on this requirement and to instill confidence behind these products. Food safety is not a competitive issue, and members of the RPA will work together in a culture of continuous improvement on the recommended best practices. RPA will monitor developments in research, advancements in cleaning equipment and tools for optimum effects, and extend partnerships across the supply chain to achieve maximum exposure and compliance.

Safe use of reusable containers depends upon the diligent efforts and food safety commitment of all parties throughout the distribution chain. RPA encourages all members of the supply chain involved to implement the recommendations and guidelines in order to continue the safe production and handling of foods in reusable containers. ■

Debus is president and CEO of Reusable Packaging Association. Reach him at tdebus@reusables.org.

Easing Recall Burdens at the Warehouse

Warehouse automation technology helps direct, control, and optimize internal material flow and order picking

BY **DAVE WILLIAMS**

From reports of cashews tainted with *Salmonella*, to beef patties contaminated with wood, to spinach containing allergens, to the now infamous Chipotle Mexican Grill *E. coli* outbreak, recalls and foodborne illnesses are regular fixtures in today's news.

Recalls are costing food manufacturers millions of dollars and negatively affecting companies' brands—a July 2015 report from Swiss Re, a reinsurance company, estimates that half of all food recalls cost the affected companies more than $10 million. As more industry and government regulations, such as the Food Safety Modernization Act (FSMA), come into play to reduce recalls and prevent illnesses, food professionals are looking for ways to comply with these standards and advance their food safety efforts. A good place to start is by tracking and tracing goods with warehouse automation technology.

Traceability Using Warehouse Automation

Warehouse automation technology is proving effective in helping food manufacturers and distributors reduce and prevent detrimental recalls through advanced track-and-trace capabilities. One of the most powerful tools enabling traceability is a warehouse execution system (WES).

Typically, companies have relied on two separate software applications—a warehouse management system (WMS) and a warehouse control system (WCS)—to manage inventory and materials handling throughout a facility. However, a WES can combine the functionality of a WMS and WCS in a single application to optimize, manage, and control internal material flow and order picking without the need for complex integrations.

With a WES, food professionals can track inventory or raw materials (and any number of attributes, such as lot numbers, temperatures, etc.) throughout a product's lifecycle. The system logs the product's every move until it is loaded onto a truck for delivery. This creates an audit trail of every person and piece of equipment that touched that inventory, as well as every adjustment made along the way. But tracking and tracing capabilities go beyond the product's movement within the warehouse's four walls. Utilizing its flexibility to interface with other software systems like enterprise resource planning (ERP) and host systems, a WES can also capture batch data from the growers and manufacturers, and marry the data with the lot information created during processing. Then the system carries that data throughout each subsequent step in the supply chain—from storage, to packaging, to transportation, to the retail store shelf.

Mitigating Recalls

How does a WES assist in the recall process? With the data captured, food companies can quickly access detailed product information in real time. Therefore, if a product must be recalled, it is easy to search the system for a batch or lot with a particular UPC or SKU, and pinpoint when it departed and to where. With this specific information, manufacturers can

pull only the affected items from store shelves. There is no need to spend valuable time and money removing every single product—an extremely expensive and inefficient approach that often draws more negative attention to the issue at hand. For example, in 1982, Johnson & Johnson famously spent $100 million pulling all Tylenol products from the shelves after discovering bottles containing cyanide. Although this was a precautionary action to ensure that all tainted products were off the market, Johnson & Johnson could have saved a great deal of money if it identified which lot contained tampered bottles and pulled just that lot.

It is also possible to link manufacturing data from a WES to a retailer's point-of-sale system. A recall could be as simple and low key as an automatic phone call to alert those who purchased the item in question. Also, with reliable data and accurate audit trails, food manufacturers can prove compliance with safety regulations, like FSMA, and confidently give consumers peace of mind that they have withdrawn all affected products.

Integration with an AS/RS

While a WES can streamline manual materials handling efforts, it provides additional value when integrated with an automated storage and retrieval system (AS/RS). These robotic systems can optimally store layers and cases, with and without pallets, and rapidly retrieve them from inventory. In addition to a software system like a WES, an AS/RS comprises four components: a rack system to store product, a storage/retrieval machine (S/RM) running on a floor rail, a load-handling device or shuttle that moves product from the S/RM to the rack, and a conveyor system that move goods to and from the AS/RS to the staging areas.

Compared to a conventional warehouse storage system, a high-density AS/RS allows warehouses to improve their space utilization so companies can store more products, more efficiently, in a smaller amount of space. For the food industry, the speed that an AS/RS moves products in and out of the warehouse prevents the spoilage of goods, like meat and dairy products. It also enables just-in-time order fulfillment strategies, a methodology in which orders are brought out when needed instead of staged hours in advance. This attributes to keeping products fresh and safe, as perishable items are stored in their respective freezers until the truck arrives. In these cases, when the truck "checks in," the WES directs the S/RM to dynamically pick and deliver the appropriate product to its designated area for loading. At the same time, an AS/RS provides safer materials handling and reduces redundant, error-prone manual picking processes, thereby decreasing the likelihood of product damage and contamination.

...an AS/RS provides safer materials handling and reduces redundant, error-prone manual picking processes, thereby decreasing the likelihood of product damage and contamination.

Implementation Considerations

The beauty of an AS/RS is that it can be installed in an existing warehouse or designed specifically for a new facility. However, many companies considering the technology are unsure where to begin. Here are a few considerations to get started.

Carefully select your vendor. The vendor should possess credentials in your industry vertical (food, beverage, frozen goods, etc.), and therefore, will better understand your business' unique requirements. As a result, the vendor will be able to recommend, develop, and implement a solution that meets your particular needs.

Purchase high-quality equipment. Lower cost does not mean a better business deal. You'll find that your initial savings will soon be replaced by expensive equipment downtime and repairs.

Consider the long term. Success is not achieved overnight, so be patient in realizing results. Usually, you must implement progressive steps over time before obtaining return on investment (ROI).

Involve operating personnel from the get-go. Do not wait until the system is about to go live to involve key staff—operating personnel should be part of your project team from the start. This reduces the learning curve and helps with buy in.

Be proactive. Follow recommended preventative maintenance schedules instead of waiting for something to break at the most inopportune moment. You will not have to pay for expensive, major repairs down the road, and will avoid delays that negatively affect customer satisfaction.

Positioning for the Future

While warehouse automation technology—a WES and an AS/RS—can help food professionals keep products fresh, prevent and mitigate recalls, enable compliance with industry regulations, and protect consumers, they also provide long-term benefits that generate additional cost savings. The WES-AS/RS combination allows companies to improve overall efficiency, meet growing customer demand, raise productivity, lower risks, boost throughput, and increase inventory accuracy. Plus, an AS/RS has an average lifespan of 25 to 30 years, so ROI is often realized in the first five years.

For companies considering a WES, it is important to note that although a WES is able to replace WMS and WCS applications altogether, its flexibility allows for various deployment options. With a WES, users can enable or disable the WCS functions as needed. This approach lets companies implement an integrated WMS and WCS solution, while only using the functionality needed at the time. As the company's needs grow and automation is introduced, the WCS functionality can be enabled quickly, saving time, training, and other costs associated with buying a new system.

As reports of recalls and industry regulations show no signs of slowing down, it is up to food professionals to investigate new means for mitigating these harmful incidents and promoting food safety. The answer lies in technology, and warehouse automation is a key piece of the puzzle. ■

Williams is director of software and solutions delivery at Westfalia Technologies, Inc. Reach him at DWilliams@westfaliausa.com.

NEW PRODUCTS

Empower 3 Support for Ion Chromatography

Metrohm expands Ion Chromatography instruments and accessories supported by Waters' Empower Chromatography Data Software. With the release of new drivers the company adds support for more sample handling accessories, IC systems with amperometric and conductivity detection, and dual-channel systems for combined anion and cation analysis. Metrohm integrates with Empower to control all aspects of the system, from a small volume autosampler to detection schemes. Users have the ability to determine anions, cations, and polar substances by ion chromatography and suppressed conductivity detection in concentrations ranging from percent to ultratrace. **Metrohm USA, Inc., 866-638-7646, www.metrohm.com.**

Digital Food Safety Management

The IntelliConsult digital food safety management platform is a combination of novel technologies and cloud-based data management that allows different data streams to converge into one single platform and deliver multi-layered, interactive reporting. By collecting accurate, structured and continuous data, and monitoring and measuring the critical control points in daily operations, food business operators gain actionable insights that can help improve training and operations, reduce risk, and deliver a better customer experience. The modular suite includes: Food Safety and Temperature Monitoring, Hand Hygiene Compliance, Auditing Tools, Training, In-Store Traceability, and Laboratory Analysis. **Diversey Care, a division of Sealed Air, 262-631-4001, www.diversey.com.**

Gluten-Free Verification Program

The gluten-free verification services are based on the FDA's final ruling on the use of a gluten-free claim and are intended for products sold in North America. Services are risk-based and supported by a validated sampling and testing regimen. Companies can choose an individual service such as testing, or adopt a comprehensive gluten-free certification and testing program where the CERT ID Gluten-free Trustmark can be applied to a product. The program is designed as an addendum to recognized system certifications such as organic, Non-GMO Project, and GFSI. **Genetic ID NA, Inc., in conjunction with CERT ID, 888-229-2011, www.genetic-id.com, www.cert-id.com.**

Updated Viscometer

DVE Viscometer features a new user interface and keypad. The contemporary design adopts the look and feel of the DV1, DV2T, and DV3T family. Lit display features distinctive alpha-numeric characters that are easy to view, both close up and at distance. The bubble level has been situated on the front of the instrument below the display panel so that users can adjust the instrument for vertical position. Updated system also offers a choice of scientific units for viscosity measurement including both cgs units: cP (centipoises) and P (Poise), and SI units: Pa-s (Pascal-seconds) and mPa-s (milliPascal-seconds). **Brookfield/AMETEK, 800-628-8139, www.brookfield-engineering.com.**

Coating for Food Packaging

Purekote 23589 is a coating that can be used safely in food packaging applications regulated by the U.S. FDA. The water-based coating delivers a matte appearance and velvety feel to paper and plastic bags, pouches, lidding films, foil bags, and sachets. Coating can be applied via gravure or flexographic process with an enclosed-chamber doctor blade. It does not have temperature limitations. Purekote can be pattern applied to create packaging with both matte sections and clear "windows" that allow consumers to see the product inside. **Ashland Inc., www.ashland.com.**

Rodent-Proofing Solutions

Pest Control Astragal Door Seals and Pest Control Block Caps are available for Integrated Pest Management applications. Astragal Door Seals are designed to protect entry doors, sealing the gap between double doors or between a single door and its frame. It safeguards gaps with a 96-in. retainer and reinforced EPDM rubber gasket lined with Xcluder fill fabric—a patented combination of stainless steel and poly-fiber that the company says is virtually impenetrable to rodents and other pests. Pest Control Block Caps prevent rodents traveling and nesting within hollow block walls by covering their entry point. Ideal for new and existing construction, each 6 in. x 8 in. tin plated steel cap features a stamped inset and overlapping design to be able to quickly place. **Xcluder, 847-495-4700, www.getxcluder.com.**

Upgrade Extends Metal Detector Capabilities

A way to extend life and improve functionality for select Thermo Scientific metal detector platforms is available via the APEX Upgrade. Units based on the DSP3 architecture currently installed in food manufacturing facilities can be upgraded to APEX electronics and software to help meet more stringent quality standards with the ability to detect smaller diameter metal contaminants. Improved sensitivity reduces rework and scrap caused by occasional false rejects. Maintenance and training also can be simplified via a common user interface if the plant has both APEX and DSP3 platform metal detectors. **Thermo Scientific, 763 783-2500, www.thermoscientific.com.**

Loading Dock Seals

ArmorGuard (models ADS-HP and ADS-HC) loading dock seals feature Kelley SHARC (Super High Abrasion Resistant Compound) fabric. According to company, the seals can stand up over time to the abrasive movements caused by air ride suspensions and intermodal trailers. ADS-HP features Kelley Wear Master Head Pad with a full width SHARC wear face and 4-in. exposure wear panels where the toughest contact with trailers occurs. ADS-HC dock seal features an EFC (Encapsulated Foam Chambers) Head Curtain with 1-in. by 3-in. chambers that provide a seal for trailer tops. **Kelley Entrematic, 800-558-6960, www.kelleyentrematic.com.**

Miniature Flame-NIR Spectrometer

The Flame-NIR delivers near infrared spectroscopy pairs an uncooled InGaAs array detector with a small optical bench for spectral response from 950 to 1650 nm. Its spectral sensing can be used in agriculture to gauge crop readiness and characterization, and in food production to ensure quality and ingredient integrity. Some applications include quantifying sugar, moisture, protein, acidity, vitamin C in fruits and vegetables; screening for internal rot, pests, and ripeness in produce; identifying and classifying seeds, grains, and pulses; confirming species of fish; and gauging cheese ripeness, and measuring fat and protein in milk. In addition, the compact unit can deliver high thermal stability and low unit-to-unit variation without compromising the flexibility and configurability. **Ocean Optics, 727-733-2447, www.oceanoptics.com.**

Hygienic Twin-Screw Pump

SLH-4U is a single-flow, self-priming positive displacement pump that can handle high viscosities, high pressures, and sensitive media. The twin-screw pump technology utilized in the SLH series pump provides the ability to maintain high levels of sanitation and product quality across a wide range of food products. Minimal maintenance is required as there is no metallic contact between the conveyor screw and pump housing. Customers can also potentially save time and cost because pumping and cleaning are processed within a single pump. Using a modular system, the SLH-4U is available in three sizes with different screw sets to cover a conveyance range up to 150 m^3/h and viscosity up to 1.000.000 cST. **ITT Bornemann, www.bornemann.com.**

Metallic Cable Gland

Skintop Hygienic stainless steel cable gland features FDA approved material for a wide range of food and beverage applications. This gland meets IP68 and 69K standards and is designed to withstand high pressure and high temperature washdowns. With design features that prevent microorganisms and bacteria from sticking to the surface, Skintop Hygienic has a temperature range from -20 to 100 degrees Celsius. Polyamide insert and special elastomer sealing element are also included for food and beverage safety. **Lapp Group Co., 800-774-3539, www.lappusa.com.**

In Other Product News

Unitherm Food Systems receives U.S. Patent No. 9,215,892 B2 for its new flame pasteurization system and method that uses a flame tube to burn the skin off of onions, pasteurizing the surface.

Icicle Technologies has launched a new smart suggestion feature in its ICICLE food safety management system, offering users intelligent algorithms that suggest processes and hazards when creating and managing food safety programs to accelerate compliance with regulations.

AOAC-RI approves a method extension of Performance Tested Method #030502 to include the **DuPont** BAX System X5 PCR Assay for Genus *Listeria*.

EtQ merges VERSE Solutions under the EtQ compliance umbrella of compliance management product offerings. With the merger of VERSE Solutions, EtQ has a solution for every segment of the compliance market—enterprise, small to mid-sized business and freemium.

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Events

APRIL

21-22
HACCP Certification Course
San Antonio, Texas
Email Training@FSNS.com
or call 888-525-9788 ext. 239.

27
GS1 US Data Quality Workshop
Blue Ash, Ohio
Visit http://www.gs1us.org/dataquality
or call 609-620-8074.

MAY

4-6
BRC Global Standard for Food Safety Implementation & Internal Auditor Course
Amarillo, Texas
Email Training@FSNS.com
or call 888-525-9788 ext. 239.

6
Seafood HACCP Segment II
Boise, Idaho
Visit http://www.techhelp.org/events/253/seafood-haccp-segment-two-training-course/.

10-11
Dairy Lab for Improved Quality
Columbus, Ohio
Visit http://foodindustries.osu.edu/labtech.

Employee "Train-the-Trainer" Food Safety Workshop
Logan, Utah
Visit www.usu.edu/westcent
or email kimberly.rasmussen@usu.edu.

10-12
Food Safety Summit
Rosemont, Ill.
Visit www.foodsafetysummit.com.

12-13
Advanced Sanitation Workshop
Logan, Utah
Visit www.usu.edu/westcent
or email kimberly.rasmussen@usu.edu.

17
Dairy Plant Food Safety Workshop
Denver, Colo.
Visit http://www.usdairy.com/foodsafety.

17-19
Food Microbiology Short Course
University Park, Penn.
Visit http://agsci.psu.edu/foodmicro
or call 877-778-2937.

19-20
Microbiology & Food Safety Course
Los Angeles, Calif.
Visit http://www.food-safetynet.com/docs/2016 FSNS Complete Course Schedule.pdf
or call 888-525-9788 ext. 239.

Quality Control Workshop (GMP)
Logan, Utah
Visit www.usu.edu/westcent
or email kimberly.rasmussen@usu.edu.

23-24
Advanced HACCP/HARPC Certification
Logan, Utah
Visit www.cfsrs.com
or email cclark@cfsrs.com.

23-25
FSPCA Preventive Controls for Human Food Course
Idaho Falls, Idaho
Visit http://www.techhelp.org/events/255/fspca-preventive-controls-for-human-food-course-idaho-falls/.

25-26
SQF 7.2 Implementation & Certification
Logan, Utah
Visit www.cfsrs.com
or email cclark@cfsrs.com.

26-27
SQF Training Course
San Antonio, Texas
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JUNE

2-3
Statistical Process Control Workshop
Logan, Utah
Visit http://www.usu.edu/westcent/pages/SPC_workshop.htm
or call 435-797-2106.

7-8
Dairy Plant Food Safety Workshop
Plymouth, Wis.
Visit http://www.usdairy.com/foodsafety
or call 847-627-3241.

7-9
FSMA Preventive Controls for Human Foods Workshop
Logan, Utah
Visit http://www.cfsrs.com/home.html
or call 571-931-6763.

15-16
Better Process Control School Acidified Food Only
Columbus, Ohio
Visit http://foodindustries.osu.edu/events/.

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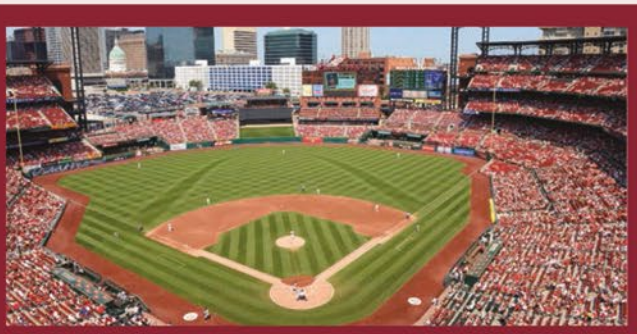

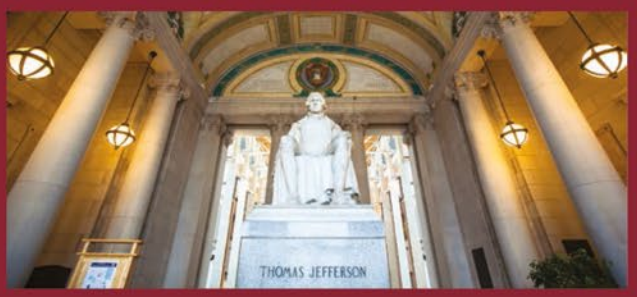

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