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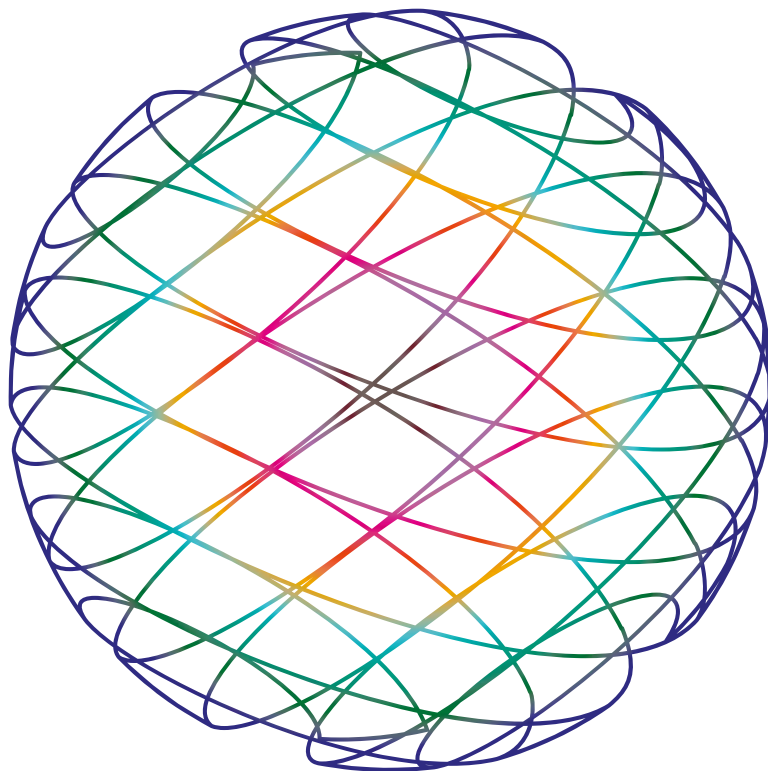


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# From The Editors

## Zen and the Art of Food Processing

**H**ow many of you have taken the time to think about what quality really means? Quality is a concept—a concept that will vary between individuals. In 1974, Robert Pirsig's book *Zen and the Art of Motorcycle Maintenance* was finally printed (William Morrow and Company, New York, NY). Some may believe that the book is simply the story of a cross-country motorcycle trip, but it is more than that. It's also a discussion of the concept of quality. The following is a quote from the book:

*Quality ... you know what it is, yet you don't know what it is. But that is, self-contradictory. But some things are better than others, that is, they have more quality. But when you start to say what the quality is, apart from things that have it, it all goes poof! But if you can't say what quality is, how do you know what it is, or how do you know it even exists? If no one knows what it is, then for all practical purposes, it doesn't exist at all. But for all practical purposes, it does exist. What else are grades based on? Why else would people pay fortunes for some things and throw others in the trash pile?*

In the food industry, there are many different quality demands on each processor. There are legal requirements that must be met, there are company quality standards, there are consumer expectations, and there are industry standards. Each and every one of these elements is defined and must be met by each and every food processor. Yet, how products are manufactured changes, and the way these processes are measured and evaluated must also change.

One element of how products change is through cost reduction. Processors regularly seek to modify their products to reduce manufacturing costs, which reminds me of an old story called "Creeping Meatballism." One version of story is that a person brings meatballs to a company potluck. Everyone raves over the product, so the company decides to produce the item. It's a great success but, after a year or so, company executives decide to cost reduce the formula. A year later, they decide that it's too expensive and conduct another cost reduction. The process is repeated again and again, and it reaches a point where management cannot understand why sales have started to decline. The problem? Instead of comparing the new version of the product to the original gold standard, the new version was compared to the previous version, so there was a continuous decline of product quality. Additionally, consumers detected this drop in quality, which was reflected in sales. So, while quality at the corporate level might not have dropped significantly, consumers figured out what was going on.

So, for an industry that relies on repeat sales, we cannot forget those who buy or use the product. As Pirsig implied, don't let quality go poof.

**Richard F. Stier**  
 Co-Industry Editor

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# NEWS & NOTES



## GFSI Sets First Benchmarking Requirements for Food Safety Auditor Training

The Global Food Safety Initiative (GFSI) has launched the first-ever set of benchmarking requirements for food safety auditor professional recognition bodies. By raising the profile of the profession of auditing and focusing entry requirements on competence, the aim is to attract talents to and retain them in this profession.

Over the years, the industry has faced mounting difficulties in recruiting and retaining auditors, putting a strain on the certification bodies' ability to cater to the increasing demand for food safety audits. GFSI says the situation has worsened due to increasingly complex and duplicated requirements applying to new and existing auditors, including the increasing GFSI benchmarking requirements for certification program owners on auditors.

To combat this, GFSI has now developed a new program for professional recognition bodies in the food safety sector, setting them up as responsible for validating common competencies in a food safety auditor for all GFSI-recognized certification program owners. The move also means that the food industry can rely on this registration and validation to verify the competency of the auditor.

GFSI says that this initiative forms part of the larger GFSI Race to the Top framework, which works to improve trust, transparency, and confidence in GFSI-recognized certification and audit outcomes. For more information, access the benchmarking requirements at [mygfsi.com](http://mygfsi.com).

## EPA Releases Plan to Tackle PFAS in Food Packaging and Drinking Water

BY KEITH LORIA

The Biden Administration announced in October that Environmental Protection Agency (EPA) regulators will set enforceable limits on per- and polyfluoroalkyl substances (PFAS). The chemicals have been manufactured since the 1950s and are now widely detected in nearly every human. However, there are still a lot of unknowns regarding how they get into the body and what harm they cause.

The EPA's PFAS Strategic Roadmap is a three-year plan detailing actions to help prevent PFAS from being released into the air and food supply and to expand cleanup efforts. The agency wants to implement the roadmap prior to the 2024 presidential election.

Craig Butt, PhD, staff application scientist in the Americas for SCIEX, believes the new roadmap is a broad and ambitious plan to tackle PFAS contamination thanks to three main objectives—research, restrict, and remediate. “The approach considers the entire lifecycle assessment of PFAS from manufacture to use in commercial and industrial products to final disposal, which helps to ensure a more comprehensive and protective strategy,” he says. “The roadmap also emphasizes a strong investment in scientific, evidence-based decision-making through supporting research to fill key knowledge gaps, such as exposure pathways, toxicity assessment, and remediation.”

Specific plans include testing drinking water nationwide, implementing drinking water regulations and health advisories, assessing exposure and toxicity, developing new analytical testing methods, and monitoring PFAS in fish tissues and air emissions.



## USDA Grants \$32 Million to Meat, Poultry Processors

USDA says it has awarded \$32 million in grants to 167 meat and poultry slaughter and processing facilities to support expanded capacity and efficiency through the Meat and Poultry Inspection Readiness Grant (MPIRG) program.

“Today’s investment supports local and regional meat and poultry processors as they recover from the pandemic and also work to expand capacity,” said Tom Vilsack, USDA Secretary, in a statement. “Achieving a Federal Grant of Inspection or operating under a Cooperative Interstate Shipment program allows meat and poultry processors to ship products across state lines, pursue new market opportunities, and better meet consumer and producer demand along the supply chain.”



Meat and poultry processing businesses can use the funding to cover costs for improvements such as expanding existing facilities, modernizing processing equipment and meeting packaging, labeling, and food safety requirements needed to achieve a Federal Grant of Inspection under the Federal Meat Inspection Act or the Poultry Products Inspection Act, or to operate under a state’s Cooperative Interstate Shipment program. These changes will allow these facilities to serve more customers in more markets.

To learn more about MPIRG and see the list of awards, visit [www.ams.usda.gov/mpirg](http://www.ams.usda.gov/mpirg).

# Washington Report



## Hold the Salt

FDA sets sodium reduction targets for the U.S. food supply

BY KEITH LORIA

**A**mericans consume nearly 3,400 mg of sodium per day on average, which is almost 50% more than the recommended 2,300 mg limit set by federal guidelines for people aged 14 and older.

“High sodium, especially when coupled with low intake of potassium due to inadequate intake of fruits and vegetables, in some individuals is associated with increased risk of high blood pressure and heart disease,” Julie Miller Jones, PhD, an emeritus professor of nutrition at St. Cath-

arine University in St. Paul, Minn., and a member of the Grain Foods Foundation’s Scientific Advisory Board, tells *Food Quality & Safety*.

FDA sees this as a major problem, which is why it has unleashed a new set of guidelines designed to encourage the food industry to gradually reduce sodium in a wide range of foods over the next 2.5 years, with the goal of an overall 12% reduction.

“Americans are consuming too much sodium in their diet, and the majority comes from processed, packaged, and

prepared foods, not the salt shaker,” said acting FDA Commissioner Janet Woodcock and Center for Food Safety and Applied Nutrition Director Susan Mayne, in a statement. “To gradually reduce sodium across the food supply, the FDA is taking an iterative approach that includes establishing voluntary sodium targets for industry, monitoring and evaluating progress, and engaging with stakeholders.”

The guidelines have been in the works for years, with the recommendations pending since 2016. A list of 163 categories of food products in which salt can be reduced was offered by FDA; the list ranged from condiments to potato chips and deli meats to store-bought bakery items.

Tia Rains, PhD, vice president of customer engagement and strategic development at Ajinomoto Health and Nutrition North America, Inc., a food and beverage manufacturer headquartered in Itasca, Ill., notes that, for decades, public health institutions have recommended that people lower their sodium intake, and yet there has been no improvement, based on population data. “About 70% of sodium in Americans’ diets comes from sodium that is added to packaged foods and food prepared by restaurants,” she says. “Excessive sodium intake can lead to high blood pressure, a major risk factor for heart disease and stroke, which are among the leading causes of death in the U.S. Based on current scientific evidence, a reduction in sodium intake will help mitigate the risk of these health conditions and help improve general wellness among the U.S. population.”

### Making Changes

Even before the new guidelines, processors have been trying to reduce sodium because guidelines over the last 20 years have been concerned about the ingredient. The most common food and beverage industry strategies have been reformulating, developing target goals, and trying to meet front-of-pack labeling goals. The industry has also tried monitoring and



consumer education, in addition to menu labeling.

Given FDA's new guidance, Dr. Rains anticipates growing interest among food processors in materials and ingredients that contribute to lower sodium levels in food applications that are cost effective and don't impact taste. "A largely unexplored solution for reducing sodium is the use of glutamates, like monosodium glutamate (MSG)," she said. "Even though MSG has 'sodium' in its name, it actually has 2/3 less sodium than table salt, and, when used in the place of some salt, it can significantly lower the sodium content of a dish or product—in some cases up to 50% in packaged foods and snacks—without compromising taste."

MSG also provides umami, a savory taste that allows foods to be delicious with less sodium. The seasoning has even been recognized by the National Academies of Sciences, Engineering, and Medicine as a tool to reduce sodium in the food supply.

Some producers have a strategy of slow sodium reduction over time, to allow consumers to adjust their palates; however, this has had mixed success and has been shown to be product dependent. "Technical advances using different forms of salt crystals and applying salt on the surface has allowed salt reduction without loss of flavor," Dr. Jones says. "Further advances in this and other technologies are being researched and may be expected in some food products. In soups, stews, vegetables, and main dishes, the addition of more onion, garlic, and herbs and flavor-rich ingredients is a great strategy, but all these ingredients are much more costly than salt and do not give the same flavor roundness."

Various oleoresins extracted from herbs are being used by processors, while salt mixtures that include some potassium chloride are also being studied. "Sodium reduction is very challenging in many foods because salt is added not just for taste but very often for the inhibition of microbial growth in salted fish, meat, pickles, and the like," Dr. Jones adds. "Lowering sodium in bread a great deal is problematic as the salt controls the rate of yeast fermentation and decrease keeping quality. It also changes the character of the gluten and the crust color as well as enhancing the flavor."

Therefore, while manufacturers are trying to maintain sensory qualities so as not to impact sales, some companies have lost significant market share and stopped trying to reduce sodium after initial efforts didn't succeed.

**Sodium reduction is very challenging in many foods because salt is added not just for taste but very often for the inhibition of microbial growth in salted fish, meat, [and] pickles.—**

**Julie Miller Jones, PhD**

#### **Arguments Against**

While many see sodium limits as a great benefit for public safety, the guidance has drawn concern from many businesses, food vendors, and manufacturing facilities.

For instance, the Competitive Enterprise Institute, a non-profit think tank based in Washington, D.C., argued that a one-size-fits-all approach to sodium fails to take into account the dietary needs and risks of people as individuals. "FDA's nutrition guidelines need to be based on the best available science, and that is especially true when it will impose billions of dollars in costs and when peer-reviewed scientific articles point out that dietary salt is extremely controversial," says Devin Watkins, an attorney with the group. "Following the science means listening to independent scientists, many of whom disagree with FDA on this issue. At a minimum, before FDA starts overhauling American diets, its scientific assessment needs to be peer reviewed."

Salt is a highly addictive taste; the brain and body both enjoy salt because they view it as necessary for survival. Because sodium is added to just about every snack, food companies are now worried about losing their consumer cravings, which would result in a decrease of sales. Another factor that is sometimes overlooked is the preservative-like properties

of salt, as the ingredient allows food to have a longer shelf life. In fact, high-sodium snacks have been shown to last twice as long, due to a high salt index.

#### **Highlighting Sodium Reductions**

FDA states that companies will need to reformulate products or change label claims if they have lowered the sodium. Some food manufacturers are touting their reduction in sodium on their product labels, but many use a "stealth approach," announcing the change only in the nutrition facts panel, not on the front panel. "Research shows that labeling foods as lower sodium causes many consumers to perceive them as bland, causing low salt products to gather dust on the shelf and hurting a company's bottom line," Dr. Jones says.

Joe O'Neill, VP of sales and business development at A&B Ingredients, a food processor based in Fairfield, N.J., supports FDA's sodium reduction initiative, and the company would like to see more manufacturers follow these guidelines. "Lowering sodium intake is an ambitious yet important condition of improving the state of public health," he says. "Manufacturers can reduce sodium in existing formulations and maintain a familiar taste with a clean label ingredient statement. All it takes is replacing conventional salt with a natural, lower sodium option, like a low sodium sea salt."

#### **Looking Ahead**

FDA plans to monitor the sodium content of the food supply and evaluate progress toward achieving the targets in the final guidance. The agency expects to issue revised subsequent targets in the next few years to facilitate a gradual, iterative process to reduce sodium intake. "Looking to the future, it is worth considering alternative messages to convey this message to consumers to share that sodium reduction doesn't necessarily mean compromising on great flavor," Dr. Rains says. "It would also be wise for companies to highlight their sodium reduction initiatives through external communications, such as company commitments [and] front-of-pack labeling." ■

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# Legal Update



## The PFAS Paradigm Shift

Food companies should take steps now to address PFAS packaging

BY JOEL S. CHAPPELLE, ESQ., AND SHAWN K. STEVENS, ESQ.

**P**er- and polyfluoroalkyl substances (PFAS) refer to an expansive array of chemicals that have been used in industrial applications since the 1940s. There are thousands of different types of PFAS, estimated to include as many as 10,000 chemical compounds, which are utilized for countless applications. PFAS are oil, water, and friction resistant and can withstand significant variations in temperature. PFAS are used in textiles, paper, cookware, fire suppression foams, and packaging. They are used widely in industries such as aerospace, microchip manufacturing, automotive, construction, aviation, and food packaging, among many others.

Given their uniquely valuable properties and range of uses, PFAS were initially

hailed as wonder compounds. In 1967, FDA approved the first PFAS for use in food packaging. In the decades that followed, PFAS were used in the packaging of countless thousands of products. Currently, FDA's Inventory of Food Contact Substances Listed in 21 CFR includes more than 30 PFAS. Such a listing means the agency has deemed the PFAS safe for their intended use and allows them to be legally marketed as food contact substances.

### The Problems with PFAS

Once heralded, PFAS have turned out to be decidedly more problematic than previously imagined. They are long-lasting, environmentally destructive, and potentially toxic. PFAS take an extraordinarily long time to break down. Decades

of widespread use have led to dangerous environmental accumulation. These “forever chemicals” can now be reliably detected in the oceans, drinking water, soil, plants, other animals, food, and even our own blood. Numerous studies indicate a causal link between human and animal health problems and environmental exposure to PFAS.

In recent years, there has been a significant push by consumers, scientists, environmental advocacy groups, and many companies seeking to end the use of PFAS, especially in food packaging. Numerous food companies—including household names like Chipotle, McDonald's, Panera, Taco Bell, Whole Foods, and Wendy's—have pledged to stop using food packaging manufactured with PFAS. Additionally, Connecticut, Maine, Minnesota, New York, Vermont, and Washington have enacted laws banning the use of PFAS in food packaging.

The federal government has also been getting in on the act. In 2016, FDA banned manufacturers from using long-chain PFAS in food packaging. These are even longer lasting than the comparable “short-chain” PFAS. However, after the discovery that at least one short-chain PFAS continued to linger in the body after consumption of a food contaminated with the compound, the FDA and manufacturers partnered in announcing that they would phase out use of the compound as a food container coating.

On October 18, 2021, EPA Administrator Michael S. Regan announced a strategic roadmap aimed at significantly reducing the use of the chemicals, including a comprehensive strategy to address the problem.

According to EPA, exposure to high levels of certain PFAS has been shown to lead to adverse health outcomes; however, research is ongoing to determine how different levels of exposure to various PFAS can lead to a variety of health effects. Research is also underway to better understand the health effects associated with

low levels of exposure to PFAS over long periods of time, especially in children. These are difficult questions to answer for many reasons. The sheer ubiquity of these chemicals and our continuous exposure to them makes it difficult to identify correlations. Additionally, it is exceedingly difficult to identify which problems are attributable to which of the thousands of PFAS in widespread use. Consequently, it will take time to get clear answers.

What is clear is that PFAS are subject to significant backlash and food companies may soon face a litany of risks by continuing to use PFAS in their packaging. Among these risks are geographical sales constraints, regulatory violations, lawsuits, and product boycotts.

Sales constraints simply refer to the inability to ship products into jurisdictions that ban the use of these chemicals in packaging. These bans subject companies to potential regulatory enforcement actions, including fines and other penalties. Moreover, we predict a significant uptick in class action claims brought against companies using PFAS packaging. Already, we are seeing an increase in product boycotts against such companies. The fact that so many large companies have already disavowed the use of these products will likely serve to strengthen the argument that companies are on notice that these products pose a potential danger to consumers. Thus, we strongly recommend that companies still utilizing PFAS packaging materials consider switching to non-PFAS products.

### The EPA Roadmap

The EPA's PFAS Roadmap is a lengthy document that details the agency's thinking, explains the need for change, and sets timelines by which EPA intends to take specific actions. In short, EPA commits to a series of new policies aimed at safeguarding public health, protecting the environment, and holding polluters accountable for violations arising from the use of PFAS.

EPA proposes a comprehensive, multi-tiered approach, shaped by the unique challenges of addressing PFAS contamination. That is, because PFAS pollution is not a legacy issue, meaning the chemicals continue to be used in U.S. commerce, EPA must focus on both cleaning up down-

stream PFAS pollution and preventing future PFAS pollution. In turn, the EPA approach will focus on three central directives: research, restrict, and remediate.

**Research.** The research directive refers to EPA making significant investments in research, development, and innovation to increase understanding of PFAS exposures and toxicities, human health and

PFAS are subject to significant backlash, and food companies may soon face a litany of risks by continuing to use PFAS in their packaging.

ecological effects, and effective interventions that incorporate the best available science. That is, because we are still understanding the severity and significance of the risks posed by PFAS, the agency intends to pursue a science-based approach to better understand the risks and solutions involving PFAS.

**Restrict.** The restrict directive refers to taking actions intended to restrict future use and pollution. Here, the agency plans to pursue a comprehensive approach to proactively prevent PFAS from entering air, land, and water at levels capable of causing an adverse impact on human health and the environment.

**Remediate.** The remediate directive predictably refers to the agency's goal of cleaning up PFAS pollution. To accomplish this, the agency intends to broaden and accelerate the cleanup of PFAS contamination to protect human health and ecological systems.

EPA's goals and timelines address a broad area of regulatory decision making, reporting requirements, and environmental thresholds that will span a period of years, with most planned actions being implemented by the end of 2024. For example, EPA is looking at PFAS chemicals that it has previously reviewed through the Toxic Substances Control Act (TSCA) New Chemicals Program, including those that it reviewed prior to the 2016 TSCA amendments. This could lead to currently

approved PFAS being disapproved. EPA also recently launched a stewardship program to encourage companies to voluntarily withdraw previously granted PFAS low volume exemptions (LVEs), and is currently revisiting past PFAS regulatory decisions and addressing those that are insufficiently protective.

Given this plan, it is unlikely that a formal federal ban will be implemented in the near term. However, a formal withdrawal of an LVE or other similar action could have substantially the same effect. Thus, and for all the reasons described above, now is the best time for companies to begin planning and taking action to address PFAS packaging.

### Alternative Options

The good news is that emerging technologies are allowing for a mostly seamless transition between PFAS packaging and safer, more environmentally friendly packaging with the same qualities that PFAS packaging is known for. Already, numerous companies are offering sustainable, PFAS-free packaging to accommodate the expected boom.

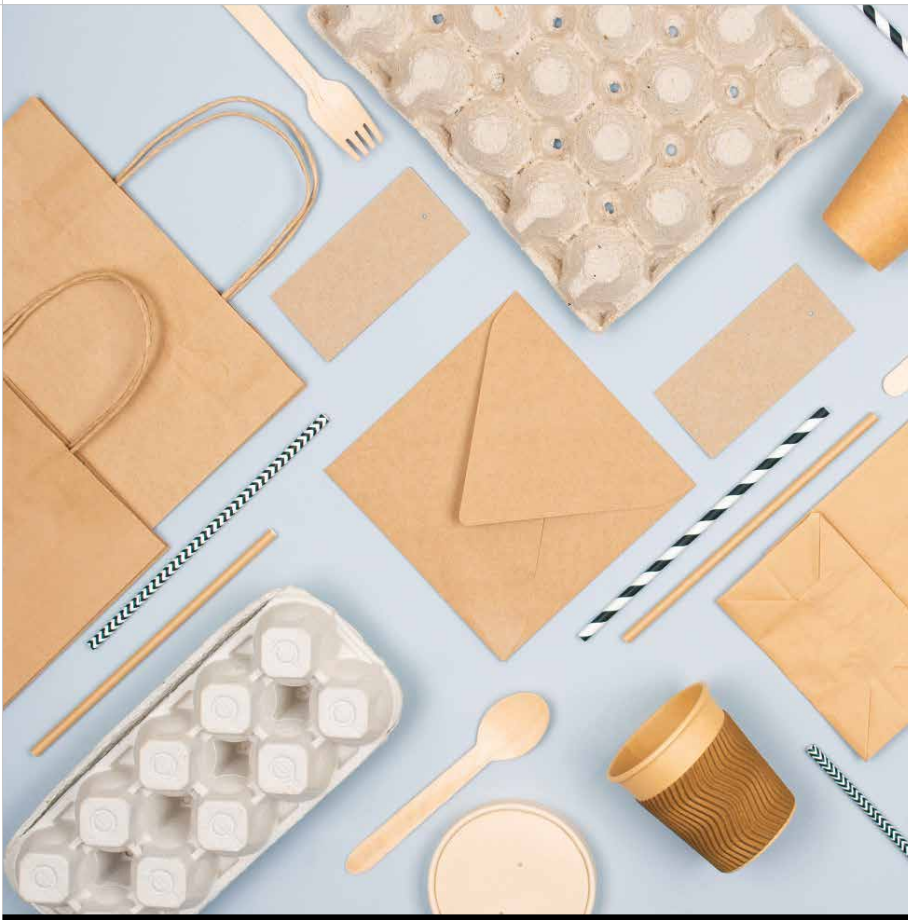
Two of the most common types of paper that provide barrier protections (i.e., grease and water resistance) are natural greaseproof paper (NGP), which is made through the refinement of wood pulp, and vegetable parchment. These two materials both have a dense cellulose structure that confers grease resistance. Additionally, novel applications using common plant-based fibers have shown great promise.

The creation of new types of sustainable, PFAS-free packaging is creating significant market opportunities for forward-looking companies. Given the regulatory outlook, that will only increase, as companies expand further into this area and deploy more resources to development and innovation. Consequently, we should expect to see the continuing proliferation of novel packaging products that will serve the same purpose as PFAS, but without the concomitant health and legal risks. Thus, we again advise companies to take steps now to prepare for the changes ahead. ■

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# Global Interests



## Sustainable Food Packaging

Does the consumer understand what it is?

BY AURORA A. SAULO, PHD

From the the consumer's point of view, "sustainable packaging" is packaging that positively impacts the environment. Sustainable packaging, according to a recent report in *Sustainability*, is important to consumers who dislike waste created by packaging-related issues, visible pollution on land and water caused by plastics, negative changes in the climate and air quality, and the conditions of water and soil where many of the used packaging are found. To address this consumer value, several

companies, including Coca-Cola, PepsiCo, Unilever, McDonald's, Nestle, and Kraft-Heinz, announced their plans for improved packaging sustainability by at least 2025. Their action plans address the consumer understanding of sustainable food packaging and include enhancing their use of recycled materials while increasing their own recycling programs, choosing sustainable sources, reducing packaging weight, and improving package design to improve materials recovery. Since most of these plans involve capital

costs, lengthy delivery times to the consumer, and technical gaps, manufacturers will likely encounter serious implementation problems.

### Sustainable Packaging Coalition Definition of Sustainable Packaging

The term "sustainability" emerged in the 1987 Brundtland United Nations report. At that time, sustainability was defined as "the development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Its definition has since evolved in the packaging industry. According to the Sustainable Packaging Coalition in 2011, sustainable packaging is a product that:

1. Is beneficial, safe, and healthy for individuals and communities throughout its life cycle;
2. Meets market criteria for performance and cost;
3. Is sourced, manufactured, transported, and recycled using renewable energy;
4. Optimizes the use of renewable or recycled source materials;
5. Is manufactured using clean production technologies and best practices;
6. Is made from materials healthy throughout the life cycle;
7. Is physically designed to optimize materials and energy; and
8. Is effectively recovered and used in biological and/or industrial closed loop cycles.

The life cycle assessment (LCA) tools used by the packaging industry consider sustainable food packaging as primarily protecting the food. Other functions that the consumer wants are addressed only after the protection of food has been defined. Otherwise, food stops being a food and cannot or should not be eaten. The LCA tools additionally expect sustainable packaging to enhance food quality and shelf life, consequently mitigating food loss and waste and leading to a more sus-

tainable food supply. Research published in the *Annual Review of Resource Economics* in 2020 also contends that sustainability-related food labels promote a more sustainable world.

### Sustainable Packaging Terms for the Consumer

As previously stated, consumers view sustainable packaging as packaging that has a positive impact on the environment. One term that consumers use is “eco-friendly,” which refers mainly to the environmental impact of the packaging. The social and economic aspects of food packaging are not part of this term. The consumer also usually believes that recycling results in sustainable packaging. As with the term “eco-friendly,” there is no consideration of its cost, convenience, or reliability as a package. The term “bio-packaging” has also been used. To the consumer, bio-packaging is a product that readily biodegrades in the environment. This is not a true assumption, because there are bio-based plastics that are not biodegradable.

“Greenwashing” is another term that is similar to “eco-friendly”; it attempts to project the idea of a more environmentally sustainable packaging than other packaging alternatives. Sometimes a symbol, such as a green leaf or the color green, is used to enhance this perception. Because the symbol is simple and goes well with consumer perception of sustainable packaging, greenwashing has been incorporated rapidly into sustainability marketing efforts. But, when consumers observed that even greenwashed packages littered the environment, they became distrustful of these companies due to a perceived lack of corporate commitment to sustainability through their brands and marketing.

### Consumer Understanding of Sustainable Packaging

Several studies have verified such consumer understanding of sustainable packaging. Results of a 2017 study indicated that consumers perceived bioplastic cups as highly sustainable, glass jars as second most sustainable, and dry carton sachets as the least sustainable packaging. The LCA measurements, however, contradicted these consumer perceptions. Bioplastic cups had the highest LCA impact,

whereas dry carton sachets had the lowest LCA impact. Results of a 1996 study indicated that the consumer frequently ranked the sustainability of the package based on how it was used post-consumption. Reusable glass, plastic, and paperboard were

The elements of the definition of sustainable packaging have not been clearly explained to the consumer. As a result, their perception of sustainable packaging does not always align with actual sustainability of a package.

ranked by consumers as most sustainable, and non-returnable plastics, plastic, and paperboard were ranked least sustainable. The origin or source of the product or how it was produced were not considered in the total environmental impact of the packaging. LCA tools, however, ranked paper and glass as having the highest environmental impacts.

Results of a consumer study conducted in Lithuania in 2021 on sustainability-related food labels indicated that Lithuanian consumers were not yet familiar with sustainability. The researchers recommended conducting educational efforts for consumers, who were very interested in health and nutrition, price-quality relationship, local sourcing of raw materials, production, and labels, and environmental sustainability. Similar results were obtained from a 2021 study out of Indonesia, where most consumers were also not well-versed in sustainability. The researchers saw a strong need for communication (corporate, social, and mass media) that will disseminate information on sustainability, improve food labels, and convince consumers to be active in green consumerism. In the U.K., where consumers are more aware of sustainability efforts, a 2015 study recommended that educational efforts emphasize the sup-

port of local sustainable consumption, because that support will lead to global sustainable development. Providing facts alone was insufficient and would result in ineffective marketing approaches.

### Food Labels and Sustainability

Slovakia considers its practice of regional labeling to be a contribution to regional development and sustainability. Results of a 2020 study of local residents on eco-labeling indicated that consumers who were sustainability aware were mainly those who did not consider financial spending their top concern. But Slovakia confirms the potential of using regional eco-labeling to develop their agricultural and food industries.

The Czech food industry deals with more than 40 food labels in addition to those that meet food labeling certification schemes, including those that focus on sustainability. Results of a 2021 study of food producers indicate that, overall, consumers positively considered the labels certified by these schemes. The producers, however, did not realize their anticipated economic gains, competitive edge, and new markets. Among the recommendations presented were consumer educational efforts to strengthen awareness of and trust in labels.

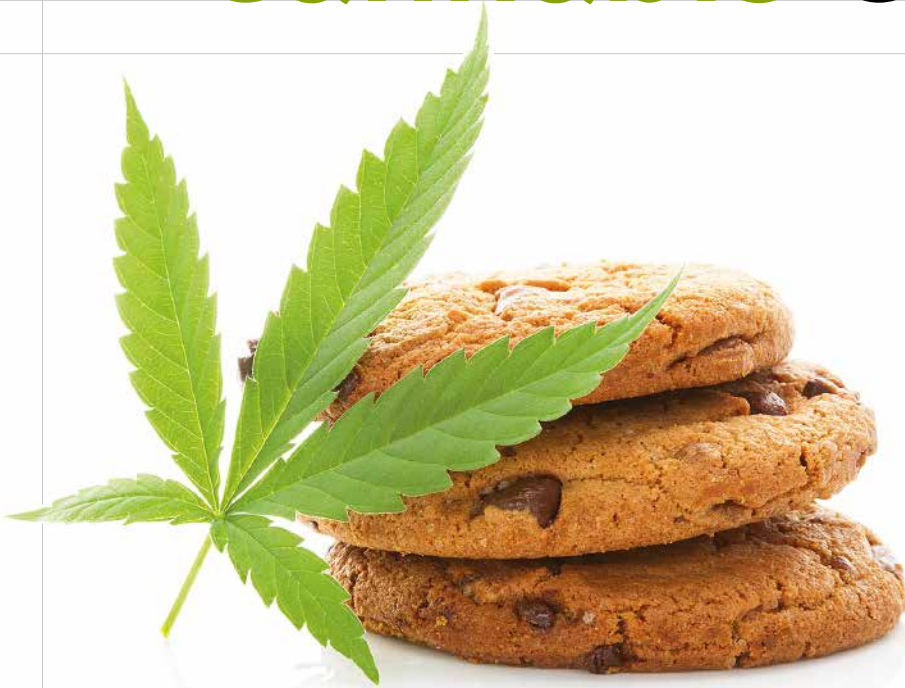
### Food Waste and Sustainability

Capitalizing on the perceived strong relationship between sustainability and food waste in the minds of the consumer, researchers conducted a study in 2019 to determine the volume of food waste generated if the “best before” phrase on food labels was eliminated, as proposed by the European Union to simplify food label dates. Results indicated that consumer reactions significantly differed in all the Italian regions studied, erring on the side of food waste when there was no best-before marking on food labels. Italian consumers were surveyed because they were considered more knowledgeable about expiration dates than the other EU28 citizens.

In 2019, researchers also found that consumers in The Netherlands wasted less food when, during their planning and purchasing, they consciously focused on food waste. Their results also indicated that less food is wasted as the consumer gets older.

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# Cannabis Corner



## Potency Caps

Many states are cracking down on THC potency in cannabis-infused foods

BY JESSE STANIFORTH

**W**hile no one is exactly sure how strong cannabis was in the 1970s, one thing most people agree on is that levels of tetrahydrocannabinol (THC), the main psychoactive compound in cannabis, have increased dramatically—or even exponentially—since that time. As high-potency cannabis flower has given way to even more potent cannabinoid concentrates and extracts, discussion has turned to the possibility of limiting THC content in cannabis products to protect consumers from high doses of the ingredient.

The good news about THC is that in adult users, it's rarely associated with adverse medical effects. This is the reason for the distinction many cannabis users

and industry insiders make between the term “overdose” (applicable to potentially fatal or physically health-risking drugs like opioids or cocaine) and the recent term “green-out” (meaning an excess dose of THC leading to acute discomfort and disorientation). The bad news is that a large dose of THC has the potential to leave users suffering through hours of confusion and terror, even while presenting little physical threat.

With those concerns in mind, many states have started to crack down on the potency of infused cannabis foods by imposing “potency caps,” which refer only to the potency of THC (rather than cannabidiol [CBD], for example), since that cannabinoid is responsible for psychoactive effects and, likewise, is responsible for the

discomfort associated with an uncomfortably large dose.

### Potency Limits

Colorado was the first U.S. state to experience national pushback for its “wild west” climate of unregulated products and, accordingly, the state was early to adopt regulations to control edibles. In 2017, Colorado banned edibles that could be confused with candy and limited edible products to a maximum 800 mg of THC per package.

As of 2021, many other states have implemented THC caps on edibles between 50 mg and 100 mg per package; at the same time, Colorado has dialed down its maximum limit into that range. However, other states, such as Illinois and Montana, have per-package limits as high as 500 mg and 800 mg, respectively. Most states mandate a maximum serving of 5 mg to 10 mg but allow many servings per package. (A chocolate bar containing 100 mg will be broken down into 10 squares, each containing 10 mg of THC.) The most extreme approach comes from Canada, where federal regulator Health Canada has capped edibles potency nationally at 10 mg of THC per package.

### Who Is at Risk from Edibles?

The urge to protect children comes from legitimate concerns, says Daniele Piomelli, PhD, the Louise Turner Arnold Chair in the Neurosciences and Director of the Center for the Study of Cannabis at University of California, Irvine. “Doing no harm is the first thing one must always think about: The Hippocratic oath of ‘Do No Harm’ is also a good strategy in life,” he says. “To do no harm with THC, the first thing one must do is identify vulnerable populations: groups of folks who are at risk of developing toxicity if they’re exposed to high doses of THC.”

One group we know can be adversely affected by high doses of THC is teenagers still undergoing brain development in regions of the cortex full of cannabinoid re-



ceptors. A second group, pregnant women, may also be adversely affected by THC. Among teenagers, the research is fairly stark. “We have substantial data from animal work, but also epidemiological data from human populations, giving the sense that [teenagers are] a population that should be warned against excessive use of THC,” Dr. Piomelli concludes. “[Teenagers] should not see high levels of THC, ever, or if they do, they should take that only very occasionally.”

Outside of teenagers and pregnant women, Dr. Piomelli is less concerned about high doses of THC, noting, “When it comes to adults, the risks of THC, even at high doses, are relatively minor. They can be offset by some education: the idea that you want to avoid frequent use to prevent developing a habit or use disorder. If you use frequently, keep your doses low. There are ways we can reduce harm, because luckily THC is not a very toxic substance to adults.”

For these reasons, Dr. Piomelli opposes THC caps as an unwise approach. “Caps on potency, just like caps on prices, end up being circumvented by the black market—and we have a gigantic black market, especially in states like California where regulations are very tight. Once something goes into the black market, as the word indicates, it’s a black hole: We have no data, and we lose control of the safety issues.”

### The Government’s Challenge

Katharine Neill Harris, PhD, the Alfred C. Glassell Fellow in Drug Policy at Rice University’s Baker Institute for Public Policy in Houston, agrees, though she also understands Dr. Piomelli’s concern about potential risks to younger users. “I get the urge to limit the amount of THC,” she says, “Some of the efforts to limit THC content come from very good intentions and public health concerns. But I don’t really think it can have the intended effect at this point. The time to have tried to limit the amount of THC in any of these products was 30 years ago, long before the illicit market started getting saturated with high-potency products. The cat’s out of the bag on that. We’re not going back. Because the government didn’t regulate this decades ago, it missed that opportunity, and the illicit market adapted to create high-potency products.”

This circumstance presents leaders with the difficulty of balancing public health concerns against the profit motive of what is clearly a booming business, Dr. Harris says. “Once you create an industry that has a profit incentive, and people are using these products and using them more regularly,” she says, “you’re sort of automatically sacrificing something to public health with the creation of that market. That’s how we’ve done it, and there could have been a conversation about government regulation of these things—for ex-

The limits that are being proposed by state legislators are just arbitrary numbers. I don’t know where any of them come from. ... I haven’t seen anything in the literature that provides definitive guidance.—

Katharine Neill Harris, PhD

ample, only having the government supplying edibles, and they could make it so there are no edibles available for purchase above a certain amount.”

Would cannabis users trust government guidance? Dr. Harris isn’t sure, saying that she thinks the average marijuana consumer is unlikely to trust what the U.S. government is saying about cannabis. In practice, she says, this will make it difficult for federal government agencies above all to try to educate consumers about safer cannabis consumption. One outcome of this distrust, she suggests, is that consumers may not believe warnings about the acute discomfort of excess THC unless they’ve experienced it themselves.

A second concern Dr. Harris raises about caps on THC is that nearly every cap—either suggested or enshrined in law—is arbitrary. While we know high-potency THC can be connected with adverse effects and bad experiences, we have no hard numbers to indicate which doses connect with which harms. “We don’t have research saying, ‘above 15%, that’s

when it becomes [risky].’ The limits that are being proposed by state legislators are just arbitrary numbers,” she says. “I don’t know where any of them come from. I haven’t spoken with the legislators behind the bills. I don’t know where the people proposing these bills are getting the ideas for these limits. I haven’t seen anything in the literature that provides definitive guidance.”

Accordingly, legislators tend to choose numbers divisible by five as their cap targets. “These are nice easy numbers, and the products that have been on the market have been divisible into amounts like that—that’s what people have experiences with,” Dr. Harris says. “But we don’t have any research that tells us what people feel like when they take 5 mg or 10 mg. We don’t have that research because it’s a Schedule 1 drug and we have no facilitated research to look more at the effects of cannabis use beyond concluding that it’s bad for us.”

### Achieving the Same Goals without THC Limits

All of these commentators agree that the rise of highly potent edibles presents public health concerns, chiefly related to the possibility that such high doses may be consumed by minors with still-developing brains. Likewise, all of them oppose THC caps in favor of other means of discouraging high THC consumption.

For Dr. Piomelli, the best means of limiting THC consumption is through economic incentive. “I’m very much in favor of increasing the price and putting a price on high-level THC,” he says, noting that such an increase shouldn’t be steep, but just enough to sway potential users away from the stronger products, and ideally encourage buyers to consume lower-THC products in general. “The price premium they pay should be enough to dissuade them from using it very frequently. I see price escalation—as a function of amount of THC in a given preparation—as a reasonable compromise. That would be consistent with the complexity of the pharmacology of THC.”

Dr. Harris agrees, though she urges care in setting taxes that raise prices on cannabis, since this could drive consumers back to illicit sellers. She believes a modest tax applied, based on THC content, might

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do the trick, though she also counsels measures that encourage the consumption of CBD as a means of reducing potential mental health harms. “Don’t just punish high-THC, but encourage the use of products that have CBD or that are less potent in THC,” she says. “One of the concerns people have about high-THC products is about psychosis and [adverse mental health effects]. Research shows CBD can counteract some of the psychoactive effects of THC. To breed high-THC flower, they remove all the CBD, but you can put it back in with concentrates. We have edible products with 25 mg CBD and 10 mg THC.”

If the federal government were to get into the game, Dr. Harris says, telling consumers to mediate their THC consumption with CBD, that might be useful, provided consumers believe government sources.

Public education is the core of concern for Jay D. Wexler, a professor at Boston Uni-

versity School of Law. He supports measures that focus on informing consumers, such as the widespread packaging requirements now in place across most, if not all, U.S. states where cannabis is legal, which demanded labeling that clearly states how much THC an entire package of edible products contains. Along with this information, Dr. Wexler calls for education programs to more effectively introduce the edibles mantra of “start low and go slow” to the widest possible American public.

“When we sell liquor, you buy it in the whole bottle,” he says, “you don’t buy little shots of it. My whiskey comes in [units of] 20 shots. We teach people how the stuff affects them, what’s in the bottle, and it’s not so hard.”

### Potency Limits May Discourage Moderation

But even alcohol is a strange comparison for Dr. Piomelli, who comes from Italy and

reports a dramatically different culture of moderate alcohol consumption in that country. “In the U.S.—or other countries—we’ve never been politically willing to explain to people what is a healthy culture of alcohol,” he says. “We tend to fall back on the prohibitionist idea that no quantity of alcohol is good for you, and you’re better off not ever using it. This is the position of the American Medical Association, and it’s so extreme that it ends up undercutting the credibility of the statement. It belies the personal experience of millions of people across entire countries.”

With that attitude in mind, Dr. Piomelli says a cap on THC is the wrong way to introduce a lifestyle in which consumers use cannabis in moderation. “Having the government impose a cap hasn’t worked in the past.” ■

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## Sustainable Food Packaging (Continued from p. 13)

### Private Brands and Sustainability

In the past, U.S. consumers considered legacy brands to be trustworthy. They depended on legacy brands for the food quality that they expected and consistently obtained. Prior to the new millennium, legacy brands introduced many new products and distributed them rapidly, exerting a strong influence on the U.S. consumer food culture. The focus then was on quality attributed to the brand, appearance, and nutritional content. Loyalty to the legacy brands was high.

During the COVID-19 pandemic (2019 to present), about 75% of U.S. consumers tried new products for convenience and value with more than half of people (mainly Generation Z and Millennials) switching completely from their legacy brands. Presentation of new brands (private labels) dramatically changed from lower priced, not-so-good copycats to premium, organic, and healthful. Consumers considered private brands as “more modern, innovative, fun, adventurous, ethical, and experiential” equally trusting private labeled products as they do legacy brands.

There was a new focus on emerging benefits: pure ingredients, clean labels, simple process, sustainable sourcing, and environmental and social responsibility. Private brands now offer most (if not all) of the attributes found in legacy brand products except for one major difference—they are still lower priced. Private labels are exerting strong influence on younger consumers who are the arbiters of future food culture, according to research by The Hartman Group in 2021.

A recent study was conducted on the attitudes of British and Polish consumers toward private labels. The results seem to indicate that they might be demonstrating the same behavior as the U.S. consumer. Polish consumers are currently more focused on lower prices offered by private labels that have been introduced only relatively recently in the late 1990s. On the other hand, British consumers have known private labels since the 1970s and are now comparing the qualities that they receive from private labels with those of legacy brands. As private labels improve in product attributes in both locations,

British and Polish consumers may eventually focus on the same emerging benefits that the younger U.S. consumers are seeking, including sustainable products and packages.

### Filling the Gaps in Consumer Understanding

The elements of the definition of sustainable packaging have not been clearly explained to the consumer. As a result, their perception of sustainable packaging does not always align with the actual sustainability of a package as determined by the LCA. Not clearly communicating to the consumer the function and contribution of greenwashing to sustainability, for example, was a factor that led to the failure of greenwashing efforts.

There is a need to clearly communicate to the consumer that the most critical function of food packaging is to protect the food so that the consumer will have a realistic expectation of what sustainable food packaging is. ■

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# Whole-Genome Sequencing

# How the technology is revolutionizing food safety and public health

BY SHAWN STEVENS, ESQ., AND PURNENDU C. VASAVADA, PHD

**F**ood safety is a global concern and foodborne illness outbreaks remain a significant challenge to public health and pose a huge economic burden worldwide. In the U.S., foodborne pathogens cause an estimated 9.4 million illnesses each year, including 56,000 hospitalizations and 1,400 deaths. Additionally, foodborne pathogens cause a 10% gastroenteritis in Europe annually. While 31 known pathogens cause foodborne illness, *Salmonella*, *Campylobacter*, *Listeria monocytogenes*, and *E. coli* O57:H7 have been implicated as the cause of many multi-state outbreaks of foodborne illness in recent years. Often the investigations of foodborne illness outbreaks fail to find the source, and the illness outbreak is referred to as caused by “unknown etiology” or by “unspecified agents.” Foodborne illnesses are preventable, yet they remain a significant challenge to the food industry and pose a huge public health and economic burden.

Pathogenic bacteria such as *Salmonella*, *E. coli* O157:H7, and *L. monocytogenes* are recognized as the most significant biological hazards, not only in ingredients, raw materials, and finished foods, but also in the food plant environment. Pathogens in the food plant environment can contaminate food, especially ready-to-eat (RTE) foods post processing and prior to packaging. Thus, the food industry and FDA are increasingly employing sampling food manufacturing facilities to isolate pathogenic organisms and characterize and subtype them to develop a microbiological profile of the processing facility that was sampled in addition to the products from that facility.

Similarly, epidemiological investigations by public health agencies (e.g., the Centers for Disease Control and Prevention (CDC) and state and local departments of public health) also involve pathogen isolation, characterization, and subtyping to identify which pathogen is causing an outbreak or recall and tracing the source involved in the outbreak. Clinical isolates obtained from patients affected by a foodborne illness can be compared with samples collected from foods and food plant environments to potentially identify a source of the pathogen that is causing the foodborne illness. When a match is made between clinical isolates and samples from a food or food plant, the scope and impact of the

foodborne illness can be best understood. Product recalls may also be targeted based on the results of these efforts.

Food microbiologists have always been interested in methods of identification and characterization of microbial isolates in food and beverages. Early techniques included staining and microscopy; comparison of physiological, biochemical, and serological characteristics to discriminate species; and strains of microorganisms of interest. These techniques allowed for evaluation of the target organism; however, they did not have sufficient discriminatory power to allow precise identification of and differentiation between related strains of microorganisms. Also, these traditional methods are material and labor intensive, time consuming, and expensive for routine use in the identification, characterization, and subtyping of bacterial strains.

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Advances in molecular biology during the last part of the 20th century have resulted in the development of efficient techniques that have made possible the rapid identification and characterization of microbial isolates. Next generation sequencing (NGS) methods have transformed from being solely research tools to being routinely applied in diagnostics, outbreak investigations, antimicrobial resistance, forensics, and food authenticity.

NGS is predominantly used in two ways:

1. Determining the whole-genome sequence (WGS) of a single cultured isolate (e.g., a bacterial colony); and
2. Application to a biological sample generating sequences of multiple (if not all) microorganisms in that sample (i.e., “metagenomics”).

WGS, which is a type of NGS that has a high discriminatory power when compared with traditional molecular typing tools, is increasingly replacing traditional microbial typing and characterization techniques.

## The genomic information obtained through WGS can help develop culture-independent methods for the rapid detection of pathogens from a food without the need for isolating the bacteria.



WGS can differentiate microbial strains at a high enough resolution and is increasingly used by FDA, CDC, USDA Food Safety and Inspection Service (FSIS), and other public health agencies worldwide for epidemiological investigation of foodborne illnesses, identification of related cases, source attribution, and development of intervention strategies.

The main applications of WGS technology include investigating foodborne illness outbreaks, achieving trace back and source tracking the cause of outbreak, and linking isolates obtained from food and the food plant environment to clinical isolates from patients. Genomic technology such as WGS can also be used for developing rapid method and culture-independent tests for monitoring ingredients and raw material, detecting emerging pathogens, assessing the persistence of pathogens in the food plant environment, and determining the effectiveness of preventive and sanitary controls. WGS technology can also be used as a possible indicator of antimicrobial resistance.

In 2013, FDA adopted WGS technology and created the GenomeTrakr WGS Network as a tool to help improve food safety. The GenomeTrakr Network is made up of more than 50 national and international laboratories that are sequencing foodborne pathogens and uploading the genomes into the National Center for Biotechnology Information Pathogen Detection (NCBI PD) web portal. Other national and international public health authorities also share their WGS data through the NCBI.

FDA, CDC, USDA-FSIS, and public health agencies have adopted WGS from 2013, replacing the Pulsed-Field Gel Electrophoresis (PFGE) as the preferred subtyping method for use in PulseNet. The GenomeTrakr is an open-access genomic reference database that contains archived genome sequences obtained from foodborne outbreaks, contaminated food products, and environmental sources. The database can be used to identify contamination sources and to help develop new rapid methods and culture-independent tests based on the genetic information available.

Perhaps the most basic application of WGS technology in food safety is using it to identify pathogens isolated from food or environmental samples. Other applications of WGS include determining the scope of foodborne illness outbreaks, determining which ingredient in a multi-ingredient food is responsible for an outbreak, differentiating sources of contamination (even within the same outbreak), linking illnesses to a processing facility, linking small numbers of illnesses that otherwise might not have been identified as part of the same outbreak, and identifying unlikely routes of contamination.

Examples of the use of WGS of bacterial isolates for regulatory and outbreak investigations include:

- Identifying the source of an *E. coli* O121 outbreak linked to raw flour: An epidemiological investigation showed that patients had contact with raw flour before the onset of illness. Traceback investigations identified a flour producer as the possible source. *E. coli* O121 was isolated from open packages of flour that were obtained from the residences of sickened people.
- Matching food isolates from a food product produced by one firm to environmental isolates from another facility: An FDA investigation linked a strain of *L. monocytogenes* detected in ice cream to an ingredient supplier using WGS technology and confirmed that





## Case Study: Using WGS to Link Foodborne Outbreaks with Food Isolates

In 2015, Blue Bell ice cream was linked to an outbreak that involved only 10 confirmed cases and spanned a total of five years. After the identification of the outbreak and in the investigation that followed, FDA sampled Blue Bell ice cream at retail locations, and then collected environmental and finished product samples from the company's production facilities and linked positive samples from that investigation to a total of 10 case patients in the CDC database who carried the same strain of *L. monocytogenes*.

What made the investigation most alarming for industry was that the first people who became sick in the outbreak became ill more than five years before the outbreak was solved. The first illness was reported in January 2010. Two more illnesses were recorded in 2011. There was only one illness in 2012, and there were five in 2014. The final illness was reported in January 2015. All of the case patients were linked together by WGS.

Reportedly, after some case patients from a healthcare facility were confirmed by WGS to have been sickened with the outbreak strain, FDA was able to obtain exposure histories. One of the common exposures to each case patient was Blue Bell ice cream used by the healthcare facility to make shakes. As the beverages sat out along the bedside and warmed, the low levels of *L. monocytogenes* present in the beverage began to grow to levels that could cause illness. This common exposure factor led FDA to suspect Blue Bell's products as a possible source of the contamination.

FDA initiated an investigation and subsequently identified the same strain in Blue Bell's facilities and finished products that had sickened the 10 case patients. Although we will never know how many of the finished products that Blue Bell shipped were ultimately contaminated, what is clear is that a large amount of product was unknowingly contaminated intermittently within Blue Bell's facilities over a long period of time.

The Blue Bell case confirms that once *L. monocytogenes* is allowed to enter a food processing environment, no food product (not even ice cream) is safe. In turn, the federal government's growing use of WGS during investigations and routine inspections is significantly increasing the chance that if a food company has persistent contamination in its facility, that contamination will in fact be found.

the *L. monocytogenes* in the ice cream matched *L. monocytogenes* found within the ingredient supplier's facility.

- Identifying a resident strain of a pathogen: A *Salmonella* strain was isolated from environmental samples collected from the same facility during inspections that occurred in 2011, 2012, 2015, and 2016. Other investigations illustrating the use of WGS technology by regulatory agencies are discussed elsewhere in this article.

### Identifying Sources of Foodborne Illness Outbreaks

In 1993, the highly publicized Jack in the Box outbreak was responsible for infecting more than 600 consumers with *E. coli* O157:H7. Four people lost their lives. Most of the victims were children. Before Jack in the Box, there was no system or mechanism in place in the U.S. to track foodborne illness outbreaks in real time. The source of the outbreak was undercooked hamburgers. In the absence of a national outbreak surveillance system in the early 1990s, the outbreak was likely only discovered because the victims who became sick were becoming infected in a relatively limited geographical area. In turn, in many cases, the patients were treated in the same hospitals. In some instances, the case patients were treated by the same medical professionals. Because this enabled the medical community to identify and suspect an emerging or ongoing outbreak, they were able to bring their suspicions to the attention of public health officials and work together to eventually determine the source of the outbreak.

Due to the lessons learned from the Jack in the Box outbreak, the federal government realized that similar large-scale outbreaks were likely occurring throughout the U.S. without any organized means or mechanism to detect them. In a successful effort to enhance the federal government's ability to detect and respond to outbreaks as they were occurring, the government developed and then implemented a nationwide system of mandatory foodborne illness reporting.

Beginning in the late 1990s, as the new system was put into place, whenever a medical professional in any state discovered that a patient was positive with a pathogen of concern (such as *L. monocytogenes*, *Salmonella*, or *E. coli* O157:H7), they were (and are to this day) required to report that finding to the relevant state health department. Individual states were then able to request copies of the isolates and test them. In the late 1990s and early 2000s, the states used PFGE to isolate the specific genetic DNA fingerprint of the pathogen making the patients sick.

Once the PFGE fingerprint was obtained, the results would then be uploaded into the PulseNet database, where the CDC could identify patterns or clusters of illnesses. When indistinguishable DNA fingerprints were uploaded from multiple victims, this told CDC that a foodborne outbreak was emerging. CDC would then share this information with FDA and USDA, as applicable, along with other federal, state, and local health departments. The public health officials at the federal and state levels would then work collaboratively to determine a common source for the cluster of illnesses.

Eventually, between 2005 and 2010, the states began shifting from PFGE analysis to multiple locus variable-number tandem repeat analysis (MLVA). The reason for the shift to MLVA was that

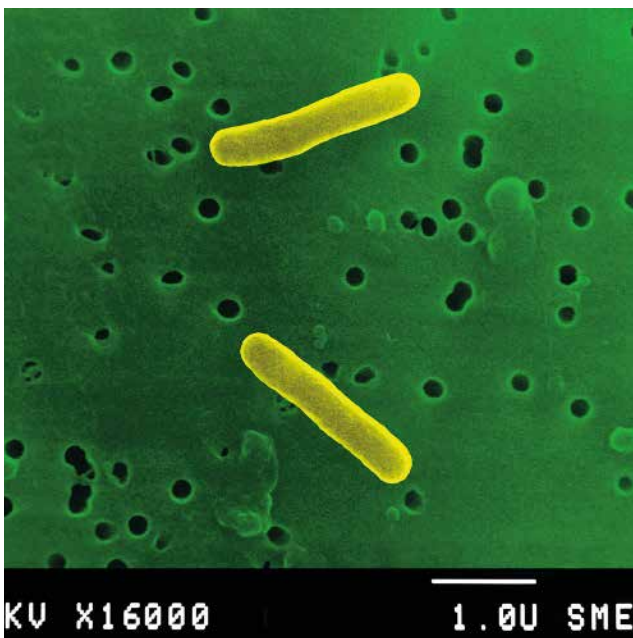
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the analysis gave public health officials greater resolution over the specific DNA fingerprint of the organism in question. From a lay perspective, MLVA turned a somewhat blurry image of the DNA fingerprint into a crisper image with more delineation, enabling case patient clusters to be identified and defined with more precision and confidence.

A few years later, CDC began moving from MLVA toward the even higher resolution methodology of WGS, which analyzes the entire genome. In turn, the higher resolution DNA fingerprint is uploaded by CDC into the GenomeTrakr database. By shifting from MLVA to WGS, CDC has been able to achieve higher resolution, making a slightly blurry DNA fingerprint crystal clear. MLVA is the standard by which public health officials, including those working for CDC, USDA, and FDA, now link clusters of indistinguishable clinical (human) isolates to food products of concern.

**Knowledge about specific genes associated with virulence, pathogenicity, survival, adaptability, and antimicrobial resistance obtained through NGS technologies will allow for preventive food safety and quality assurance worldwide.**



When PulseNet first came online in the late 1990s, numerous overlapping outbreaks were almost immediately identified. PulseNet proved that, although they were not being detected prior to the mid-1990s, many outbreaks were, in fact, occurring. Over the next 20 years, as the methodologies improved and the surveillance system became more effective and capable, outbreaks were identified at an increasing rate. As the national foodborne illness outbreak surveillance system continued to develop and mature, it also became clear that many of the food products sold in commerce, and many of the ingredients used to produce those food products, were at risk from contamination with pathogens of concern. In many cases, a single contaminated ingredient would be sold by a single supplier to dozens of customers and then used to produce hundreds or even thousands of products that would then be distributed to thousands (or tens of thousands) of retail stores.

PulseNet, MLVA, and WGS have given public health officials and government agencies the ability to effectively identify and subsequently solve foodborne illness outbreaks. We suspect, as the methodologies and data sets continue to grow and improve, that fewer and fewer national foodborne illness outbreaks will evade detection.

#### **WGS Technology: Applications, Benefits, and Barriers**

The application of WGS technology for investigating foodborne illness outbreaks, conducting traceback, and source tracking the cause of outbreak and linking isolates obtained from food and the food plant environment to clinical isolates from patients is well known. WGS can also be used for developing rapid methods and culture-independent tests for monitoring ingredients and raw material, detecting emerging pathogens, assessing the persistence of pathogens in the food plant environment, and determining the effectiveness of preventive and sanitary controls within the food plant environment.

WGS technology can also be used as a possible indicator of antimicrobial resistance. To facilitate such applications, FDA is sequencing all pathogens collected from food and food plant environments and uploading the genetic information obtained to the publicly searchable GenomeTrakr database. National Antimicrobial Resistance Monitoring System (NARMS) laboratories are using WGS sequences to determine whether the presence of certain genes in pathogens such as *Salmonella* and *Campylobacter* can be used to predict the pathogen's resistance to antibiotics. Research has shown a high degree of correlation between clinical antibiotic resistance and the presence of known resistance genes. WGS data from NARMS may be useful for understanding the dissemination of antibiotic resistance bacteria and their genes via food.

#### **Benefits and Barriers**

WGS technology is extremely powerful and highly capable of providing information on contamination sources as well as aiding in the detection, resolution, and prevention of foodborne outbreaks with great precision and in a cost-effective and timely fashion. WGS can also provide information about pathogenicity and virulence, adaptation, and survival of pathogens, which allows regulators to develop, design, and prioritize intervention procedures that will prevent pathogens from entering the food supply. Additionally, the genomic information obtained through WGS can help



develop culture-independent methods for the rapid detection of pathogens from a food without the need for isolating the bacteria.

Several barriers limit the implementation of WGS technology by the food industry. Significant barriers include:

- The cost of necessary equipment and consumable materials;
- Lack of trained personnel;
- Difficulty in multiplexing (analyzing several independent samples in the same run);
- The complexity of analysis, including bioinformatics, interpretation, and management of the data produced;
- The requirement of a powerful IT infrastructure for storage of genomic data;
  - A lack of standardization of methods;
  - Time to results: Retrospective results are not useful for release of the food product or timely corrective action;
- A lack of uncertainty around legal and regulatory implications;
  - A lack of clarity on data ownership;
  - Potential regulatory obligations and/or pressure to share WGS data that is collected; and
  - The potential risk of the misinterpretation of data generated during internal investigations.

### Outlook and Summary

WGS technology is an extremely powerful tool that is useful in epidemiological investigations, in tracing a potential source of contamination, and in the detection of pathogens, thus allowing for a comparison of the genomic information of clinical isolates with that of food and environmental isolates. The technology makes the successful investigation of foodborne illness outbreak events possible. Additionally, knowledge about specific genes associated with virulence, pathogenicity, survival, adaptability, and antimicrobial resistance obtained through NGS technologies will allow for preventive food safety and quality assurance worldwide.

While WGS technology has been readily adopted by regulatory agencies and academic researchers worldwide, adoption and implementation of the technology within the food industry is quite variable. Recognizing the excellent potential of WGS technology, some companies have taken a proactive approach to understanding and adopting the technology for sequencing isolates obtained from microbiological analysis of their ingredients, products, or processing environment and for tracking resident versus transient pathogens that may be present within the processing environment. Also, adopting WGS technology has allowed food companies to discuss genomic-based information with regulators, suppliers, and other food companies. Other companies are in the process of evaluating the cost benefits of sequencing and WGS analysis of bacterial isolates.

Companies that have not yet implemented WGS technology should consider becoming familiar with the technology, evaluating potential risks and benefits of adopting the technology, and developing a plan for accessing and implementing the technology if necessary. ■

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# How Sweet It Is

Pecan Deluxe Candy Company wins the 2021 *Food Quality & Safety* large business award

BY LORI VALIGRA

The owner of Pecan Deluxe Candy Company, Jay Brigham, likes to say, “We’re not just nuts.”

The tagline is borne out of the pandemic, when the company found eager homebound buyers for ice cream and other products containing its brownie and ready-to-eat cookie dough add-in ingredients and toppings. In fact, nuts are a small percentage of the company’s overall business. The family-owned, international food supplier was named winner of the prestigious 2021 *Food Quality & Safety* award for large businesses.

The award, presented annually by *Food Quality & Safety*, honors the dedication and achievement of organizations that make significant contributions to uphold the highest food standards supported by quantifiable results. This year, our judging panel of food industry safety experts determined that Pecan Deluxe Candy Co. demonstrated a comprehensive food safety and quality management program that included a robust focus on advanced technology and training and an additional strong food safety culture.

Founded in 1950 and headquartered in Dallas, Texas, Pecan Deluxe employs 618 people, with 318 of them in Dallas and the remainder split equally between plants in England and Thailand.

The facilities are certified under the Global Food Safety Initiative (GFSI). The company, which makes ingredients to be added to dairy, dessert, cereal, beverage, and other products, attributes its success to being guided by family values, with a hyper-focus on food safety and innovation.



## Continuous Improvement

In the past couple of years, the company has invested in technology aimed at keeping loose particles and potential contamination out of its 160,000-square-foot plant in Dallas. It upgraded its floors and installed insulated stainless steel walls and equipment, says Stephen Posey, MBA, the company’s executive vice president of global food safety and quality assurance.

It redesigned its metal detector conveyor with a smaller aperture and higher sensitivity to decrease the chance of tiny metal objects getting into products. The redesign provided higher sensitivity to 1.5 mm ferrous, 1.5 mm non-ferrous, and 2 mm stainless particles.

“We designed our whole setup so that you have an appropriate transfer of product, running it through the metal detector and



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then landing it on a scale that weighs it properly,” says Posey. The metal detector and workflow design are especially important because the company makes sticky candies that can trap particles and potentially stick to a conveyor belt and fall to the floor. The biggest source of metal particle contamination is equipment.

Pecan Deluxe also installed an automated hand- and boot-washing system at every production entrance as well as sanitizing floor foamers that spray all entrances. It invested in three air showers, glass rooms

**Because of FSMA and business needs, we are trying to make sure we approve our supply chain. For suppliers that we feel may be at higher risk, we make on-site visits.**

—Stephen Posey, MBA

where high-velocity jets remove loose hair and potential contaminants that are captured by HEPA filtration. “It’s appropriate that they make sure everything is sanitized before team members walk into the facility,” he says. “We put a lot of investment into our people because we really know that our team is the key to our success.”

Posey added that the automated hand- and boot-washing system, along with more training focused on personal sanitation, led to a significant improvement in employees using the system. The current level of compliance based on hand swabs is 98.3%, compared with less than 95% before the new system was installed.

### A Focus on Employee Training

Employee training is a big part of the company’s culture. Continuing education is done using Alchemy learning software for both new employees as well as annual retraining on topics including food safety, allergens, sanitation, good manufacturing practices, HACCP, security, microbiology, and preventive maintenance. Posey says the software is a great tool because employees need to answer questions to show they learned from it.

In addition to the training program, Pecan Deluxe pairs an experienced person with one who is learning to ensure they truly understand everything they need to do before they go onto the production floor and work alone. The company also provides training on new methods, processes, and lessons learned from plant incidents, Posey says.

When the company hires a food safety and quality assurance technician, it puts them through three weeks of training working alongside a knowledgeable technician so the new worker can ask for specifics, such as questions about allergen swabbing. The company performs thousands of allergen tests every quarter.

Pecan Deluxe has 22 Preventive Controls Qualified Individuals on staff in Dallas and is certified through the Food Safety Preventive Controls Alliance. FSMA requires FDA-regulated food and beverage facilities to have at least one such qualified individual on staff.



The food manufacturer also brings in outside companies to train its employees, including training to teach workers how to set up the metal detectors and how they function. Food defense awareness training is done by the Food Safety Preventive Controls Alliance. Additional training includes sessions on food product sampling and environmental monitoring.

Posey says cross-training to create a team environment, focusing corporate culture on food safety, and sharing relevant key performance indicators to see how they affected improvements are all helping staff “do things right the first time.” Cross-training also provides upward job mobility.

### Strong Food Safety Plans

The company is SQF Level 2 certified and received a score of 97 last year. Posey says the company has continued to earn better scores every year, and closely monitors its key performance indicators to make sure they are producing the impacts the company wants, such as reducing waste, cutting the amount of product put on hold, and decreasing customer complaints per million pounds of products sold.

Pecan Deluxe uses software to manage its food safety plans. The company is able to conduct hazard analysis, internal audits, non-conformance tracking with corrective actions, and other functions critical to food safety.

The company is focused on long-term, consistent improvements so workers can perform their jobs correctly the first time, Posey says. Part of the reason is the nature of its business. “Some customers regard us as having high-risk ingredients,” he notes. That’s not just because some of the products contain nuts. Most of its products are shipped refrigerated or frozen for including in ice cream and yogurt. The products are ready to eat, so customers can take a product like a brownie inclusion and just add it to their ice cream without any additional treatment.

Because of that, the company has more audits, including visits from customers, to assure that their products are safe. The SQF audit is conducted by a third party. Pecan Deluxe also conducts internal audits frequently using cross-functional teams. In addition, good manufacturing practice audits include weekly personal practices and equipment audits. Inspections are also done for triggering events such as every allergen changeover or equipment readiness.

Pecan Deluxe also provides a manual to all its suppliers about its expectations and requirements, such as having suppliers submit third-party audit results as part of their approval process. “Because of FSMA and business needs, we are trying to make sure we approve our supply chain,” Posey says. “For suppliers that we feel may be at higher risk, we make on-site visits.”

Pecan Deluxe partners with an outside company to contain pests in the production area, warehouse, break area, and other

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parts of the plant. That company uses bait stations, internal traps, blue lighting, and pheromones to catch pests, and inspects the entire facility a minimum of every other week to keep on top of pests, which are attracted to floors that can get sticky with cookie dough or spilled cookies or candy.

## Investments Lead to Results

Posey says the owner of Pecan Deluxe “puts his money where his mouth is” to improve food safety. “As the company continues to grow and develop, he continues to invest in the facility, equipment, processes, and new technology,” Posey adds.

The overall improvements, Posey says, can be credited to a thorough environmental monitoring program that includes third-party allergen validations and running more than 6,000 swabs annually to test for contaminant or pathogen activity. The monitoring program also includes third-party reviews of all preventive control plans and validations of biological risk controls.

Additional major investments that have helped substantially reduce contaminant and pathogen activity include the implementation of a uniform and shoe program under which each employee gets one pair of slip-resistant footwear for free in the production, quality assurance, and research and development departments. If they are worn only for work, the shoes last up to a year, and employees must wear them. They also help reduce injuries.



## New Opportunities

Pecan Deluxe’s track record of strong third-party audit scores, including from customers, has increased business opportunities. One of those is the “popping boba,” a sweet-flavored, tiny, juice-filled sphere encapsulated in an edible shell and used by yogurt and tea store chains, and more recently being added to desserts and beverages. The opportunity came about with the lack of U.S. suppliers and the slowdown during the pandemic in getting boba from Taiwan, where most of the product’s manufacturers are located.

Pecan Deluxe is making the popping boba in a newly expanded, 55,000-square-foot facility in Dallas. The expansion also increases its current production capabilities and warehouse space and improves its operational workflow. The boba are being made on two lines right now, and the company is preparing to add another eight more, Posey says. “We’re investing in becoming the largest boba maker in the United States,” he says.—LV



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Pecan Deluxe has focused on microbiological swabbing to ensure that its products are made in a safe environment. In 2021, that involved 6,900 allergen swabs and more than 1,700 pathogen swabs completed. The company also conducted more than 7,000 microbiological verification tests on the daily equipment swabs. The swab results showed a significant reduction in contamination by allergens and pathogens, including yeast, coliform bacteria, and mold.

Posey says the company has had no product recalls.

## Positive Results

The investments made by Pecan Deluxe are already showing returns. The quality management software has reduced the paperwork required from employees and, in turn, has saved time. The software can track supplier and customer issues to help eliminate redundant efforts between organizations.

By creating an environment where team members own the results of their efforts, less product is being held as questionable, Posey says. The company uses a check-and-balance documented quality verification procedure to assure food safety and quality. Handling the product correctly the first time around has decreased waste and products placed on hold, which has yielded significant savings, he says.

The company has been better able to produce products to order and manage shelf life, which has also saved money because less product ages in its warehouse. Customer satisfaction has increased its annual sales more than 15%.

“We have really been blessed by significant growth opportunities and we really do believe that team members are our No. 1 asset,” Posey says. “We’ve continued to invest a lot in our team members so that as they grow, we grow, and we’re all successful together.” ■

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# A Cut Above

Kern Meat Company wins the 2021 *Food Quality & Safety* award in the small business category

BY LORI VALIGRA

**A**n expansion into a new production facility in September 2020 presented Kern Meat Company, Inc., with a largely blank slate for investing in the latest technology to promote food quality and safety. The family-owned company, which is now operated by a third generation, was recently named winner of the prestigious 2021 *Food Quality & Safety* award for small businesses.

The award, presented annually, honors the dedication and achievement of an organization that makes significant contributions to uphold the highest food standards supported by quantifiable results. This year, our panel of judges, composed of food quality and safety experts, determined that Kern Meat demonstrated a comprehensive food safety and quality management program that included a robust focus on advanced technology and training.

Founded in 1948 and headquartered in Bridgeton, Mo., the company employs 19 people and is on target to reach \$11.25 million in sales this year, the equivalent of 2.5 million pounds worth of beef, pork, veal, lamb, turkey, and other sundry meat products. After operating in the same building in St. Louis for 64 years, the company moved its processing operations, warehouse, and offices to a location about 25 miles away, a renovated 22,000-square-foot

facility in Bridgeton. It took the company 10 years, looking at 108 buildings, before it found a suitable facility for expansion.

Locating and moving into a new facility proved a challenge during the pandemic, but the larger production area opened up new possibilities for growth as well as food quality and safety improvement, says Matthew Sherman, PhD, who is general manager and HACCP coordinator at the company. His wife's grandfather H. A. Kern, started the company, which was able to keep producing and to retain all of its workers during the pandemic.

And it managed to attain a safety record that he says is "unheard of in our industry," with no positive test for *E. coli* since 2005 and no recall of any product it has produced.

"Our exceptional record, training program, and investment in new technology to reduce foodborne illness has resulted in only one non-compliance record from the USDA since moving to our new facility in September 2020," Dr. Sherman says. "We promote a culture of continuous improvement, and that takes a financial commitment, too. My in-laws and the owners of Kern Meat Company, Dennis and Bettina Markwardt, believed in making such capital investments to achieve an exceptional food safety record." He credits the family ownership for being willing to continue investing in quality and safety at the meat company. *(Continued on p. 28)*





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### Keeping Up Safety During the Pandemic

While the company considered the details of a normal move to a new plant, it also had to accommodate the challenges of the pandemic. The big tipoff on how normal activities might be altered came on March 11, 2020, when the National Basketball Association suspended its season. The pandemic shutdowns soon affected Kern Meat's biggest customers, including sports stadiums, high-end hotels, and assisted living facilities, which canceled orders, forcing Kern Meat to pivot to retail and other markets to sell its perishable products.

Inside the plant, the company stocked up on face masks and sanitizer to keep employees safe. It also realized the supply chain would be backed up, including products from China such as packaging film. The company quickly stocked up on the film and other supplies needed to keep the plant running.

The new building gave the company a broad range of options to address COVID-19 and make significant investments in new food quality and safety technologies to reduce foodborne pathogens, increase shelf life, produce wholesome meat products, and create a healthy work environment. It even invested in two robot vacuum cleaners to sweep the office floors, placing stickers of Rosie the Robot from the Jetsons cartoon on them to make them friendlier for staff. "The pandemic created a very fluid situation, so we could plan for new technologies like ultraviolet lights," Dr. Sherman says. He got the idea to use ultraviolet treatment from an ultraviolet water bottle his wife gifted him at Christmas.

The processing room, dock, warehouse, and employee welfare areas are treated using ultraviolet lights every night for three hours when workers are not on site. The lights deliver lethal 254-nanometer ultraviolet wavelength light that destroys several microorganisms, mold, and other pathogens, including COVID-19, on contact surfaces, on floors, on walls, and in the air. The lights also destroy pests and other living organic matter. The timing on the ultraviolet lights proved fortuitous. The company bought them in January 2020, before they became popular at restaurants and other businesses that installed them in the fall of 2020, driving up demand and prices, he says. "It was a relatively small expense at the time to protect a very valuable investment," he adds.

The company also installed several ultraviolet disinfection systems to continuously sanitize the air during operating hours,

in addition to ionizers in its rooftop HVAC units. As a result, employees have had far fewer colds and sick days, Dr. Sherman says, and none have tested positive for COVID-19.

In addition to the ultraviolet light systems, the company uses a third-party laundry service that is ISO 14001 certified and uses a disinfectant to completely kill *E. coli*, *Listeria*, and other pathogens during laundering.

Kern Meat Company also invested in two handwashing stations for its processing room that Dr. Sherman says delivers a safer and cleaner handwashing solution than traditional soap and water. The stations achieved the same efficacy in 12 seconds as handwashing reached in 20 seconds. The handwashing stations also provided some energy savings. At the former plant, which was five times smaller than the new one, the company consumed about 400 gallons of water per day for employee handwashing; the new stations cut that in half.

The company also bought two airless foamers to cover all contact surfaces, equipment, disassembled equipment, walls, and floors with an alkaline chemical in a wet, clinging foam. And it bought an electrostatic sprayer that helps sanitizer last longer on surfaces to better reduce the risk of pathogen growth.

To verify that its sanitation standard operating procedure plans are reducing pathogen growth, the company regularly measures the levels of adenosine triphosphate using an ATP monitoring system. Dr. Sherman notes that adding all those systems was much easier in a new facility. "I can't imagine retrofitting an older plant," he adds.

### Improving Food Quality

Midwesterners know Kern Meat for its corned beef. Last year, the company bought a corned beef injector that puts a nitrate and nitrite curing solution into the products. Previously, workers hand-stitched and injected the products, which, although it gave them an artisanal look, was inefficient, labor intensive, and potentially hazardous if an incorrect amount of curing solution was injected. The new machine consistently injects the proper amount of curing solution to pickle the corned beef, which Dr. Sherman says is critical for food safety. The machine can also recover unused solution, which is expensive and had previously been wasted as it ran down the drain. And fewer hands touch the meat product, improving both quality and safety.



# We promote a culture of continuous improvement, and that takes a financial commitment.

— Matthew Sherman, PhD

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On the sausage and bratwurst casing line, the company is getting a more consistently sized product using new stuffing, linking, and cutting systems. It also invested in a clipping system that works with the stuffing system to improve the shelf life and quality of its value-added bulk pork and ground beef products. The packaging machine also reduces labor.

The newest investment will be a conveyor line to move the product, ensuring that fewer hands touch the product.

## Food Safety Plan and Training

Kern Meat became USDA-inspected in 1972 after being inspected by the State of Missouri Department of Agriculture from 1948 to 1971. It has a food safety plan on file with USDA and, since 1995, has managed a HACCP and SSOP program with the agency. The plan was established one year before the USDA Food Safety and Inspection Service (FSIS) final rule was released. Kern Meat's program has three parts: a HACCP raw intact plan, a HACCP raw non-intact plan, and a HACCP plan for products like corned beef that contain secondary inhibitors. It also has a food safety defense plan and a recall plan in place with FSIS.

The company made big changes to the plan in 2008 to meet new USDA HACCP requirements. Dr. Sherman said the HACCP and SOP plans fill 10,000 pages and are housed in 15 binders. They include flow charts, temperature logs, control books, sanitation records, and USDA records.

Dr. Sherman and a company foreman give employees hands-on training on how to use equipment safely and cleanly. Employees also learn from manuals. He said that USDA's random sampling program and Kern Meat's third-party testing service have shown that its in-house training program, as part of its food safety program, has led to improved food quality and safety.

The meat company also has an audit program in place that requires suppliers to provide letters of guarantee for all source and packaging materials. The records are updated annually. The program has caught problems: For example, in 2011, a box manufacturer used by Kern Meat printed boxes with the incorrect USDA establishment number. Kern Meat notified the inspector and conducted both an in-house audit and an audit at the box maker. It issued a new procedure to ensure the problem wouldn't happen again.

The company is small, so it is not able to afford an outside firm to audit its food safety program. It had planned to hire an outside

firm in 2020, but the pandemic caused a decrease in business and revenue. Instead, it's focusing on intense training inside the company, daily checklists, and weekly sanitation meetings.

The company says that its investment in quality assurance is showing up in bottom-line financials. It has brought in new contracts in the retail and food-service sectors, including a national corned beef contract signed in 2020 and launched in August 2021. It's also co-packing bratwurst for several Midwest regional retailers.

## Meeting Standards

Sources of meat are screened carefully, especially because it is a perishable product. Kern Meat regularly works with USDA and FSIS to evaluate potential hazards and the company's preventive programs such as cold-chain management and food defense and testing programs to assure that products are wholesome, safe, labeled properly, tested, and traceable.

The veal it supplies is from calves younger than 20 months of age to avoid the risk of meat containing bovine spongiform encephalopathy. The beef is from cattle younger than 30 months of age. It buys beef and veal from a limited number of suppliers that can verify their food safety programs and meet the company's purchase specifications.

The company applies an antimicrobial processing intervention spray to all pinned, cubed, and pounded beef and veal products to eliminate pathogens. Beef used for grinding needs to have a negative *E. coli* certificate. The company also samples ground beef products.

To keep pests away, and apart from the ultraviolet light treatment, Kern Meat employs a third-party pest-control company to catch mice, geckos, and lizards. It also has a 2-foot strip of gravel around the building to discourage rats from nesting.

The company attributes its strong food quality and safety record to the addition and investment of ultraviolet lighting, ionized air, proper air flow in the building, and employee education and training. Dr. Sherman says this leads to safe products for consumers, including demanding chefs and customers.

"Our products have to be right on the plate for our customers every single time, since they are only as good as the last meal they serve," he says. ■

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# Safety & Sanitation



## Culture Club

Carve a pathway to a culture of food safety

BY NEIL COOLE

**F**ood safety culture is a topic that has been discussed within the food, beverage, and retail industry for decades. Books have been written, videos created, surveys developed, position papers published; Global Food Safety Initiative (GFSI) benchmarked standards have incorporated requirements into their clauses and, most recently, regulations have been passed. Most notably, the European Union enacted regulations requiring organizations to “establish, maintain, and provide evidence of an appropriate food safety culture” (Regulation EC 852).

Closer to home, organizations throughout the United States will remember the announcement made by FDA in April 2019 that introduced the New Era of Smarter Food Safety initiative and gave shape to the four key areas of focus—an exciting and innovative approach to food safety that leverages technology and other tools, including core element four, which focuses on a culture of food safety. The New Era of Smarter Food Safety makes this important point: “We will not make dramatic improvements in reducing the burden of foodborne disease without doing more to influence the

beliefs, attitudes and, most importantly, the behaviors of people and the actions of organizations.” Frank Yiannas, FDA’s deputy commissioner, has been a vocal advocate of food safety culture throughout the industry and has been quoted as saying “you can have the best documented standards in the world, but if they’re not consistently put into practice by people, they’re useless.” This is an important reminder on why a culture of food safety is a prerequisite for organizations throughout the food, beverage, and retail industry.

So, how do you develop a culture of food safety in your organization? First, we need to define food safety culture. Second, we’ll unpack some of the common myths and misunderstandings related to the topic of food safety culture that many organizations struggle with. We’ll start by breaking the topic into the two key areas:

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- **Food safety:** The handling, preparation, and storage of food in ways that prevent foodborne illnesses; and
- **Culture:** The shared values, beliefs, and norms that an organization has established, throughout the entire organization, which is strengthened through various methods that shape employee perceptions, behaviors, and understanding.

### Defining Food Safety Culture

The GFSI Technical Working Group defines food safety culture as the “shared values, beliefs, and norms that affect mind-set and behavior toward food safety in, across, and throughout an organization.” The key point of this definition is “... that affect mind-set and behavior toward food safety,” which many organizations describe as the “why” in their food safety management systems. Many have struggled with the purpose behind the requirements, processes, and procedures of their food safety management system, not understanding why they were being asked to follow a specific rule or requirement. They also often have challenges with empowerment, fear, and communication, which, unfortunately, reflect the organization’s existing culture, rather than the culture they are striving for.

The GFSI benchmarked standards that exist today are very clear in articulating the “what” required from a site with regards to food safety culture. For example, BRCGS Food Safety Standard Issue 8 states: “The site’s senior management shall define and maintain a clear plan for the development and continuing improvement of a food safety and quality culture. This shall include the defined activities involving all sections of the site that have an impact on product safety.” In other words, the site’s senior management must understand food safety and know how to define and maintain clearly delineated plans for the development and continuing improvement of food safety and quality culture.

### Common Misconceptions

Despite the need to lean on top management for the planning and development of a food safety culture, many organizations consider that a major challenge; engaging senior management and gaining the support and commitment needed to imple-

ment the necessary programs designed to support positive changes to affect their culture of food safety can be challenging.

Another common misconception facing food safety and quality professionals when addressing the topic of food safety culture is that it’s something that an orga-

A culture of food safety isn’t something that you buy or get; it’s something that you build, then live and breathe every day, from senior management to front line operators, and throughout the entire organization.

nization needs to “get.” The reality is that if an organization is operating in the food industry, and they have people in their organization, then they already have a culture of food safety. The first step on their pathway to a culture of food safety is to identify what level of maturity they are currently operating to, using tools like the Cultivate’s Food Safety Maturity Chart. I was fortunate enough to speak with industry thought leaders on food safety culture during a recent workshop. They explained that a culture of food safety isn’t something that you buy or get; it’s something that you build, then live and breathe every day, from senior management to front line operators, and throughout the entire organization.

Other misunderstandings regarding food safety culture include the perception that a culture of food safety is something that needs to be in place solely to pass an audit, GFSI benchmark, or otherwise; this isn’t the case. In many cases, organizations have gained additional benefits from implementing a food safety culture program, including helping to improve internal communication and gaining greater engagement from employees who are trusted and empowered and celebrate food safety performance on their lines and in their respective areas. Successfully passing a food safety audit is often seen as confirmation of having an effective and

more mature culture of food safety; however, this does not confirm that the organization has bridged the gap between the requirements of the food safety standard and their colleagues’ understanding of the “why” and “how.”

### Commitment to Food Safety

One of the more debated and contentious topics related to a culture of food safety is that it isn’t—or shouldn’t be—seen as a competitive advantage. A culture of food safety could be a competitive advantage for organizations, however, as it would help to demonstrate their commitment to their people, reduce staff attrition, improve efficiencies, and reduce the cost of failure. All of these benefits could be positioned as a competitive advantage, used to positively differentiate themselves from other organizations in the industry by demonstrating to new and existing customers how they empower their people to do more to keep food safe.

Organizations who seek to build a culture of food safety, whose staff are appropriately empowered by a culture of trust, openness, and innovation, and they are both motivated and able to assume ownership of and address risks and issues as they arise, will see the benefits from the bottom line to their reputation and brand. If a senior management team could see a graph that showed how a poor culture of food safety costs the organization an average of 20% in the cost of quality in percentage of sales versus a mature culture of food safety, where the average cost of quality in percentage of sales would be around 2.5%, not considering all of the organizational benefits from an effective culture of food safety, the numbers speak for themselves.

Getting it wrong is an expensive exercise, both financially and from a brand integrity perspective, whereas a positive and effective culture of food safety builds an engaged and resilient framework for food industry organizations. The first step on the pathway to a culture of food safety is to understand your maturity today, and then build your food safety culture team—the same approach as if you were going to develop a HACCP plan: You assemble your team first. ■

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# Testing

BEVERAGES



## FT-IR Spectroscopy for Winemakers

This testing method can help secure detailed, data-driven information about a finished product, helping winemakers create a competitive advantage with consumers

BY JACKIE TRUDELL

**T**oday's winemakers, like other food and beverage producers, are working in unusual and changing times. Paradigms have shifted in the COVID-19 era, where booming online selling channels and the limited availability of raw materials is prompting winemakers to adapt their business models to the realities of fast-changing consumer demands.

In several regions, including North and South America, China, and parts of Eastern Europe, unfavorable weather patterns and natural disasters have either limited grape harvests or changed the characteristics of

the grapes, placing increasing importance on the testing of grapes and other raw materials. Further, the pandemic has spurred a major shift in consumer behavior toward online buying channels as restaurants temporarily closed to prevent the spread of the virus. Given large selections online versus what is available in most standard brick-and-mortar establishments, consumers are also exerting more buying power and demanding more transparency and quality.

To remain competitive, many wineries are starting to leverage more advanced analytical testing to supplement traditional

sensory evaluations and basic testing, helping to ensure product consistency and reduce losses tied to poor product and raw material quality. They also aim to use the collected data as a competitive advantage. Although testing has played an important role at large wineries for decades, many small to mid-sized wineries, often citing budgetary concerns or gaps in technical proficiency, have not yet embraced the potential that analytical testing offers. Recent advances in Fourier transform infrared (FT-IR) spectroscopy instrumentation can help address these challenges, not only by drastically reducing the complexity of testing procedures, but also by reducing the upfront investment required to purchase instrumentation, making advanced yet easy-to-use testing more attainable to wineries of any size.

### FT-IR Spectroscopy for Winemakers

FT-IR instrumentation uses spectroscopic imaging to essentially map, or “fingerprint,” a sample by creating an infrared spectrum of the absorption or emission

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of components in the sample across a number of wavelengths. Spectral images, such as those shown in Figure 1 (below), are then compared to a library of known components to both identify and quantify compounds in the sample. Modern FT-IR instruments can produce results in less than a minute and are small enough to transport in the trunk of a small sedan, allowing for agility and portability throughout the winemaking process.

The benefits of onsite FT-IR testing are numerous and include fast results, ease of use, and a low cost of operation, allowing winemakers to monitor their process by measuring critical parameters throughout vinification, thus enabling more comprehensive process control. This provides a more beneficial approach than conducting single data-point measurement, as it helps to ensure full process and input control and avoids product loss if processes fall out of specification before or after isolated test points. As such, it is recommended that testing occur throughout the winemaking process, including the analysis of grapes at intake, must under fermentation, and the finished product after fermentation.

### Grape and Must Testing

Testing grapes throughout the growing process and at harvest using an FT-IR ensures product soundness, optimal grape maturity, and fair pricing. Deciding when to harvest grapes has often been more of an art, with harvesters and wineries relying on decades of experience, skill, and a “gut feel.” Supplementing this human

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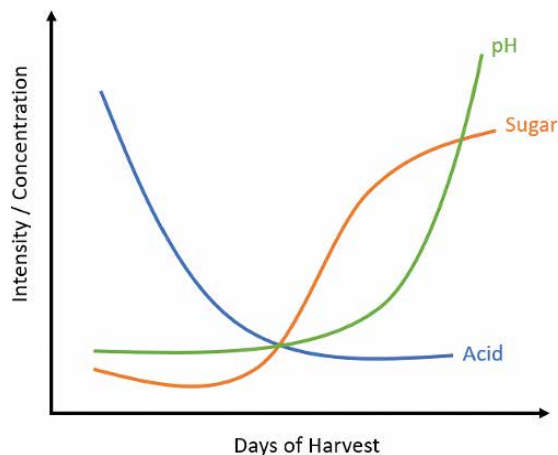


Figure 2. Conceptual model of acid, pH, and sugar content in grapes during the harvest season.

knowledge with actionable data enables an optimal blend of experience and science. Striking the correct balance between phenolic and physiological maturity is key and, taking into account the potential impacts of unfavorable climate changes, the importance of testing grapes to determine harvest dates has become increasingly important.

Three of the most common factors in the determination of optimal grape ripeness for harvest are sugar content, pH, and acidity. As grapes mature on the vine, sugar content and pH increase, while acidity decreases, as shown in Figure 2 (above). Sugar content is measured to ensure that there is enough sugar in the grape to be converted into alcohol during vinification. Sugar content can be determined by a measurement of fermentable sugars glucose and fructose, or by calculating the total soluble solids (°Brix). Monitoring the

pH and acidity of grapes and must provides insights into the potential microbial stability of the ingredients throughout fermentation and allows for the planning of acidity corrections.

### Must Under Fermentation Testing

Once grape must enters the fermentation process, yeasts take center stage. Although winemakers may have less control of the process during this stage, testing during fermentation is crucial. Yeasts play a major role in winemaking, as they consume sugars and nitrogen in grape must and juice, subsequently producing ethanol and carbon dioxide.

Like the parameters analyzed at harvest, pH, sugar, and acidity levels should also be tested in must undergoing fermentation to monitor the progress of the yeast. Monitoring sugars during fermentation will provide insights on how much longer the must needs to ferment to achieve the ideal sweetness and alcohol content. Finished wines with an intended sweeter taste will have some residual sugar after initial fermentation, while dry white wines will have few or no sugars remaining after fermentation. Conversely, as sugar content declines, ethanol content will increase.

Closely monitoring pH during fermentation is important, as it correlates with the level of sour taste in wine: The lower the pH, the sourer a wine tastes. Further, pH can affect the appearance and stability of wine, with higher pH wines more susceptible to oxidation. Measuring specific acids, such as malic acid, an organic acid that produces a tart taste in wine, can

(Continued on p. 43)

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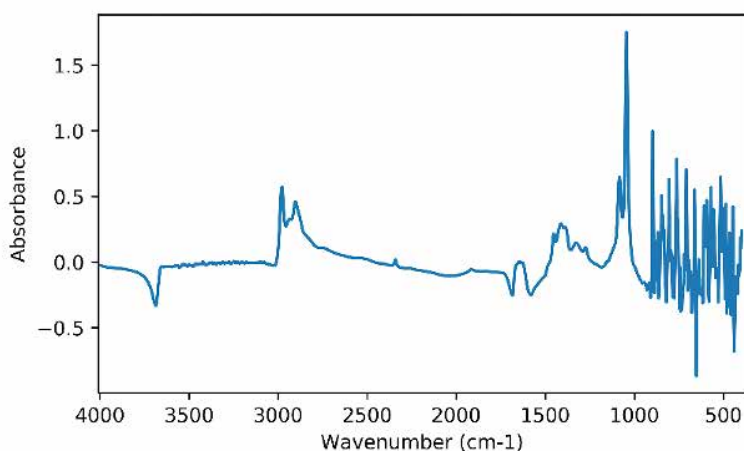


Figure 1. Spectrum of a wine sample generated with an FT-IR instrument.



# The Importance of Analytical Testing in Winemaking

Regular testing during production can boost wine quality and consistency | BY RICKI HARTWELL

**F**or thousands of years, vintners have harnessed a complex system of living organisms and biochemical processes to make wine. While the beverage has evolved over time and styles have diversified, the fundamental process of making a wine has stayed the same: Yeast ferment the sugar in grape juice, transforming it into ethanol, carbon dioxide, and heat.

The art of winemaking lies in knowing how to use different grape varieties, yeast strains, and production steps to create distinctive styles that are recognized for their aroma, taste, and appearance. Those traits, however, result from complex interactions among the growing conditions of grapes, their biochemical makeup at harvest, the reactions that occur during fermentation, and the biochemical development of must, juice, and wine during processing. Any imbalances in these interactions during production—from vine to glass—can alter the outcome and decrease the quality and palatability of a wine.

The wine market is highly competitive, and brand loyalty hinges on creating distinctive and enjoyable experiences again and again. Therefore, a winery's success comes from deftly orchestrating vinifi-

cation to preclude imbalances. Ensuring customer satisfaction and building brand equity means making timely decisions that steer winemaking toward the exact experience a vintner aims to create.

## Data Enables Time-Critical Decisions in Winemaking

When it comes to creating premium wines, there is no substitute for the experience and knowledge of a vintner. But complementing that expertise with a precise characterization of the biochemical changes occurring in a batch better informs decisions to optimize production, ultimately boosting wine quality and selling price. Analytical testing at all production stages is the key to such data-driven decisions. Sensitive, easy-to-use analyzers allow the vintner to monitor the material composition and conditions of biochemical reactions and identify when and how best to intervene. Imbalances can be anticipated and corrective action can be tailored to reestablish ideal conditions in a timely manner.

Analysis is crucial from the beginning of the winemaking process, even while grapes are still on the vine. A refractometer can be used to measure grape sugar

content and thus determine the best harvest time. Sugar and organic acid content should also be measured in grapes brought in from external sources, as these parameters typically vary with growing conditions (e.g., temperature, soil type, rainfall). Different wine types and varieties build on different acid-to-sugar ratios, and a suboptimal biochemical starting point can lead to a stuck fermentation that falls short of reaching the necessary final gravity.

Dedicated electrodes can be used to accurately measure the pH, organic acids, and nitrogen content of must. The results can better guide the use of additives to promote fermentation and control pH, while preventing an imbalance in acidity that can derail the flavor, color, and microbial stability of the wine. Sulfur dioxide, which is used as an antioxidant and inhibitor of microbial activity, can be monitored to prevent an excess that dulls fermentation and lowers wine quality. Finally, hand-held devices can measure liquid turbidity and dissolved oxygen in barrels and bottles to ensure desired clarity and prevent excessive oxidation that discolors and degrades wine flavor.

Analytical needs vary from one winery to another. Therefore, the first step toward establishing a cost-effective analysis infrastructure is to systematically evaluate the type and frequency of testing that best serves production procedures.

## Design an Analytical Testing Plan

A range of advanced, easy-to-use, and highly reliable analytical instruments make measuring critical winemaking

parameters straightforward. Designed to withstand the wear and tear of a manufacturing floor, these analyzers enable testing of a few to several hundred samples, either in a lab or directly at vines, vats, or barrels. The choice of instrument depends on three factors: the number of bottles produced at a winery, the frequency of measurements needed throughout the production process, and the vicinity of an accredited food analysis and safety lab. The latter point is important; waiting for results to return from an offsite lab can be the difference between a successful batch and one that is downgraded or lost. At a minimum, a wine producer should consider quantifying the parameters listed in Table 1 (see p. 36) on site, because changes usually require quick corrective action.

A good starting point is to design an analytical testing plan that maps the points in manufacturing where data is important to inform next steps. The plan should outline the type and frequency of measurements to be made at each point and actions to be taken based on results. As a whole, the plan dictates the number of samples to be analyzed daily, the variety of analyses needed, and the ideal timing for corrective action. That information helps decide which samples can be shipped to offsite labs and which instruments are needed on site.

Laying out a well-planned testing strategy with guidelines for subsequent actions is the foundation of a cost-effective and smart quality control infrastructure, and it simply makes good business sense.

### In-Process Analytical Testing

A robust analytical testing strategy to monitor production is the cornerstone of any good wine business. The core objective of the monitoring is to minimize variability in parameters that impact the traits of a wine, keeping them in the narrow range characteristic of a particular wine style. The benefits of this in-process monitoring, however, go far beyond just “keeping chemistry in check.” End-to-end analytical testing supports compliance with quality and safety standards, maintains a robust and efficient production, and builds brand reputation through consistently high-quality and enjoyable wines (Figure 1, below).

**Compliant quality and safety.** Global, national, and local regulatory bodies in the wine industry dictate procedures that are and aren’t allowed in vinification. For example, European Union legislation permits the addition of lysozyme for fining, but it must not exceed 500 mg/L. Other regulations stipulate that certain compo-

nents in wine be published on labels, such as sulfite residues exceeding 10 mg/L and percentage alcohol content. By continuously tracking the biochemistry of a wine under production, a vintner can optimize the use of additives and processing aids and ensure that the final product aligns with regulations. Furthermore, the data collected serve as an audit to trace problems to their origin, a survey of overall production constancy over time, and a tool to predict product quality.

**Robust, efficient, scalable production.** Commercially viable wines must achieve healthy profit margins in a highly competitive market. Even the best-tasting wine cannot succeed in today’s market without the manufacturing scale and reproducibility to secure supply. Scaling up production to a commercially meaningful volume while preserving the defining qualities of a wine—sweetness, acidity, tannin levels, flavor, and body—is challenging and may require adjustments and rethinking. Critical parameters measured along the way, from vine to glass, are benchmarks for the scale-up process, helping to ensure that buildout of each manufacturing step leaves intact the biochemistry that achieves stylistic and quality goals. With the data collected, every optimization decision begins with a known biochemical profile for the wine. As adjustments are made over time, that profile becomes a unique biochemical signature of the wine, guiding production.

**Continuity of brand.** The brand of a company is a promise to customers about what they can expect from products and services. In the case of a winery, that promise is kept by delivering on expectations of the aroma, taste, and appearance of its wines. Those precise traits are repeatedly and consistently created through the meticulous control of production processes, so it stands to reason that any investment in facilitating that control—creating an analytical testing strategy and acquiring the necessary equipment—is an investment in brand. Analytical testing renders each production step transparent, and the insights obtained allow a vintner to better craft established and new wines. In short, a unique wine may be an asset to a winery, but a memorable wine that is enjoyed year after year is brand equity.



Monitoring key parameters during winemaking is indispensable to consistently producing memorable, quality wines.

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Table 1. Routine analytical testing throughout wine making.

	Sugar	pH	Titratable acidity	Ammonia nitrogen	Sulfur dioxide	Turbidity	Dissolved Oxygen	Benefits
<b>Prefermentation</b>	✓	✓	✓	✓				Regular measurement of sugar in grapes determines the best harvest time. Organic acids in the grape can impact pH, which, conversely, can lead to growth of spoilage organisms and can influence taste and color of wine. Yeast assimilable nitrogen fosters fermentation.
<b>Fermentation (incl. maceration)</b>		✓		✓	✓			Nitrogen nutrients are consumed, and pH can change. Left unattended, the changes can halt fermentation. Sulfur dioxide may be added to inhibit native yeast.
<b>Clarification</b>						✓		The turbidity of wine is a measure of microbial stability. Careful monitoring during the clarification process ensures removal of unwanted particles.
<b>Racking</b>		✓	✓		✓	✓	✓	Sulfur dioxide may be added to suppress bacteria in wine. Oxygen is measured to prevent excess exposure that can destroy flavor. The overall balance of other parameters is also monitored in preparation for aging.
<b>Aging</b>		✓	✓		✓		✓	Levels of pH and sulfur dioxide are adjusted to maintain microbial stability throughout the aging process, while sulfur dioxide can also provide protection against oxidation from excessive oxygen exposure in barrels. The acidity of the wine is checked regularly to balance taste.
<b>Bottling and further aging</b>		✓	✓		✓	✓	✓	After sterile filtering, parameters are checked before bottling to ensure they are within specification. Turbidity is measured to ensure clear wine without haze.
<b>Available quantitative analysis methods</b>	Refractometer	pH meter	Manual or automated titration	Selective electrode or spectrophotometry	Manual or automated titration; photometry; chromatography	Turbidity meter	Oxygen sensor	

**Always on Track to Meet Stylistic and Quality Goals**

The long-term success of every business centers on giving customers a reason to return. In the wine industry, that means creating memorable and repeatable experiences through exceptional product quality, quality that not only meets food safety, regulatory, and import/export requirements, but also guarantees the flavor,

aroma, color, and clarity traits that define a brand.

With a burgeoning global wine market and unprecedented choice for customers, the competition is intense. Successful wineries make every batch count. Successful wineries know in real time how grapes evolve into wine and steer the process to meet stylistic and quality goals for each blend and varietal. Additionally, success-

ful wineries intervene at critical points to prevent that transformation from derailing. With advanced analytical tools to monitor winemaking, quality control becomes the gateway to higher-quality products, delighted customers, and stronger market positioning. ■

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# Manufacturing & Distribution

TEMPERATURE AND HUMIDITY



Gummies can easily be affected by a 1% to 2% change in moisture. Having the proper air conditioning, dehumidifiers and dryers will help avoid a messy situation.

as particle separation. Hygroscopic powders absorb water from humidity in the air, which increases the cohesion and decreases the ability to flow. If a material were to expand when introduced to humidity, the particles could form together as they expand. Powdered materials that clump together as the humidity rises will end up halting production at some point due to their moisture level and inability to be properly processed. The challenges that are faced when processing materials in different parts of the country or in environments that experience multiple seasonal changes must be considered for proper processing techniques.

Aside from the inconvenience of lost product or decreased revenue due to incorrect humidity levels, there are serious implications to keep in mind. When an increased level of moisture is present, there is the risk of microorganism growth even in areas that are usually clean. Airborne bacteria can grow without the proper airflow, which is then passed along to the food. Suddenly, there is a much larger problem than an inconsistent product. Humidity that is too high or too low can also foster mold or bacteria growth, leading to decreased shelf life.

## The Impacts of High and Low Humidity

As humidity levels fluctuate, product will become more difficult to transfer or convey because it is absorbing moisture, weighing more, and becoming stickier. Over time, conveying lines will start to clump and cake up, decreasing the pneumatic rate and slowly clogging the line. Aside from lower efficiency, sanitary concerns begin to rise when lines are clogged. When humidity levels are not balanced, plant maintenance teams will need to

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## Humidity Control in the Food and Beverage Industry

Even the slightest humidity fluctuation can require procedural changes

BY KELLY FROELICH AND KEVIN LAUD

**W**eather and humidity are factors that we deal with daily, whether inside or outside. Quality issues within food and beverage products can be traced back to inconsistencies in humidity levels, and even the slightest humidity fluctuation can require procedural changes. Hygroscopic substances absorb moisture, and a small change in humidity will impact the consistency of the product, including during the material separation phase.

This article will evaluate the importance of regulating humidity, the impacts of high and low humidity, best practices for controlling storage conditions, and recommended equipment to control humidity. Examples will highlight the con-

fectionery industry, where high sugar content in these sweet treats accelerates the products' sensitivity to humidity fluctuations.

### Importance of Regulating Humidity

Humidity is not present in only one industry; it affects all processing industries. It's important to recognize where humidity is present and rectify the situation quickly. Maintaining control over humidity is necessary to ensure that a consistent, high-quality product is produced, that performance is optimal for manufacturing processes, and that a product is stored correctly when it is ready to be consumed.

The issue of various humidity levels can play a role at any stage, even as early



# CONTINUOUS TEMPERATURE MONITORING

HACCP  
COMPLIANCE

## RFOT

### Wireless Meat Temperature Data Logger

An industry standard for meat processors, the RFOT wireless meat temperature data logger is a simple streamlined solution for continuous process monitoring. The RFOT is available in various probe lengths to adapt to the product size, ensuring precision measurements, every time.

The RFOT is perfectly suited for smokehouses, ovens, and other cooking processes up to 100 °C (212 °F), as well as refrigerators and freezers down to -20 °C (-4 °F). It is completely splash resistant and can withstand wash down cycles.



Cooking



Cooling



Shipping



Storage



Scan the code for more information on the RFOT wireless meat temperature data logger!

MadgeTech data loggers are designed, manufactured and serviced in the USA and distributed worldwide.



(Continued from p. 38)

service the lines more frequently, causing downtime in the systems.

Knowing this, effective process systems that battle humidity will be equipped with a dryer or desiccant dryer that will help to dry the product properly. Other process systems will be integrated with delumping or declumping devices, which will combat the clumping and prevent clogs. In mechanical or pneumatic transfer systems, knowing and understanding the humidity level is key to ensuring a consistent rate of transfer.

In the confectionery industry specifically, inconsistent humidity levels lead to many product issues, most of which are visible to the naked eye. Candy is typically made of sucrose and corn syrup, both of which are highly hygroscopic. Effects of high humidity on confections include a cloudy appearance, grainy and irregular coatings, and sugar blooms. Products may experience sticky, runny, or high-water content in the product, as the product cannot cool properly. These issues may result in lower shelf life and the cost of returned or spoiled products from consumers. Confectionery products experiencing lower humidity will be more fragile; product may crack as it dries too quickly. Dry material is also more abrasive, causing the equipment to wear at an increased rate. Appearance of product is very important for confectionery products, so high or low humidity levels strongly affect the “shelf appeal” of these products.

### Best Practices for Controlling Storage Conditions

Aside from having the proper process in place to combat humidity challenges, establishing best practices for controlling storage conditions will also benefit the product. If certain storage containers are introduced to the wrong level of humidity, they may begin to deform, separate, or break. Paper packaging will become soggy, and metal packaging can begin to corrode. Packaging is designed to protect the food or beverage product, so alterations to the packaging due to humidity could affect the safety of the product inside.

Recommendations for candy storage suggest 40% relative humidity (rh), with dry air, sometimes with the help of an air conditioner unit. Panned confectionery

products should have storage conditions at 40% to 50% rh. The rh value is important to avoid sticking or cracking of the product. An ideal manufacturing environment will take into consideration where the ingredients are stored before the process and where the product is stored before shipping to its final destination.

When an increased level of moisture is present, there is the risk of microorganism growth even in areas that are usually clean.

### Recommended Equipment to Control Humidity

Identifying and utilizing the proper equipment throughout a system is crucial when controlling humidity. For products that are engrossed in chocolate or yogurt, an enclosed belt coater is a reliable way to uniformly coat product while avoiding moisture build-up. Automated belt coaters can alleviate the moisture that could be introduced in a process like hand coating products.

Spray dryers can produce a dry powder from liquids/slurries, as the product is quickly dried with a hot gas. Heat-sensitive and heat-resistant foods benefit from this process. The final product is improved as the stickiness decreases. Spray dryers are fully automated and continuous, which allows for higher output.

For confectionery products, a cooling tunnel ensures that products passing through are in a controlled environment. Cooling tunnels can offer batch or continuous processes, and a slow drying of the product provides efficient and reliable cooling. Cooling tunnels can be equipped with a cold air diffuser at the top of the tunnel with a separate return air elsewhere. Insulated doors and sides help keep outside environmental factors away from the product.

Gummy products are also very specific when it comes to their environment. Although an automated depositor is ideal for gummy depositing, the production

environment plays a large role that the machine cannot account for. While being deposited, the gummies must cool and gel for a dedicated amount of time to achieve the proper moisture content. Many gummy edibles today rely on “starchless” technology, meaning that they are deposited into flexible silicone molds, and then cool and gel before being removed from the molds and finished with an oil or a sugary coating.

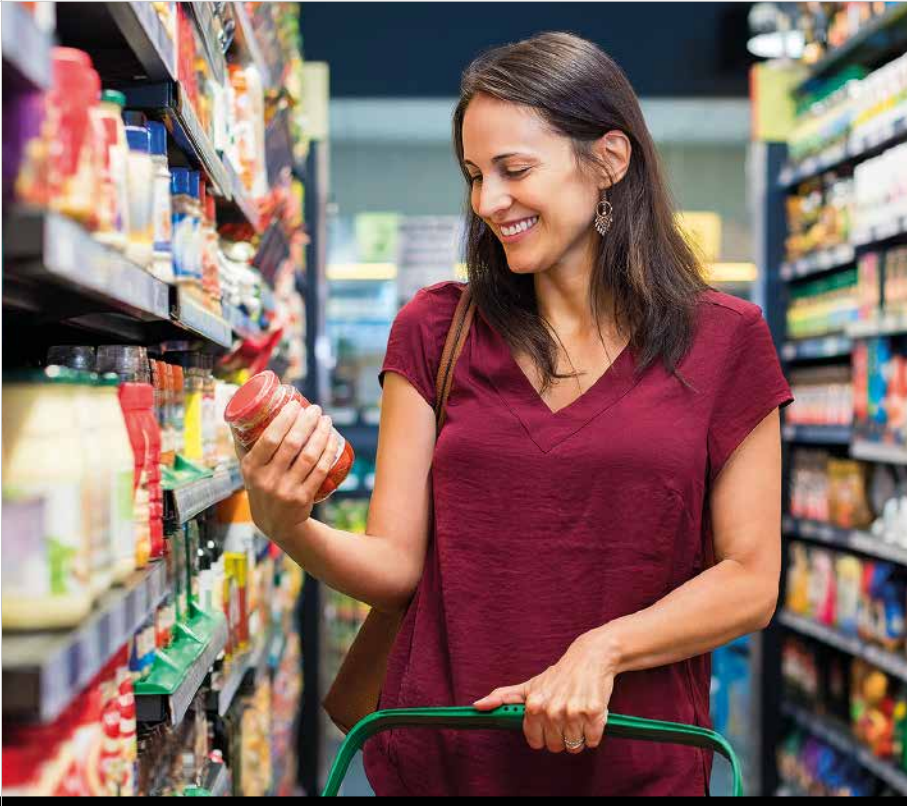
Due to this process, gummies can easily be affected by a 1% to 2% change in moisture. If the gummies sit out too long, they can turn hard or crusty. If they are pulled from the mold too quickly, they will be slimy and sticky. Having the proper air conditioning, dehumidifiers, dryers, and more will avoid a messy situation. In the end, it is not only about the processing equipment but also the equipment throughout the whole production space that plays a role in producing the end product.

All of the above equipment must consider how moisture is present within the mass it is processing. For instance, large pieces sent quickly through a dry atmosphere will only leave the outside surface dry, while the center still retains high moisture. Residence times must be accurately controlled such that internal moisture can transfer within the particles themselves.

Although the original humidity level is out of the manufacturers’ control, controlled environments and processes can be created for specific products and industries. Evaluating the products’ characteristics and reactions to humidity and weather will be important indicators for what a final process should consist of. What might be the perfect dry air for one product could be a nightmare for the next. By combining the right process with the right equipment and environment, products will benefit, realizing repeatable results, less downtime, and higher efficiency. Thinking through the ingredients, processing, and storage side of the situation will allow products to succeed. ■

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# Enterprise Labeling

How an enterprise-wide approach to labeling can help you meet changing regulations in the food and beverage sector

BY MAGGIE ALLEN

**E**volving allergen guidelines, pushes to enact the Food Labeling Modernization Act (FLMA), and many other new regulations may aid consumers, but they're also placing increased pressure on food and beverage manufacturers, distributors, and their supply chains. In this environment, many organizations are finding they must modernize their labeling processes quickly to future-proof their operations.

The key to success is dynamically adapting to changing regulations while simultaneously streamlining operations, and this will only become more critical in the coming years. But, far too many organizations are held back by issues such as a lack of consistent label templates, human error from manual data entry, or fragmented and siloed systems and facilities.

Taking an enterprise-wide labeling approach, often referred to as enterprise labeling, that properly leverages data, standardizes operations, and enables automation is critical, not only for improving traceability and food safety today, but also for propelling supply chains and businesses into the future. Here are a few crucial challenges and best practices to consider when modernizing your labeling operations.

## What Is Enterprise Labeling?

The days of different production facilities and distribution centers managing labels in isolation, with manually inputted data, varying software applications, and constantly changing ad-hoc solutions, are being rapidly phased out. Instead, many companies operating domestically and globally today are adopting an enterprise labeling approach.

Enterprise labeling involves standardizing and integrating labeling with business processes and across business lines and geographies, as well as housing labeling on a scalable, centralized platform equipped with the latest capabilities.

For instance, with enterprise labeling, labeling can be easily integrated with an organization's other applications, such as its enterprise resource planning (ERP), manufacturing execution (MES), or product lifecycle management (PLM) systems. One centralized platform can also ensure that everyone can access the same label data and that it's tracked consistently.

Additionally, with one labeling platform plugged into an entire enterprise's processes and sources of truth, organizations can implement automation, advanced logic, and other tools to improve quality and save time.

## Key Regulations

In a trend that will likely continue for the foreseeable future, recent regulatory changes in the United States, the European Union, and the United Kingdom have all bolstered standards around allergens and food safety. For example, the U.S. government has recently been seeking to approve new requirements for front-of-package labels with the FLMA, which will help improve nutrition labeling, enforce clearer listings of ingredients, and address e-commerce and online shopping labels.

Though new regulations will surely change labeling in the future, there are several prominent regulatory requirements every food and beverage company should be aware of today:

- **FDA Nutrition Fact Labels and the Food Safety Modernization Act (FSMA):** FSMA brought major changes to the entire food supply chain, with traceability being a key requirement. For example, companies must provide full transparency into how products are made and where they are located as they travel through the supply chain, a process that must be mapped out on food labels. Also of note, nutrition labels must adhere to many regulations designed to give consumers the information they need to make safer, more informed consumption

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(Continued from p. 41)

decisions. FDA also issued new nutrition fact label regulations in 2020 and 2021 (the final date for compliance is Jan. 1, 2024). Key changes from these updates pertain to label font sizes and contents to better communicate nutrition information.

- **Allergen labeling:** Natasha’s Law requires U.K. food companies to provide full ingredient lists and allergen labeling on all foods that are “prepackaged for direct sale.” This legislation, which went into effect in October 2021, will have a large impact on food prepared onsite. Similarly, in the U.S., allergen labeling regulations are continually changing. For instance, the Faster Act labeling regulations recently recognized sesame as a major food allergen of concern, and the legislation states that the allergen must be clearly labeled. Failing to meet these regulations not only endangers consumers, but also leads to hefty non-compliance penalties.
- **Mexico’s NOM-051-SCFI/SSA1-2010:** In March 2020, Mexico amended NOM-051-SCFI/SSA1-2010 to include front-of-pack warning labels for foods and beverages high in sugar, energy, trans fat, saturated fat, and sodium. Now enforced, the law applies to all prepackaged foods and impacts non-alcoholic beverages as well. The law also addresses specific labeling requirements for food supplements, which must now include information such as mandatory warnings, nutrition declarations, and expiry dates.
- **EU Regulation 1169/2011:** In place since 2011, this law gives the 28 EU member states common legislation regulating food labeling information and sets a standard format for nutrition and food labeling to provide information to the public. It applies to all food manufacturers producing or selling within the territories of EU member states and also includes food products supplied to or delivered by mass caterers. To be compliant, labels must be legible, use a minimum font size, and include both allergen and mandatory nutrition information.

These are just a few of many global food regulations that food and beverage

companies must comply with. Those who take an enterprise labeling approach to labeling now will be better equipped to meet these rules and new ones enacted in the future.

**Enterprise labeling involves standardizing and integrating labeling with business processes and across business lines and geographies, as well as housing labeling on a scalable, centralized platform equipped with the latest capabilities.**

#### How Enterprise Labeling Can Help

Here are a few ways enterprise labeling can help companies not only achieve regulatory compliance, but also improve labeling overall:

- **Integrate labeling to create a single source of truth:** Errors and delays commonly occur when organizations must maintain many different labeling solutions that have no connectivity to ensure key data is accurate. By addressing labeling on the enterprise-wide level and integrating it with other applications, organizations can ensure a single source of truth for label data. This ensures that label data is consistent and reliable, which improves traceability and helps prevent or mitigate costly recalls.
- **Centralize labeling to simplify updates and prevent mistakes:** Regulations mean label updates. Without a standardized enterprise labeling system, updates are often made in isolation, creating the burden and risk of potentially managing thousands of separate, distinctive templates for each change. Once labeling is integrated with other business processes, updates based on regulations can be made in one place, which will serve as a reliable source of truth and immediately impact labels across the enterprise. Additionally, by central-

ing label management, organizations can gain access to easy-to-follow audit trails, with a searchable detailed record, showing where and by whom a label was created, changed, and printed. Some systems can even apply data-driven business logic and enable automated updates by business users without IT assistance. This can shorten lengthy label approval and design cycles that may require custom coding or involvement with many stakeholders.

- **Implement tools for easy expansion or extension:** Agile scalability can be crucial when keeping up with labeling regulations. One of the easiest ways to scale is to use a cloud-based solution. Using the cloud, organizations can quickly add new users and remote locations without worrying about additional licenses, services, or equipment. The cloud can also quickly connect new sites with an enterprise’s corporate look and product and client information and can enable remote printing capabilities. Cloud-based solutions can also readily extend compliant, controlled labeling to third parties for remote collaboration. This ensures that suppliers and co-packers can access the information needed in the format required to eliminate re-labeling and help speed production.

#### Enabling Next-Generation Label Management

Enterprise labeling can enable companies to unify operations and master labeling with automation and advanced logic. Unlocking these new capabilities can help achieve compliance and so much more by making it effortless to update labels, barcodes, formats, languages, logos, content, and any critical product information or warnings to meet global and regional requirements.

With so many current and upcoming regulations to contend with, organizations that don’t modernize their labeling may be left scratching their heads, as continuous errors pile up alongside unused inventory, lost revenue, or—worse—a health crisis stemming from mislabeling. ■

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## FT-IR Spectroscopy for Winemakers *(Continued from p. 33)*

also aid in monitoring progress toward the desired taste profile of the finished product. During vinification, malolactic fermentation (MLF) converts malic acid to lactic acid, producing a creamy, buttery texture in the wine. Too much acid reduction during MLF can result in a higher pH, leading to the aforementioned chance of oxidation and subsequent spoilage. Using onsite FT-IR testing allows winemakers to monitor pH, total acidity, and individual acids in one analysis, without slowing down the process.

Outside of the winemaking process, this taste profile information can help winemakers who are using online selling channels improve the customer experience. Providing detailed and accurate product descriptions both informs and entices potential buyers and can create a competitive advantage with customers who want more information about the products they buy online.

### Testing at Blending and Bottling

Testing at the blending and bottling stage, often one of the most common analysis

points, provides valuable insights to ensure the finished product meets quality control guidelines and standards. At bottling, it is important to measure the amount of residual sugar left in the wine, as too much sugar could lead to further, unwanted fermentation. The acidity and pH should be stable, with no malic acid present, as it may lead to spoilage during ageing. Testing at bottling also allows winemakers to ensure that their product offers a consistent taste profile and experience for customers.

Measuring ethanol content is vitally important at bottling to ensure accurate labeling and adherence to government agency regulations, such as those developed by the Alcohol and Tobacco Tax and Trade Bureau. Outside of regulatory requirements, securing more detailed, data-driven information about a finished product can also help winemakers create a competitive advantage with consumers, such as millennials, who are demanding more information about the products they consume. According to a 2021 State of the U.S. Wine Industry Report, millennial buyers are the largest growing segment of the

wine industry, and they demand transparency as it relates to labeling and processes. As such, offering detailed, science-based information in marketing efforts and outreach can help winemakers provide the information many customers consider when comparing products.

### An Investment in Quality

Analytical equipment, such as FT-IR instrumentation, that is used to inform decision making throughout vinification is a sound investment for wineries of all sizes. Although the trends influencing the market may change in coming years, the need for data-driven decisions and a focus on quality raw materials and finished products will always be paramount. Making the decision to further invest in a more robust quality and process control program that includes testing at all stages of winemaking will not only safeguard against costly quality lapses but can also lead to improved margins and revenue. ■

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# NEW PRODUCTS



## In-Line Capper System

NJM, a ProMach product brand, has introduced the Beltorque BT-ICL Lite Capper. The system caps up to 150 bottles per minute. This in-line solution handles a wide range of bottle shapes and sizes, as well as a variety of closure types, with mechanics that speed changeover and reduce maintenance. It handles round, oval, square and rectangular bottles made of plastic or glass from 2 to 12 inches (51 to 305 mm) in height and from 0.5 to 8 inches (13 to 203 mm) in diameter. It can apply flip-top, screw and snap caps made of plastic or metal in sizes up to 4.75 inches (121 mm). The system is designed for fast, easy, and accurate changeovers that are achieved in 15 minutes or less with no tools or fine tuning required. **NJM, njmpackaging.com, promachbuilt.com.**

## Chemical Solutions for Poultry Processing Facilities

Birko has announced a new line of poultry processing solutions, including anti-foams, antimicrobials, sanitizers, detergents, and disinfectants. The line includes multiple products such as poultry scalds, rail and shackle lubricants, cleaning and sanitation chemistry, and antimicrobials

that comply with USDA (FSIS) standards and reduce cross-contamination between processing areas. To comply with green-friendly cleaning and sanitation, the products do not contain ammonia, chlorinated solvents, heavy metals, or butyl solvents. **Birko, birkoCorp.com.**



## Metal Detection System Series

Mettler-Toledo Product Inspection has a series of metal detection systems designed specifically for small and medium-size manufacturers and/or co-packers. The modular design of the M30 R-Series systems can be adapted over time in line with evolving compliance and productivity needs. The metal detector and conveyor can be easily upgraded as compliance or production requirements change. The system includes a full-color touchscreen and a choice of 33 languages as standard. The systems offer three levels of ingress protection from IP65 to IP69K to support long-term performance in a wide range of manufacturing environments. **Mettler-Toledo, mt.com/md-m30-rseries-pr.**



## X-Ray Inspection System

Minebea Intec presents two new products in the field of horizontal X-ray inspection. Both the Dymond DSV and the Monoblock offer quality control options for the food and beverage industry by detecting foreign objects such as glass, stones, metal foil, or plastic parts. The Dymond DSV offers multi-sided radiography of the products with a single X-ray source. The device is manufactured according to the specifications of the hygienic design. The Dymond D Monoblock option for the X-ray inspection solution Dymond D eliminates the need for active water cooling. The high sensitivity of its image processors means it is able to detect even those foreign objects that are positioned vertically or lay hidden at the edge or at the bottom of the container. **Minebea Intec, minebea-intec.com.**



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## Events

### JANUARY 2022

**18-19**  
**International Conference on Food Microbiology and Food Safety**  
 Los Angeles, Calif.  
 Visit [theirs.org](http://theirs.org).

**23-26**  
**Dairy Forum 2022**  
 Palm Desert, Calif.  
 Visit [ifda.org/events](http://ifda.org/events).

**25-27**  
**International Production & Processing Expo (IPPE)**  
 Atlanta, Ga.  
 Visit [ippexpo.org](http://ippexpo.org).

### FEBRUARY 2022

**15-16**  
**Food Processing Expo**  
 Sacramento, Calif.  
 Visit [foodprocessingexpo.org](http://foodprocessingexpo.org).

### MARCH 2022

**5-9**  
**Pittcon**  
 Atlanta, Ga.  
 Visit [pittcon.org](http://pittcon.org).

**9-10**  
**International Conference on Food Safety and Hygiene**  
 Edinburgh, Scotland  
 Visit [foodsafety-hygiene.alliedacademies.com](http://foodsafety-hygiene.alliedacademies.com).

**29-30**  
**Ice Cream Technology Conference**  
 Bonita Springs, Fla.  
 Visit [ifda.org/events](http://ifda.org/events).

### MAY 2022

**4-6**  
**European Symposium on Food Safety**  
 Munich, Germany  
 Visit [foodprotection.org/europeansymposium](http://foodprotection.org/europeansymposium).

**9-12**  
**Food Safety Summit**  
 Rosemont, Ill.  
 Visit [food-safety.com/food-safety-summit](http://food-safety.com/food-safety-summit).

**18-19**  
**DairyTech Conference**  
 Austin, Texas  
 Visit [ifda.org/events](http://ifda.org/events).

### JUNE 2022

**6-7**  
**Mexico Association for Food Protection Annual Meeting**  
 Virtual Event  
 Visit [amepal.com](http://amepal.com).

**9-10**  
**Turkish Food Safety Congress**  
 Istanbul, Turkey  
 Visit [foodsafetycongress.org](http://foodsafetycongress.org).

### JULY 2022

**10-13**  
**FIRST Annual Expo and Virtual Experience**  
 Chicago, Ill.  
 Visit [ift.org/events](http://ift.org/events).

**July 29-Aug. 3**  
**IAFP**  
 Pittsburgh, Penn.  
 Visit [foodprotection.org](http://foodprotection.org) or email [info@foodprotection.org](mailto:info@foodprotection.org).

### AUGUST 2022

**Aug. 22-Sept. 1**  
**AOAC Annual Meeting and Exhibition**  
 Scottsdale, Ariz.  
 Visit [aoac.org/annual-meeting-exposition](http://aoac.org/annual-meeting-exposition).

### OCTOBER 2022

**23-26**  
**Pack Expo International**  
 Chicago, Ill.  
 Visit [packexpointernational.com](http://packexpointernational.com).

### NOVEMBER 2022

**2-4**  
**Dairy Practices Council Annual Conference**  
 Bloomington, Minn.  
 Visit [dairyperc.org/dpc-conferences](http://dairyperc.org/dpc-conferences).

#### Have an Upcoming Event to Promote?

If you have an upcoming industry event that you would like considered for inclusion in our online and print listings, go to [foodqualityandsafety.com/events](http://foodqualityandsafety.com/events) for info or contact Bob Zander at [bzander@wiley.com](mailto:bzander@wiley.com).

# SCIENTIFIC FINDINGS

For access to the complete journal articles mentioned below, go to “Food Science Research” in the December 2021/January 2022 issue at [foodqualityandsafety.com](http://foodqualityandsafety.com), or type the headline of the requested article in the website’s search box.



## The Food Safety Risk of Ochratoxin A in Coffee

Under the Food Safety Modernization Act (FSMA) and preventive controls (PCs) regulations, food manufacturers must consider whether PCs are needed for potential hazards present in food. The mycotoxin ochratoxin A (OTA) is considered a chemical hazard under FSMA. It’s produced by several fungal species and can be present in various agricultural commodities, including coffee. OTA presents a unique scenario in food safety because it is known to be a potential risk; because heating may destroy it, but not completely; and because the hazard profile suggests it is not acutely toxic at the occurrence levels in coffee, although at high exposure levels, it is potentially nephrotoxic and carcinogenic in animal models. In the absence of U.S. compliance levels, it’s important for the risk assessor and risk manager to determine whether PCs are warranted. To address this complex situation in the coffee industry, these authors combined food safety and toxicology risk assessment principles to examine the available information on OTA hazard and risk in coffee. Exposure and health-based benchmarks for OTA in coffee, established by reviewing peer-reviewed literature, food recall databases, and authoritative reviews, resulted in large margins-of-exposure for both single and repeated exposure scenarios. Furthermore, no evidence was identified from historical data to suggest OTA is acutely toxic in humans from coffee consumption or other exposure sources. Therefore, findings from this assessment indicate that no PC is warranted for U.S. coffee manufactures, based on the low severity and likelihood of risk according to margin-of-exposure estimates and historical data. *Journal of Food Science*. 2021;86:4799–4810.

## Using Ultrasound for Food Preservation and Disinfection

Ultrasound has excellent potential in reducing microbial contamination and has also shown remarkable results in the wastewater treatment and pollutant removal. The different mechanisms of ultrasound in reducing the microbial contamination in food industry are rather exploratory. This review article focuses on the role of ultrasound in improved disinfection, sanitization, and preservation applications in food processing. This paper discusses the physical and chemical effects of ultrasonic cavitation on microbial inactivation. A comprehensive literature is provided to investigate and analyze the broad area application of ultrasound in preventing the microbial contamination in fruits and vegetables, meat, dairy, and during alcohol fermentation. The applied combination of ultrasound with different



novel and conventional methods to intensify the ultrasound-based effect has also been discussed. Overall, this work establishes the background on the prospects of ultrasound disinfection and cleaning in the food industry as a green, effective, sustainable approach to prevent foodborne diseases. *Journal of Food Processing and Preservation*. Published online ahead of print October 24, 2021. DOI: 10.1111/jfpp.16091.



## Mycotoxins in Beer: A Global Analysis

Mycotoxins, including aflatoxins (AFs), ochratoxin A (OTA), deoxynivalenol (DON), fumonisins (FBs), and zearalenone (ZEN), have been reported as beer contaminants. This systematic review and meta-analysis provide the prevalence and concentration of mycotoxins in beers and their worldwide distribution. Mycotoxin’s exposure and cancer risk through beer consumption were determined. The overall pooled prevalence of mycotoxins in beers was 31%. The most prevalent mycotoxins in beers were DON and its derivatives (53%), OTA (52%), FBs (47%), followed by AFs (12%). The global mycotoxin average concentration in beers was 12.52 µg/L. DON and its derivatives showed the highest concentration (26.91 µg/L), followed by FBs (23.19 µg/L), ZEN and its derivatives (20.25 µg/L), and AFs (15.65 µg/L). The African region had the highest mycotoxins concentration. The meta-regression indicated stability of the global pooled concentration of mycotoxins in beers over the years, whereas FBs concentration increased. The intake of DON and its derivatives, FBs, ZEN and its derivatives, and OTA through beers is of concern in African countries. OTA is also of concern in Brazil and Belgium. Results show high mycotoxins concentration in beers worldwide and highlight the health risks through contaminated beer consumption. *Comprehensive Reviews in Food Science and Food Safety*. 2021;20:5742–5764.



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