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FROM THE

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FIGHT FOR FOOD SAFETY

IS PATHOGEN PERSISTENCE PLUMMETING?

BY SHAWN K. STEVENS

FOOD INDUSTRY COUNSEL LLC

When it comes to pathogen control in raw beef products, a lot has changed over the past 20 years. Since 2000, there have been nearly 250 recalls of beef products for the presence of *E. coli* O157:H7. The majority of those recalls (203) occurred prior to 2012, when there was a high number of foodborne illness outbreaks caused by *E. coli* O157:H7 contamination in ground beef products. Indeed, 2007 is aptly referred to as the Year of the Recall, during which 22 recalls involving approximately 35 million pounds of ground beef were announced because of the presence of *E. coli* O157:H7. Many of those recalls were triggered because the products at issue caused high-profile foodborne illness outbreaks.

In 2008, to combat the trend of outbreaks and recalls caused by *E. coli* O157:H7, FSIS began testing raw trim as well as ground beef for the presence of the pathogens. This led to additional industry awareness and trim testing, as well as the advent of more robust "High Event Period" programs, where trim that tested negative would also be diverted to cooking when there were high levels of contemporaneous positive findings. Some companies even began to cast a wider net, diverting multiple combos of trim which tested negative when a single combo tested positive.

Coupled with improved interventions and dressing procedures, these collective efforts led to a substantial decrease in the numbers of outbreaks and recalls. By 2012, the number of recalls for *E. coli* O157:H7 in beef products dropped to only five. In the nearly 10-year period between 2012 and 2021, there were 48 recalls caused by *E. coli* O157:H7, with only one in 2020 and two in 2021. Notably, one of the two recalls in 2021 involved boneless beef from Australia. Overall, the beef industry has done, and continues to do, a phenomenal job with pathogen control.

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With respect to *Salmonella*, which is not a per se adulterant in ground beef, the industry has also done a respectable job. Since the year 2000, there have been only nine recalls due to the presence of *Salmonella* in raw ground beef products. Notably, all of those recalls were announced by the companies involved because of a reported association between the products and reports of foodborne illness. There were not any outbreaks or recalls associated with beef products in 2020 or 2021.

Moving forward, I suspect that the numbers and types of outbreaks associated with raw beef products will continue to remain at very low numbers. The beef industry deserves a pat on the back and should keep up the great work in the never-ending Fight for Food Safety.

COMMENTARY

REGULATIONS & LEGISLATION



USDA-FSIS TO CHART NEW PATH ON SALMONELLA CONTROL IN POULTRY

BY JOHN DILLARD

On Oct. 19, the U.S. Department of Agriculture's Food Safety and Inspection Service (FSIS) announced it will undertake a new approach to regulating *Salmonella* in poultry.

In the coming months, FSIS will begin a series of roundtables to gather information and recommendations on how to approach meet the federal government's Healthy People 2030 goal of achieving a 25% reduction in *Salmonella* illnesses. Based on initial discussions, we anticipate FSIS will look to the poultry industry to, among other things, implement preharvest controls and change sampling procedures.

FSIS currently uses performance standards to measure the effectiveness of *Salmonella* controls for chicken and turkey. Performance standards classify poultry establishments based on the number of FSIS samples of chicken and turkey that test positive for *Salmonella* over a 52-week moving window. Under the performance standards approach, FSIS is measuring for the prevalence of *Salmonella* and does not distinguish between strains of *Salmonella* – some of which are more virulent than others – nor do performance standards measure the quantity of *Salmonella* present in a poultry sample (e.g., enumeration).

USDA Secretary Tom Vilsack has noted that the prevalence of *Salmonella* in FSIS poultry samples has decreased significantly, the level of human infections with *Salmonella* illnesses has remained high, with more than 1 million illnesses annually. The U.S. Centers for Disease Control and Prevention (CDC) attributes approximately 23% of these illnesses to the consumption of chicken and turkey.

Secretary Vilsack has noted that FSIS has received two petitions requesting the agency take new action on Salmonella in poultry.

Vilsack and Deputy Under Secretary for Food Safety Sandra Eskin indicated that FSIS' approach will involve numerous pilot projects to generate data and provide answers on approaches that are effective at reducing *Salmonella* illnesses. FSIS intends to host numerous roundtables with stakeholders representing industry, consumer groups and university researchers to collaborate on the design of the various pilot programs. FSIS will also work with the National Advisory Committee on Microbiological Criteria for Foods (NACMCF) to help shape the agency's approach to controlling *Salmonella* illness.

This announcement is not FSIS' first signal that it wants a new approach on *Salmonella* control. In August, FSIS announced that the agency's 2022-27 Strategic Plan will likely include goals of reducing the prevalence of specific serotypes of Salmonella in poultry that are associated with human illness. This move sent a signal that FSIS is exploring an approach to targeting specific strains of *Salmonella* as opposed to a blanket approach to the pathogen.

Based on our involvement in this area, we anticipate FSIS will consider some of the following actions in its approach to controlling *Salmonella* illness:

- **Preharvest controls:** One of the primary areas where FSIS believes it can make large gains on *Salmonella* control is the implementation of preharvest controls, such as vaccines or probiotics. We anticipate the agency will target some pilot programs on steps that can be taken before birds reach a slaughterhouse. But FSIS does not have legal jurisdiction upstream of the slaughterhouse.
- Enumeration: Given the advances in laboratory methods, we anticipate FSIS may explore whether its efforts should focus on the quantity of bacteria and its impact on the likelihood of illness.
- **Changes to Sampling:** FSIS has indicated it may need to consider a new approach to sampling poultry carcasses and products. The agency currently is conducting a field study on the use of cloth sampling in beef manufacturing trimmings as a potential replacement for N60 sample collection. The findings in this field study may lead FSIS to study the use of cloth samplers in poultry.

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WHEN CONSUMERS AND STUDENTS ASK QUESTIONS ABOUT THE REALITIES OF CHICKEN FARMING, PERDUE FARMS INVITES THEM TO EDUCATE THEMSELVES ON GROUP TOURS AT THEIR NEW POULTRY LEARNING CENTER FACILITIES ON ACTIVE FAMILY FARMS IN ITS NETWORK.

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BY ANDY HANACEK EDITOR-IN-CHIEF

Although farm tours and transparency are not new concepts, Perdue Farms has taken them to another level by opening and supporting the construction of Poultry Learning Centers by its farmers, allowing everyone from students to consumers the opportunity to see the realities of chicken farming.

This fall, Andy Hanacek, editor-in-chief of The National Provisioner, visited Perdue's newest Poultry Learning Center at S&N Enterprises, LLC – a Pinetops, N.C, family farm – and interviewed second-generation poultry farmer and S&N owner Steven Brake, as well as Mike Levengood, Vice President, Chief Animal Care Officer and Farmer Relationship Advocate for Perdue Farms. Brake has been raising chickens for Perdue since 1995, and his father had grown chickens for Perdue for nearly three decades. What follows is a portion of their conversation:

Hanacek: When and why did Perdue Farms decide to create a more formal, more tangible, more inviting approach to tours of its chicken farms through the creation of these Poultry Learning Center locations?

Levengood: Our Animal Care vision has four pillars, which are the chickens, the farmers, transparency, and continuous improvement. The viewing farms fit into our Transparency pillar: Who better than the farmers to go and open their gates and let people in to see what really happens on the farm?

The very first one was a young couple that attended Oklahoma State and came back to farm in Kentucky. They had a vision to let people see what they did on the farm, while also building an educational building where they could host cooking classes and other events. They raised the money to build a separate building for education along with a viewing room attached to the chicken house with four windows.

A second farm family of ours, from Georgia, picked up on it when they met the first family to do this at our Animal Care Summit, and they took it to the next level. They decided that when they had people visit the farm to see the crops and their cattle, they wanted to include the chicken houses in the tour because it's part of the whole farm experience. These farmers decided to do a little bit more in educating groups that visit about farm life, so they added to-scale examples of the house-management equipment into the viewing room.



Hanacek: Steven, how did you decide to get involved and build your viewing farm facility here in Pinetops?

Brake: We came back from one of Perdue's Animal Care Summits and thought about the viewing farm concept as something we'd like to do. We talked to Tommy Herring, the owner of Hog Slat, and said we were interested in this, and he offered to donate the materials and labor to build it.

Our tours actually started with a middle school, who brought out members of a garden club. At that point, the tour just had the chicken houses. We then figured we'd get a lot more impact if we bring in the groups instead of individuals, and just make a bigger impact among more people in that amount of time. There has been more interest from animal science programs, poultry science programs, FFA groups, Boy Scouts and Girl Scouts. But it has been good.

We built the center, had tours lined up, and then COVID hit. A few private, small groups were able to come, but we had an open house event scheduled that needed to be postponed, and other groups had to cancel too. But that may have been a blessing, because we sat back and did some thinking about the program.

Levengood: Steven's sister, Vickie, is a schoolteacher, and she got involved at that time, writing a STEM program for the Poultry Learning Center here for each grade level, which is available on their Web site. It gives teachers materials that they can look at and use ahead of time, and make it more than just a field trip. It can be truly educational.

Brake: For example, we had a group of students from the University of Mount Olive recently, a group who will earn an associate degree in agriculture when they graduate from high school. When they go back to class, they consider all that they learned here at the Viewing Farm in the lab. They get a test on it that counts for a major part of their grade. It's being used as a part of the curriculum because of how it was designed. It's a lot of fun to be able to say the science here relates to real life. It's just not an abstract concept. We're doing physics, we're doing statistics, we're doing the mathematics, and we're doing different types of chemistry.

Getting back to the timeline, we decided we needed a logo and had a competition for high school art students in the area. The winner was a 9th grade student at a high school in Wilson, who hand-drew the logo. And that's the one we chose.

So, we started making those connections and sending out the information on the open house, which moved to August 2021. We started to get responses, and there's been a lot of interest. The whole thing just kind of developed after that.



Hanacek: Do you have a wide variety of groups that come in, and how do they react differently to the different displays you have, from the windows into the house where they can see the chickens to the working equipment you have in the room as well?

Brake: Some groups are really quiet. But some groups, you just can't get them to stop asking questions. The groups of pre-veterinary students are really, really ambitious and want to get in there, talk to you and really get hands-on into things. The engineering students want to get more into the physics of how things work. The FFA students just want to look and experience it. And then, on the other side of it, we've had a preschool out here, and all they wanted to do is sit in the room and hold baby chickens.

Hanacek: Among the visitors that are more experienced or knowledgeable about farming and agriculture, what's typically the most surprising thing or most impressive thing to them when they come out here?

Brake: They're impressed that what they see on the Internet in relation to who we are, isn't true. We can give birds access to outside. They can be free range so they're not packed in. And even when they go inside the house, they're surprised that the birds aren't packed in there. They're comfortable, and the house is clean.

Hanacek: Do you get the same reaction from the, let's call them "city slickers," who have never been on a farm?

Brake: We've had bus drivers who drive the students here and get off the bus, and they just have absolutely no idea what they were walking into. They ask, "What do you do with all of these chickens? What do you need all of this for?" So then, that starts into the conversation. So, if we can make that impact here -Idon't want to use the old cliché — but we may be throwing a pebble in the pond, and that's exactly what we're trying to do.

Hanacek: Have you had any negative reactions from visitors?

Levengood: One day, a visitor from an animal welfare group told me, "I'll give you 10 minutes in the house," which I was fine to accommodate that. After 45 minutes in the chicken house, she apologized, because she had built up a big negative perception of what it must be like, and it was not as she expected. I have to say that's 99 percent of the visitors. Typically, the most negative reactions we've seen aren't even that negative, but they come from members of the animal activist groups who are really determined to believe that this is not what we should be doing.

Brake: But I've had some skeptics. Some have said, "You just got this house ready for tours but I'll bet the other ones" I tell them they can pick any building on this farm, and I'll take them to it to see the same thing.



Hanacek: Do you cover other aspects of the farm or life in agriculture during the tours, or are you typically focused on the chickens and their lives in the chicken houses?

Levengood: In that two-year span from when Steven built the Viewing Farm to when we did the open house, Steven added the mortality management process as part of the tour as well.

Brake: Correct, we applied for a grant from the [USDA National Resources Conservation Service] for forced-air composting, for a project that we completed in June, and added a new dry stack. That allows us to not only go through the chicken house and the processes in there, but also to talk about nutrient management, soil, how our waste management plans work, and how we're handling the mortality on the farm.

On that part of the tour, I'll actually reach down and pick up the compost, and I tell them that this is what happens with birds that die on the farm — they're processed into a carbon-based product with 4-6% nitrogen that will fertilize the soil and grow the food we eat.

Then, we also talk about the regulations we must meet, how we get inspected, how NRCS is on the farm. We explain to them that if we don't do what we're supposed to do, there are consequences to our inaction or not doing things correctly. We don't just talk about the chickens – we talk about the entire process. And the goal is, for me at least: I might not be able to change the world perception of agriculture and chicken farming, but I'm going to try to improve my corner of the world.

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2022 ECONOMIC OUTLOOK: JUMPING HURDLES

THE MEAT INDUSTRY MANAGED A SUCCESSFUL 2021 IN SPITE OF THE ISSUES THAT WILL REMAIN PROBLEMATIC IN THE NEW YEAR.

BY ELIZABETH FUHRMAN

Despite multiple hurdles, the U.S. meat and poultry sector has achieved remarkable success in 2021.

"Both the red meat and poultry sectors have produced near-record volume of meat, despite processor staffing woes tied to COVID-19," says Brian Earnest, lead protein industry analyst at CoBank, in Denver, Colo.

Maintaining a stable labor force along with supply chain issues such as trucking, ingredient availability and CO2 availability were the greatest challenges for the meat industry this year, says Sarah Little, vice president of communications at the North American Meat Institute, in Washington, D.C. Unfortunately, supply chain disruptions such as port congestion will continue into 2022, she says.

"For most of this year, for the meat protein industry the traditional rules of supply and demand haven't necessarily applied because we are not nearly producing at our current capacity and the limitations are not what they traditionally are," explains Todd Southerland, Atlanta-based Truist's senior vice president of food and agribusiness industry. "Usually, you see a cycle that's driven by higher raw material prices, which are feed grains, higher corn and soybean prices. Those rising costs can result in livestock producers lowering their animal populations."

Instead, the industry was not anywhere near capacity of processing animals per day of beef, pork and chicken, he says. From plant

employees through transportation of product, Southerland says the lack of labor has made it difficult for processors to process and ship product.

Additionally, commodities are elevated and should remain elevated in 2022, Southerland says. With the supply chain not operating at full strength because of logistics slowdown, forecasting supply availability or quantifying foreign demand also has been difficult, he adds.

IN DEMAND

Exports play a major role in agriculture. Today, trade accounts for 10% to 30% of U.S. animal protein production, depending on type. For example, more than a quarter of U.S. processed pork left the country in most months this year. "Given the U.S. growing appetite for meat and moderation of supply base, it will be difficult to grow this portion of the balance sheet in the coming years," Earnest says.

China has become a major destination for global proteins. But as the country's domestic supplies rebound from being decimated by African Swine Fever (ASF), China's reliance on U.S. pork waned mid-year. Monthly, U.S. red meat and poultry exports to China went from roughly 20 to 30 million pounds from 2015 to 2018, to peaking at 350 million pounds in 2020. Demand scaled back to less than 150 million pounds per month since then, Earnest says.

"As large-scale hog farming grows in China and domestic supplies recover from ASF, reliance on U.S. pork and poultry is not likely to rebound in 2022; however, U.S. beef exports to China have grown exponentially," he says.



Domestically, this year saw the kick-off to grilling season coincide with a push to reopen the dining segment as restrictions eased following a perceived drop in COVID-19 risk, Earnest says. Both were beneficial to meat and poultry demand. This winter will likely be challenging for the restaurant sector as COVID-19 remains a consideration among dining patrons.

Tracking trends across red meat and poultry items, freezer inventories have been drawn down more than 16 percent from a year ago, to decade-low levels, despite accumulation to record-high levels in some items, such as breast and leg meat along with pork loins in

2020, Earnest says.

Key meat items such as chicken breasts and ground beef have maintained elevated price levels, which has helped to offset elevated grain and labor costs. "Consumer sentiment has yet to reflect the entirety of wholesale inflation as it is slow to transition through grocery aisles and menus," Earnest says.

AS LARGE-SCALE HOG FARMING GROWS IN CHINA AND DOMESTIC SUPPLIES RECOVER FROM ASF, RELIANCE ON U.S. PORK AND POULTRY IS NOT LIKELY TO REBOUND IN 2022; HOWEVER, U.S. BEEF EXPORTS TO CHINA HAVE GROWN EXPONENTIALLY.

Unfortunately, meat and poultry production is a labor-intensive good. Earnest says it is not uncommon within the industry to hear of processors raising wages 20% to 25% or even higher when compared with pre-COVID pandemic levels. "Keeping plants fully staffed was a challenge prior to 2020," he says. "Some areas will likely have to deal with staffing levels down 15% to 20% from pre-pandemic levels for quite some time."

During the pandemic, the most common response of employers was to raise wages, Southerland says. Cost of an employee now averages \$18 to \$20 an hour in some regions, and these additional costs have a direct impact on retail food prices, he says. Not surprisingly, these labor challenges coupled with higher commodity prices have caused food prices in grocery stores to increase, which isn't necessarily a bad thing for the meat and poultry industries.

"Our food system is rooted in commodity industries, but it is also the most diverse and differentiated food supply in the world, which drives significant value with consumers," Southerland says. "The reality is that a good share of today's price increases will have lasting effects long past this commodity cycle, which is perfectly acceptable because the revenues are being directed to the right people: farmers, ranchers, laborers and other producers that have struggled historically due to receiving a disproportionate share of industry revenues. In that respect, if food manufacturers can embrace and leverage the power of their supply chains and these critical commodity partnerships, the rising tide will have a way of lifting all boats."

While the meat sector saw plant capacity not fully used in 2020 or 2021, more production will be brought online in the years to come, Earnest says. "There have been multiple proposals for new beef packing facilities publicized this year, but adding plants will likely increase competition for labor, further complicating staffing," he explains. "In addition, the cyclicality of cattle supplies suggests reduced cattle to process beyond 2021."

In turn, the World Agricultural Outlook Board forecasts moderation of total red meat and poultry production for 2021 and 2022 with 2020 totals. Within the sectors, broiler production is seen at a moderate rise, up about 1% in 2022, while beef production is forecast to fall roughly 3% in 2022 after peaking in 2021. U.S. pork production is seen relatively flat.





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POST-TRANSLATIONAL MODIFICATIONS IN MYOGLOBIN INFLUENCE FRESH BEEF COLOR STABILITY

BY YIFEI WANG, GREGG RENTFROW, SURENDRANATH P. SUMAN, ANIMAL AND FOOD SCIENCES, UNIVERSITY OF KENTUCKY

At the point of sale, consumers often use the cherry-red color of beef as an indicator of wholesomeness and quality of the product. Meat discoloration, which mainly results from oxidative browning, leads to consumer rejection and huge economic loss for the beef industry. Fresh meat color stability is determined by the postmortem interactions between myoglobin and several other biomolecules in skeletal muscle.

Post-translational modifications (PTM) are the covalent, and generally enzymatic, changes in proteins following protein biosynthesis by the addition or the removal of modifying group(s) at the amino acid level. PTM play a fundamental role in modulating protein's functionality, turnover and interactions with other proteins.

The complex relationship between PTM of muscle proteins and meat quality has become increasingly evident. However, myoglobin PTM and their role in fresh meat color stability has not been characterized. We hypothesized that PTM in myoglobin can influence the protein's structural and functional properties and its interaction with other biomolecules, and in turn influence fresh meat color stability. Therefore, our objectives were to identify myoglobin PTM sites in beef longissimus lumborum muscle during postmortem aging and their influence on fresh beef color stability.

The *longissimus lumborum* muscle was collected from nine (n=9) beef carcasses obtained from the USDA-inspected meat laboratory at the University of Kentucky (Lexington, Ky.), and were divided into four equal-length sections. The muscle sections were vacuum packaged and randomly assigned to wet-aging at 2°C for either 0, 7, 14, or 21 days. At the end of each wet-aging

period, the muscle sections were removed from their vacuum packages and fabricated into four 1.92-cm thick steaks. One steak from each muscle section allotted for proteome analyses was then immediately vacuum packaged and frozen at -80°C until it was used. The remaining three steaks assigned for evaluation of instrumental color and biochemical evaluation were aerobically packaged and assigned to refrigerated storage (2°C) in the dark for either 0, 3, or 6 days. Myoglobin PTM were analyzed using two-dimensional electrophoresis. Gels were stained for phosphorylated protein and total protein using Pro-Q Diamond and Sypro Ruby, respectively. The protein spots with molecular weight of 17 kDa were excised and subjected to tandem mass spectrometry for PTM identification. The instrumental color and biochemical properties were analyzed as a split-plot design with aging time as a whole-plot factor, and storage day as a sub-plot factor. The carcass was considered as a random effect. The data were analyzed using PROC MIXED procedure in SAS, and the differences among the means were detected using the least significant differences at a P < 0.05 level.

MEAT DISCOLORATION, WHICH MAINLY RESULTS FROM OXIDATIVE BROWNING, LEADS TO CONSUMER REJECTION AND HUGE ECONOMIC LOSS FOR THE BEEF INDUSTRY.

In agreement with previous investigations, fresh beef color traits such as redness (a* value), color stability (R630/580), and myoglobin concentration decreased (P < 0.05) upon aging. Gel image analysis identified six myoglobin spots with similar molecular weight (17kD) but different isoelectric pH. Our observation indicated that the six myoglobin isoforms were post-translationally modified to different degrees, since PTM can change proteins' isoelectric pH by modifying titratable groups in amino acids. Tandem mass spectrometry identified multiple PTM (phosphorylation, methylation, carboxymethylation, acetylation, and hydroxynonenal alkylation) in the six myoglobin spots. Phosphorylation was detected in serine (S), threonine (T), and tyrosine (Y) residues, whereas lysine (K), arginine (R), and histidine (H) were susceptible to other PTM. In addition, distal histidine (histidine 64) which is critical to heme stability was modified by hydroxynonenal alkylation. Phosphorylation, acetylation, and carboxymethylation introduce the negatively charged phosphate group, acetyl group, and carboxylic acid, respectively, in myoglobin, which could alter the ionic network, and therefore might influence the distal histidine's spatial interaction with hydrophobic heme pocket. While methylation and hydroxynonenal alkylation contribute to minimal change in isoelectric pH of myoglobin, they increase the hydrophobicity and stearic hindrance, and thus alter myoglobin's tertiary structure.



Overall, greater number of myoglobin PTM sites were identified in aged beef (wet-aging for 7, 14, or 21 days) compared with non-aged counterparts (wet-aging for 0 days). These aging-induced PTM, especially those located close to the hydrophobic heme pocket, could compromise myoglobin redox stability by adding modifying groups to amino acid residues, and therefore accelerate myoglobin oxidation and beef discoloration. Interestingly, differential alkylation sites between non-aged and aged beef were identified at lysine residues, indicating a potential role of lysine alkylation in myoglobin redox stability. Furthermore, PTM at K45, K47, and K87 were unique to myoglobin from non-aged beef, whereas PTM at R31, T51, K96, K98, S121, R139, and K147 were unique to myoglobin from aged counterparts (Figure 1). These myoglobin PTM could be used as novel biomarkers for fresh beef color stability. The knowledge of protein PTM may be combined with artificial intelligence and machine learning to predict the color stability of beef muscles, and this approach could be utilized in production lines to optimize the value and to minimize food waste. Moreover, innovative processing strategies to improve meat color stability could be developed by minimizing myoglobin PTM-induced meat discoloration. For instance, future research would be valuable in understanding the influence of enzymes on meat color stability through reversing myoglobin PTM. Further research is required to determine the role of myoglobin PTM in internal cooked color to improve the safety of cooked ground beef.

For more information, please see the authors' work published in Meat and Muscle Biology: Yifei Wang, Shuting Li, Gregg Rentfrow, Jing Chen, Haining Zhu, Surendranath P. Suman, "Myoglobin Post-Translational Modifications Influence Color Stability of Beef Longissimus Lumborum" Meat and Muscle Biology 5(1). p.15, 1-21. Doi: https://doi.org/10.22175/mmb.11689



HISTORICAL PERSPECTIVES O

BY ANTHONY W. KOTULA. PH.D.: AND KATHRYN L. KOTULA. PH.D.

IRRADIATION: THE RESEARCH

For many decades scientists have studied Gamma irradiation of meat and poultry to ascertain whether that could be the Holy Grail for the preservation of freshness of meats and even destroy pathogenic microorganisms.

In 1963, we were given the opportunity to evaluate the use of Gamma irradiation to destroy bacteria on prepackaged poultry. The irradiation facility consisted of an 18,000-curie Cobalt-60 source in a shielded mobile irradiation trailer (Demonstrator, Atomic Energy of Canada Limited), through an arrangement with the U.S. Atomic Energy Committee. The dose rate was 5,000 rads/min. Ice packed and frozen chickens, were irradiated with 0, 0.1, 0.3 and 0.5 Mrads. (1 Mrad = 10 kGy). Increased irradiation levels resulted in greater decrease of viable surface bacteria. Irradiation increased shelf life of the poultry stored at 4.4C. We were not allowed to have our sensory panel taste the cooked chicken samples because the U.S. Food and Drug Administration (FDA) had not yet approved the safety of the procedure. Our panelists, however, were allowed to smell them and report their scores. The 0.3 and 0.5 Mrad samples had off-odors described as sour, spoiled, sweet, soapy, sharp, acrid and musty. I recall some characterizations as "wet dog" and "burning chicken feathers."

Other scientists, including Einar Risvik, Ph.D., (1983), reported beef and bacon irradiated at doses between 1 and 10 kGy had significant changes including off-taste, metallic taste, juiciness and off-color. Now, five decades after our research cited above, scientists are still seeking methods to prevent the formation of off-odors in irradiated meat. Chae, et al. (2009) reported, "Irradiation increased the cardboard and painty aromatic attributes." Brito et al. (2011) cited irradiation odors of mechanically deboned chicken irradiated with 0.32 kGy/h. In their study, the odor of irradiation was defined as, "Odor of burnt chicken skin after manual feather plucking the feathers are scorched over flame to facilitate the manual removal of feathers." Thus, the irradiation odor of burnt chicken feathers in their study is the same as our original study 54 years ago, as referenced above.

After a few decades of study of Gamma irradiation of meat by scientists at universities, the U.S. Department of Agriculture (USDA), the Natick Army Research/Development Laboratory, and industry, neither the FDA, nor the USDA had approved the use of Gamma irradiation for the destruction of spoilage and pathogenic microorganisms on and in meat and poultry. Takeguchi, (1983), food safety officer at the FDA, said "However, food irradiation must not be used as a substitute for good sanitation practices." The Natick Army Research and Development Laboratory spent more than \$50 million dollars on irradiation research and finally transferred the responsibility to the USDA in 1980.

The military, the meat and poultry industries and scientists have sought to understand the advantages and limitations of the use of irradiation to preserve meat and poultry from microbial contamination. Ronald E. Engle, D.V.M., Ph.D., deputy administrator for science at the USDA's Food Safety and Inspection Service (FSIS), (1986), described the Department's position on irradiation. He reported, "with low-dose irradiation of raw meat, the reported D-value, or 90 percent reduction value, for Salmonella spp. was 0.55-0.78 kGy, for Yersinia enterocolitica, 0.10-0.22 kGy, and Campylobacter jejuni 0.14-0.16 kGy. Therefore, even with an absorbed dose of only 100 Krad, there will be a 1.8-log reduction for Salmonella, a 10-log reduction for Yersinia, and a 7-log reduction for Campylobacter."

He also reported, however, "vacuum packaging combined with refrigerated storage at <5 degrees C is the preferred method for extending the shelf life of many perishable products, including pork. Vacuum packaging retards the growth of common aerobic spoilage bacteria, such as Pseudomonas spp., on refrigerated fresh meat, poultry, and fish. Low-dose (<1.0 kGy) irradiation has the potential of reducing competing microflora and thereby allowing Clostridium botulinum to flourish in the vacuum-packaged environment. Some strains of C. botulinum can produce toxins at temperatures as low as 3.3 degrees C., thus calling into question the value of cold storage of irradiated vacuum-packaged products. And, although the normal growth of C. botulinum causes a foul, putrid odor that should warn the consumer, spores of type E C. botulinum can produce toxins without sensory evidence of spoilage."

GROUP	DOSAGE ²	EFFECT - DESTRU	EFFECT - DESTRUCTION OF:				
		10 Mrad	Viruses				
	Sterilization						
		3 - 5 Mrad	Most resistant hacteria				
		5 511144	(those destroyed by capping)				
			(those destroyed by canning)				
		0.5 Mrad	Food Poisoning bacteria, e.g.				
			Salmonella and Stanhylococci				
	Destourization						
	Pasteurization	a Marial Ma					
	0	.3 Mrad Mo	ad most of spollage organisms				
	and spores of fungi						
	0 1 Mrad	Meat narasites	Meat parasites e a taneworm				
	0.1 11100	and Trichinglia	and Trichinella spiralis				
		and monimena s					
Subpasteurization							
	0.01 Mrad	Insects and repr	Insects and reproductive cells of				
horticultural crops.							

TABLE 1. A GROUPING OF RADIATION-ABSORPTION DOSAGES AND THEIR EFFECTS ON LIVING CELLS¹

This table clearly indicates spoilage microorganism were destroyed at lower levels of irradiation than the levels required to destroy some potentially pathogenic microorganisms. Some individuals still dispute these results. If these data are accurate, then irradiation preferentially would destroy spoilage microorganisms, thus eliminating microbial competition, and fostering growth of potentially pathogenic microorganisms.

IRRADIATION: THE PETITION

Raltech Scientific Services, a Division of Ralston Purina, conducted 20 different studies related to the safety, toxicology and genetic research of irradiated meat (1983). The studies, funded by the USDA, included the toxicology and genetic histopathology of fruit flies, dogs and mice fed irradiated chicken treated with higher doses than those ultimately authorized by the FDA. Their studies lasted from 1976 to 1983. Their results demonstrated an increase in lesions, tumors and other concerns. Raltech Scientific Services concluded they could not recommend the irradiation of meat.

Tracor Jetco assessed the results of the studies and did not agree with the conclusions by Raltech Scientific Services, who conducted

the studies.

A six-member panel, five from the Agricultural Research Service, and one from FSIS reviewed the Raltech results. Four members considered the results to be weakly supportive of irradiation. Two members of the panel considered the results to be "indeterminate" and possibly slightly adverse" toward irradiation. They were concerned that a reduced production of offspring occurred among Drosophila melanogaster, who were reared on irradiated chicken. They observed that a dose response was evident. Additionally, survival of both sexes of mice was reduced in the group of mice fed irradiated chicken. The mice fed irradiated chicken also had the highest incidence of several tumors, and lesions, when compared to the controls. The panel then recommended that Tracor Jetco prepare a petition to the FDA (Contract 53-3K06-143), at an additional cost to USDA of \$314,270 to be paid to Tracor Jetco.

Takeguchi, (1983), Food Safety Officer, FDA, quoted the standard of safety as "... reasonable certainty that no harm will result from the proposed use of an additive. It does not - and cannot - require proof beyond any possible doubt that no harm will result under any conceivable circumstances" (HR No. 2284, 85th Cong. 2d Sess. 1, 1958). Tageguchi (1983) stated, "One arduous avenue is to identify all the possible products formed during that process under all plausible conditions. However, this may be too costly and impossible to do."

The USDA, being interested in methods to identify irradiated meat and poultry in the marketplace, supported research to find URPs, Unidentified Radiation Products, in irradiated chicken. Karam and Simic, National Bureau of Standards, found instead that irradiation converts phenylalanine into ortho-tyrosine, and that the increase of ortho-tyrosine in the insoluble fraction of irradiated chicken meat is linear. Ligon, (1986) suggested that URPs are formed, but not yet identified. He compared URPs caused by food irradiation, with the evolution of species that is caused by natural radiation, where URPs are called modified DNA.

At the request of the FDA, the National Toxicology Program's Board of Scientific Counselors, U.S. Public Health Service, reviewed the Raltech's histopathology data of mice fed irradiated chicken, (1985). They disagreed with Raltech's conclusion that irradiated chicken fed to mice elicited a carcinogenic response. (see Table 2, below)

Treatment	Number of Mice		Interstitial Cell Tumor		Gonadal Stromal Tumor
		Number	%	Number	%
Control Chow diet	105	0	0.0	1	1.0
Control Frozen	159	1	0.6	2	1.3
Control Heat treated	109	0	0.0	1	0.9
Gamma irradiation 5.9 Mrads	107	3	2.8	3	2.8
Beta irradiation 5.9 Mrads	106	4	3.8	4	3.8

TABLE 2. RALTECH DATA FOR MICE FED IRRADIATED CHICKEN

Data for this table are from Tables 2 and 3, in the Minutes of the National Toxicology Program Board of Scientific Counselors Meeting, 28 March 1985.

The FDA reviewed 409 toxicity studies on irradiated foods and "concluded that any chemical differences between foods irradiated at doses allowed by the regulations and non-irradiated foods are too small to cause concern about safety". (See 51 FR 13379).

Thayer et al., (1987), reviewed toxicology studies of irradiated-sterilized chicken that were published between 1955 and 1983. He stated, "On the whole, the studies were consistent in producing negative results in all the variety of tests performed. There were however, some results that were difficult to explain on the basis of the available data. These were a) the unexplained reduction in the hatchability of the eggs of Drosophila reared on gamma-irradiated chicken. b) the poor survival of the virgin female mice fed irradiated chicken, c) the myocardial and glomerulonepropathy in mice that were fed irradiated chicken."

On July 22, 1985, in response to a petition from Radiation Technology, Rockaway, NJ, the FDA approved irradiation of pork for the control of Trichinella spiralis (Federal Register, 1985). In that petition, Radiation Technology Inc. cited research that indicated Gamma rays penetrate meat, thus could destroy parasites such as Trichinella spiralis, within the meat. On 15 January 1986, the USDA approved irradiation, at doses from 0.3 to 1.0 kGy. (Federal Register 1986), for the control of Trichinella spiralis in pork carcasses, of fresh or previously frozen cuts of pork carcasses that have not been cured or heat processed. Pork, however, needs to be frozen to minimize the off-flavors and off-odors that occur when irradiated. Kotula, et al. (1990) demonstrated conditions under which freezing would destroy Trichinella spiralis in pork. Therefore, the freezing of pork is sufficient to kill Trichinella spiralis without the irradiation step.

LINGERING QUESTIONS:

One may then question why irradiate frozen pork when the Trichinella are already dead? One may wonder why irradiate meat to destroy microorganisms, when Takeguchi, indicated irradiation should not be used as an alternative to good manufacturing practices to reduce bacterial contamination. One may wonder whether consumers (and therefore the companies that provide products for those consumers) would want products with poor quality (objectionable off-odors and off-flavors) and questionable safety. One may also wonder whether this petition process raises any other concerns.

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LESS EXPENSIVE, MORE FLEXIBLE VISION SYSTEMS ARE APPEALING TO PROCESSORS.

BY MEGAN PELLEGRINI

CONTRIBUTING WRITER

While the state of vision systems may not have vastly shifted over the last few years, the hardware is certainly less expensive today, and the systems are much smarter and cost effective.

"It's more attractive to processors to look at vision systems now," says Colin Usher, research scientist for Georgia Tech Research Institute (GTRI), in Atlanta. "If the machine is run properly, then it brings great benefits to the processing line."

Vision systems utilize cameras to look at meat and poultry products for quality, food safety standards, labels, packaging and foreign materials. In short, they can offer quality control and immediate feedback and identify problems as soon as they occur – faster even than manual inspections.

"Employees can get distracted on the inspection line or are stretched too thin to respond immediately," notes Usher. "A plant might have only one inspector now, not two, for example; and employees can take a longer time to detect and capture defects than vision systems."

Imaging systems exist today that use differences in the light spectrum to detect anomalies in the product. "There is artificial intelligence [AI] that goes along with these imaging systems that analyzes this data, and the technology is able to detect quality defects like woody breast, bruises, bones, etc.," says Rafael Rivera, manager of food safety and production programs, U.S. Poultry & Egg Association, Tucker, Ga. "It is also capable of identifying foreign material such as wood, plastic and metal."

This technology can either replace or complement existing quality control and foreign material prevention systems, says Rivera. "It has the capability of readily adjusting it to specific needs, whether quality or food safety," he says.

Computing capability has led to opportunities to expand this technology. "With AI, you can collect data in real time, and it generates enormous amounts of data," says Rivera. "You have to account for data storage and computing capabilities in order to quickly receive this data and have the ability to make decisions."

VISION SYSTEMS UTILIZE CAMERAS TO LOOK AT MEAT AND POULTRY PRODUCTS FOR QUALITY, FOOD SAFETY STANDARDS, LABELS, PACKAGING AND FOREIGN MATERIALS.

However, vision systems still tend to be rigid, especially when designed around a product, notes Usher. "So, if there are changes in the products being examined, it requires a new algorithm for the system, which can otherwise be somewhat rigid and inflexible," he says.

Some new AI systems are adaptable to multiple product changes, though.

STEALTH

Meat Pump Pipeline

"If the product going through the system is different, then we still need people to tell the system, and they don't always do that," Usher explains.

While vision systems deal with high-tech solutions, they also need basic maintenance. "When it comes to installing and operating a vision system, owners need to understand all aspects of the system," says Usher. "They need to clean the glass, for example, because it can get foggy or splashed with water, maintain and operate the system and learn and gain the expertise to run it."

If the system goes down, there needs to be a backup. "Processors will need workers to step in or stop the entire process," says Usher.

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Fortunately, vision systems are typically pretty user-friendly to run. "It depends on the complexity of the system, though," he notes. "If the products regularly change that go through the system, unless the vision system can detect the changes, then the technology will look at the 'wrong' product or will require complicated camera data interfaces."

Al is becoming more flexible in these systems, as long as processors can also be flexible with their internet connections. "Some systems require internet connectivity to the cloud," says Usher.

However, agriculture is lagging behind the food industry in connecting to the cloud. "Some companies are limiting their capability because they don't want to look at cloud platforms as a solution," says Usher.

HOW TO SOLVE THE BREADING AND BATTER RIDDLE

THE POPULARITY OF BOTH TRADITIONAL AND HEALTH-ORIENTED PROTEINS REQUIRES A JUGGLING ACT BY MEAT AND POULTRY MERCHANDISERS.

BY RICHARD MITCHELL CONTRIBUTING WRITER

Developing and marketing meat and poultry with breading or batter can be a double-edged sword.

Merchandisers seeking to maximize sales face the burden of appealing to two distinct shopper groups: those who seek traditional selections; and the growing base of wellness-focused shoppers. It is a tricky situation. Despite a greater emphasis on better-for-you eating, conventional options remain dominant.

"Even with a greater interest in healthier eating, it's comfort food and proven classics that continue to drive strong sales of proteins with breading and batter at retail and foodservice locations," says Anne-Marie Roerink, principal at 210 Analytics, a San Antoniobased market research and marketing strategies firm and preparer of The Power of Meat 2021 report. "From the start of the pandemic, we saw comfort foods do very well, and with sports and entertainment back on, chicken wings quickly made their way back on menu to the point of being hard to source despite significant inflation."

The stronger shopper interest in fried chicken containing breading and/or batter, meanwhile, is helping to fuel the chicken sandwich wars among the major fast-food operators. In January, Louisville, Ky-based KFC Corp. launched the new KFC Chicken Sandwich, which it describes as being a double-breaded extra-crispy chicken breast filet. The company notes the rollout followed a test in which sales were twice that of expectations.

Other 2021 launches include Chicago-based McDonald's Corp.'s Crispy Chicken Sandwich; Miami-based Burger King Corp.'s handbreaded Ch'King chicken sandwich; Atlanta-based Chick-fil-A Inc.'s Spicy Chicken Sandwich; and Miami-based Popeyes Louisiana Kitchen Inc.'s Chicken Nuggets which are hand battered and breaded in buttermilk.

NO END IN SIGHT

The demand for such products will likely be ongoing, says Russell Zwanka, associate professor in food marketing, at Western Michigan University, in Kalamazoo. He notes the chicken sandwich battle "sees no abatement in sight. KFC's new chicken sandwich is performing as well as McDonald's and Popeyes', and Chick-fil-A never seems to take a hit."

"Fried chicken sandwiches are not only prevalent but are increasingly so," agrees Maeve Webster, president of Menu Matters, an Arlington, Vt.-based food industry consulting firm. "These are incredibly on-trend and are likely to remain so for some time."

She notes fried chicken sandwiches and fried chicken in general are two of the most popular meat and poultry items containing breading and batter. Iterations of fried chicken from around the globe, including katsu and karaage, "are beginning to pick up steam. Chicken and waffles had a moment a few years ago and continue to be popular but have certainly been eclipsed by fried chicken sandwiches."

Katsu is a Japanese dish typically consisting of breaded chicken or pork cutlets, while karaage is a Japanese cooking technique in which foods, frequently chicken, are deep fried in oil.

"These items are solidly indulgent and leaning into indulgence still works, particularly heading into the winter and holiday months," Webster says.

Breaded and battered pork and beef options, however, are far less common and interest in such dishes is declining as many consumers view such selections as "old fashioned" and "extremely unhealthy," she says.

Despite the popularity of fried chicken, consumer health concerns are limiting sales of other fried proteins, analysts say. A 2019 U.S. study published in The BMJ, a peer-reviewed medical trade journal published by the British Medical Association, for instance, found that eating one or more servings of fried chicken a day was linked to a 13 percent higher risk of death from any cause and a 12 percent higher risk of heart-related death compared with no fried food. The study notes that "up to a third of North American adults have fast-food every day, and previous studies have suggested that a greater intake of fried food is associated with a higher risk of type 2 diabetes and heart disease."

While the research focused on postmenopausal women, the study states that "reducing the consumption of fried foods, especially fried chicken and fried fish/shellfish, may have clinically meaningful impact across the public health spectrum."

A previous investigation by Harvard University found that fried foods can increase the risk of heart disease by as much as 68 percent. The researchers, who followed the diets of 15,300 doctors as part of the Physician's Health Study for about three years, also noted that those who ate fried foods up to three times a week saw an 18 percent increased risk for heart disease. The investigation found that risk rises to 25 percent if fried foods are eaten four to six times in a week, and up to 68 percent if eaten seven or more times in a week.

EVEN WITH A GREATER INTEREST IN HEALTHIER EATING, IT'S COMFORT FOOD AND PROVEN CLASSICS THAT CONTINUE TO DRIVE STRONG SALES OF PROTEINS WITH BREADING AND BATTER AT RETAIL AND FOODSERVICE LOCATIONS

A HEALTH HALO STILL PAYS DIVIDENDS

As a result of such findings, more merchandisers are emphasizing recipes with lighter, healthier batters such as tempura, or lighter breading, Webster says. "Many consumers focused on healthful eating are likely to avoid these formats regardless," she says.

Nevertheless, Webster notes that if meat or poultry with breading or batter can leverage a bit of a healthy halo by being lighter or incorporating functional ingredients such as herbs, "then it may create a more permissive indulgence that expands the potential market to a degree."

Consumers, meanwhile can create breaded items with less fat, including chicken wings, chicken fried steaks and chicken cordon bleu, by using air fryers, Roerink says, adding that incorporating cauliflower for breading helps make selections suitable for lower-carbohydrate diets.

"We don't need to make the full offering better for you, but having options is important in today's market," she says. "The innovation we're seeing in the product itself and the preparation method opens doors for more health-focused consumers."

That is important as 28 percent of meat shoppers report they put a lot of effort into making nutritious and healthful choices when purchasing meat and poultry. An additional 43 percent give it some effort, according to The Power of Meat 2021 report. The Arlington, Va.-based Food Marketing Institute (FMI) and the Washington, D.C.-based Foundation for Meat & Poultry Research & Education are publishers of the report.

Despite such a wellness focus, there still are possibilities for merchandisers to also expand the sale of items with breading and batter. That includes carrying the optimal selections in each outlet as the most popular items vary by region, Roerink says. Selections may include breaded pork tenderloins, chicken fried steak, schnitzel, chicken Milanese, country fried steak and chicken wings.

"Retailers and restaurateurs have a nice opportunity in leveraging the different cuisines that use breaded items," she says. "As both retailers and foodservice are contracting their total assortment and menus, limited-time offers will take on a greater role and that's where breaded items can make for something different from the same old."

In addition, retailers can help boost category interest by merchandising the meal components to create recipes with breading and batter together in stores or online, Roerink says.

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ANTIMICROBIAL SPRAYING IS SERIOUS BUSINESS

THE POPULARITY OF BOTH TRADITIONAL AND HEALTH-ORIENTED PROTEINS REQUIRES A JUGGLING ACT BY MEAT AND POULTRY MERCHANDISERS.

BY RICHARD MITCHELL CONTRIBUTING WRITER

Antimicrobial spraying plays a key role in the never-ending battle to eradicate pathogens from meat and poultry carcasses.

While many operators, particularly smaller processors, position antimicrobial spraying as a low-cost, efficient and effective method of reducing bacterial contamination, the procedure also can be hazardous to workers who do not follow the proper safety measures, analysts say.

Spraying involves the application of such elements as organic acids (including lactic, acetic and citric), peroxyacetic acid and chlorinebased compounds such as sodium hypochlorite on the surface of carcasses, parts and organs. The activity can result in up to a 99% reduction of bacteria on carcass surfaces while extending the shelf life of meat by several days with a cost of only a few pennies to dimes per carcass, according to the Alberta, Canada-based Alberta Ministry of Agriculture, Forestry and Rural Economic Development.

"Research studies have shown that applying a pre-chill treatment solution containing 2% lactic acid to beef carcasses reduced the counts of *Salmonella typhimurium* and *E. coli* O157:H7 by five log cycles," says Nicole Keresztes-James, supplier assurance programs technical scheme lead for NSF International, an Ann Arbor, Mich.-based food safety auditing firm and standards developer. "In comparison, when a water-only wash was applied, the result was a reduction of just three log counts." The greater the logarithm (log) reduction, the more effective a product is at killing bacteria and other pathogens that can cause infections.

To better achieve such results, prior to antimicrobial spraying, operators should clean the carcass surface with warm water and allow excess water to drip from the carcass for at least five minutes to dissipate the water film and enable the antimicrobial to make better surface contact. This information comes from a report from the Department of Food Science at Pennsylvania State University (Penn State), Department of Animal Science and Food Technology at Texas Tech University and the Department of Food Science and Nutrition at Washington State University. The report is from a study at Penn State on antimicrobial spray treatments for red meat carcasses in very small meat establishments.

DO NOT RUSH THE PROCESS

Such contact is important as harmful bacteria, including *Campylobacter spp.*, may still be present on meat surfaces after washing with warm water, the report shows. "If the carcass is not given adequate time to drip, then the excess water film could dilute the acid and make it less effective," according to the report.

After five minutes of drip time, operators should rinse the carcass with enough solution so it covers the carcass completely and some antimicrobial fluids drip off. Operators should rinse a side of beef for at least one minute while rinsing other red meat carcasses including lamb, pork, veal and goat for at least 30 seconds, the report shows.

Spraying equipment options include heavy-duty stainless steel tanks, battery-operated sprayers that can deliver fluid at a constant rate and pressure and can take the form of a backpack or tank on wheels, and garden sprayers that operate with a gentle flow rate and may take longer to thoroughly rinse a carcass. The report notes that many garden sprayers do not have a pressure gauge and require manual pumping to pressurize, though processors can retrofit the sprayer with a gauge, along with a pressure relief valve for safety and a quick-connect plug to allow users to pressurize the tank rapidly.

The effectiveness of antimicrobial sprays, meanwhile, can vary in accordance with the application, Keresztes-James says. "High water temperatures can lead to off-gassing of antimicrobials, and the high organic load may deactivate them," she says, adding that efficacy also is dependent on the pH of the environment in which spraying occurs, including the chemical composition of the various carcasses and the pH of the water used for solution preparation. Potential hydrogen (pH) is a measure of the acidity of a solution.

Some antimicrobial sprays also require longer residence times on the carcass for maximum effect, Keresztes-James says. "Sprays have been found to be less effective in reducing microorganisms in meat applications where the product has more cut muscle surfaces, such as trim," she adds. "Microorganisms can find hiding places in cracks and crevices more easily and can elude the spray, reducing its effectiveness."

Sprays, meanwhile, can cause undesirable colors, textures and flavors to appear in the meat, depending on the antimicrobial treatment, Keresztes-James says. A "graying" reaction, for instance, may occur when an antimicrobial interacts with the heme in the animal's blood, she says.



REDUCE THE WORKER SAFETY RISK

The risk of injury to workers spraying antimicrobials, meanwhile, makes it crucial for processors to implement and enforce safety measures, analysts say. Certain antimicrobial treatments such as peracetic acid, which operators frequently use in poultry processing facilities, can have a corrosive and irritating effect on people's eyes, mucous membranes of the respiratory tract and skin, Keresztes-James says.

"Exposure to high concentrations of airborne chemicals can quickly overwhelm workers, with undesirable health outcomes that range from irritation to severe irreversible effects, including death," she says, noting that spray applications in open areas create more exposure to workers than enclosed environments, such as a cabinet.

To best protect employees, operators should ensure workers are wearing the proper personal protective equipment (PPE), while receiving regular training on the use and hazards of antimicrobial spraying, Keresztes-James notes.

Necessary PPE can include goggles, chemical gloves, face shields, rain suits and sleeves that go over the gloves, says Jen Allen, vice president of operations and engineering for Allen Safety, an Orlando, Fla.-based global safety and process improvement company. Processors should consult manufacturers' safety data sheets to determine the proper PPE for chemical handlers in accordance with the dilution requirements and application methods, Allen says. It also is important that the safety sheets are easily accessible in emergency situations, the Penn State report notes.

Diluting antimicrobials mechanically to avoid worker contact with the concentrated chemical should be another consideration, Keresztes-James says, adding that it also is important for processors to store chemicals properly in well ventilated spaces and tightly closed containers.

KEEP THE CHEMICAL UNDER CONTROL

Full-strength chemicals can cause additional harm with incidents more likely to occur when there is accidental rupture of the tote or barrel containing the compounds, Allen says. Such occurrences may happen when operators use a forklift to move the chemicals into storage areas and production floors.

Workers also face risks from accidentally spilling chemicals, using chemicals at a higher strength than what manufacturers

recommend by not diluting properly and changing or modifying application methods when mixing chemicals, she says.

Mixtures typically present little safety threat to employees when there is proper titration and users follow the recommended dilutions, Allen says. "Locations will want to work closely with chemical company reps to ensure the product is being used as sold or intended, and that handlers are trained on the specific chemical's hazards, proper use, handling, mixing, storage and the limitations of the chemical," she says.





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PLENTY OF OPPORTUNITIES STILL EXISTEOR PACKAGING

BY CHIP BOLTON

Vacuum packaging is a vintage format that has aged well over the decades. Time and again it has evolved, remaining relevant to everchanging marketplace whims and needs and delivering real value in many ways.

Our attention to packaging usually goes straight to material development and innovation because technology is exciting and fun to talk about. But presently that's not the case with vacuum packaging, according to a source. "I think the focus is on automation upstream and downstream on processing lines. Labor is in short supply, and the pandemic just accelerated that focus."

Processors are driving the transition, learning from hard lessons taught over the last two years. "Most of the traction right now is in loading," the source points out. "There are a lot of people working on automation solutions." Clearly, loading technology has been

around for years, but now the thinking is that a higher level of sophistication is needed in the integration of vision systems technology and robotics. The post-vacuum process represents yet another area where automation can deliver value through weighing, tagging for traceability and putting product into shipping cartons. Progress may seem glacial sometimes, but the supply chain appears to be pulling in the same direction on this one.

Another more publicly visible and steady complaint swirling around vacuum packaging lands squarely in the recycling discussion. Most barrier materials are still multi-layered structures and difficult to recycle. Our source sums it up this way: "There's no magic material that is fully recyclable, monolayer, and has all the key performance attributes in terms of oxygen barrier, abuse resistance and other vital properties." He points out that what is often lost in the environmental furor is packaging materials have evolved to the point where they provide the maximum performance for the minimum cost. Changes to the material are going to affect both the cost and the performance and, generally, few in the supply chain are willing to pay more for it. It's a classic dilemma.

There is, however, a hopeful sidebar for vacuum packaging recycling. Without getting too deep into the weeds, he explains, "You must realize that there is no recycling infrastructure that will handle post-consumer crude packaging materials. The focus is more on doing chemical recycling of material through a pyrolysis process (decomposition brought about by high temperatures) that breaks down the polymers into their base chemicals, and those chemicals are reprocessed to make new polymers. Chemical recycling is probably the closest thing to reality today." It's encouraging news, but let's not get over our skis. Because of the considerable investment required to achieve any scale, this must be a corporate effort. There are several start-up companies out there, but none are recycling on a large scale.

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In addition to vacuum packaging's automation and recycling touchpoints, one veteran retail observer offers an intriguing marketing perspective for vacuum shrink bags. He believes there's an opportunity for smaller bags that has not been exploited to its fullest. He uses chuck roasts as one example. "Retailers already buy a lot of chuck rolls in bags as primals that are then cut into small portions, store overwrapped, and displayed in the meat case. Why not buy those smaller portions case-ready, in vacuum bags, and take advantage of the vehicle bags provide for eye-popping graphics that help to sell the product? You could include cooking method suggestions - slow cooker, oven - plus additional suggestions for the whole meal." He points to graphics' role in the growth of frozen seafood products when they went to gusseted standup pouches with powerful graphics. "If a shopper's going to spend \$20 or more for a 3-pound chuck roast, you want them to have a great experience and not sweating it out if the roast sits at home in the refrigerator for a few extra days. The quality of the meat in a store-wrapped package is not going to be as good as it would if it were in a vacuum bag." Admittedly, what he describes is happening in the marketplace, but he thinks they're only scratching the surface of the program's potential. "The key is, is there enough demand from retailers? It's the age-old dilemma of getting processors and retailers together for a solution. We have all the parts. Graphics. Smaller bags. And the benefits of extended shelf life for shoppers on the back end in their refrigerators."

Commercial vacuum packaging traces its roots back over three-quarters of a century. But its impact and reach may be greater today than those early days of revolutionizing whole-turkey packaging. Stay tuned.





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CROUNDBURGE PROCESSING:

PART HI-TECH, PART BACK TO BASICS

SMALLER PROCESSORS KNOW WHAT CONSUMERS WANT: SANITATION, TRACEABILITY AND CONVENIENCE.

BY MEGAN PELLEGRINI

CONTRIBUTING WRITER

The Virginia Tech-sponsored Meat Science Center processes 10,000 pounds of meat a year, which a traditional plant probably makes in half a shift. However, it's a witness to coming trends in the ground beef industry – automation, traceability and convenience – while educating future meat scientists and butchers.

"We can't compare to large companies," notes Jordan Wicks, meat lab manager, Virginia Tech, based in Blacksburg, Va. "But we still offer product to consumers every day and follow the same food safety guidelines." The student-run, USDA-approved meat processing plant and butcher shop partners with a local farm system for its product, and supplies a large amount of meat to the computed diving halls.

campus dining halls.

Ground beef processing is fairly automated, compared to other proteins. "Plants are pretty straightforward with processing ground beef: They have grinders, conveyor belts to move product from one place to another, and machines that pump product out to be shaped and given texture, dropped into a tray and packaged," says Wicks. "They are already very automated, and in the future they will continue to be, because automation helps alleviate food safety concerns."

In addition, robust traceability programs exist even within small-scale companies. "Traceability programs – even for smaller facilities – track the animal from the farm to lot number and on," notes Wicks.

Taking things a step further, block chain technology, or the ability to track cattle through the supply chain using digital tracking technology, is another useful but still relatively new tool. Ranches such as Flying Diamond Beef in Nebraska are using implanted Bluetooth sensors to track their steers' health and proof of life through the supply chain. The ranch is also using technology from other companies for facial recognition and analysis and genomic testing for unique identification.

Nurture Ranch in Texas is using its own Nurture Tracker technology to trace and share where and how its animals were raised, fed and processed.

"Moving forward, ground beef processing will continue to look at and follow consumer trends to give consumers what they want," notes Wicks. If consumers want more convenient packaging, traceability, scanning on their phones, accessibility and transparency, then consumers and processors will move these priorities forward.

Indeed, the Virginia Tech Meat Science Center receives many calls from consumers about its product, such as where its animals come from, notes Wicks. Customers ask if the cattle was grass-fed, supplied grains, given hormones, etc. "We train our students to answer consumers' questions and let them know we are safely producing high-quality products," says Wicks.

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PACKAGING CONVENIENCE

Smaller package sizes are trending as well today. Consumers are more interested in 1-pound versuss 2-pound packaging, packages with only two to six patties and smaller products like sliders in different sizes, notes Wicks.

"Versatility in packaging is an innovative way to move product," he notes. "More bulk packaging can then be offered during the holidays."

Ground beef is always in high demand for its flexibility, but pre-made patties and seasoned ground beef will also make up more ground beef products in the future, says Wicks.

"Processors should focus on what the consumer wants: more transparency, options or variety and convenience," says Wicks.

KEEPING IT LOCAL

Small, local niche markets are another growing area for ground beef products, which is a new consumer base that's formed since the pandemic started.

"The main supermarkets' shelves were empty in town, and they came to us for our production, processing and ability to retain their customers," says Wicks.

Increasingly, consumers want a local connection to their food, so this market should continue to grow.

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FLEXIBLE PACKAGING: THE SUSTAINABLE PACKAGING SOLUTION FOR E-COMMERCE

BY ALISON KEANE, ESQ., IOM, CAE, PRESIDENT AND CEO OF THE FLEXIBLE PACKAGING ASSOCIATION (FPA)

From pants to poultry, the COVID-19 pandemic has driven a surge in consumer demand for e-commerce goods delivered directly to their homes. According to figures from the U.S. Department of Commerce, e-commerce is experiencing a booming 32.4% surge from 2020—the highest annual e-commerce growth in at least two decades.1 It is expected e-commerce is now on track to surpass 20% of total retail by 2024.2

At the same time, the increasing number of shipments delivered directly to doorsteps has only increased consumer focus on packaging sustainability. Food companies transitioning to more e-commerce offerings – while striving to meet aggressive sustainability targets – should consider the full life-cycle benefits flexible packaging can deliver as part of their packaging mix.

The Flexible Packaging Association (FPA) recently conducted several real-world e-commerce case studies showing that flexible packaging, when compared to other packaging formats, has significantly better environmental attributes for greenhouse gas emissions, fossil fuel usage, and water usage. The Streamlined Life Cycle Assessment (LCA) case studies use EcoImpact-COMPASS[®] LCA software to quantify the environmental and economic shipping impacts of flexible and non-flexible e-commerce packaging. And while the case studies focused on items like cereal and peanut butter, the same lifecycle benefits can be applied to meat and poultry as well.

FOSSIL FUEL USAGE

Because flexible packaging requires fewer resources to manufacture, packages with flexible structures generally use significantly less fossil fuels than other packaging formats. For cereal, for example, our e-commerce case study showed using a stand-up pouch used considerably less fossil fuels than traditional bag-in-box options. The bag-in-box carton as shipped (1,031.6 g) uses nearly 4X the amount of packaging as the stand-up pouch system (277.6g), largely due to the two separate corrugated cases. Even when the overbox is eliminated, the bag-in-box option (536.5 g) still uses more than twice the fossil fuels as the stand-up pouch option.

This same principle can apply to meat and poultry e-commerce packaging, which generally uses multiple shipping containers.

GREENHOUSE GAS EMISSIONS

Overall greenhouse gas (GHG) emissions are lower with the lighter weights of flexible packaging structures. In the same cereal ecommerce case study, the bag-in-box options resulted in considerably higher overall GHG emissions than the stand-up pouch scenario. In fact, the bag-in-box option with the overbox results in +290% more GHG emissions, driven largely by the overall amount of packaging. Again, this is a similar application to meat and poultry e-commerce applications

WATER USAGE

Flexible packaging also requires significantly less water to manufacture. In that same case study, in fact, the bag-in-box cereal shipped with the overbox uses +708% more water compared to the stand-up pouch option.

REDUCING FOOD WASTE

According to the FPA Value of Flexible Packaging in Extending Shelf Life and Reducing Food Waste Report, with flexible packaging technology, a whole chicken remained fresh for shoppers to buy for 20 days. A pound of beef maintained its quality for 23 days versus 14 days when traditional packaging was used.

To learn more about the Flexible Packaging Association and review full case studies, including the Flexible Packaging Offers Significant Sustainability Benefits for e-Commerce Applications report, please visit www.flexpack.org.





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The **Meat Industry Hall of Fame** is planning an outstanding online event for February 2022, allowing you to celebrate the inductees from the comfort and safety of your home or office!

The Hall will produce a video for each of the inductees, honoring their service and success in the industry, to publish online in mid-January. These videos will culminate in a LIVE Webinar with selected inductees, February 2, 2022 @ 2pm.

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MANAGING DUST AND ODOR FROM POULTRY HOUSES

BY RICK KRECZMER, PRESIDENT OF ROBOVENT

Poultry dust and odor are a significant concern for poultry suppliers—and their neighbors. As new housing developments continue to expand into formerly rural areas where poultry houses operate, it may be necessary to rethink ventilation solutions for dust and odor control.

THE PROBLEM WITH POULTRY DUST AND ODOR

Large layer and broiler operations create both dust and odor.

 Poultry dust consists of dust particles from feed, bedding, feathers, skin cells, fecal matter and insect fragments, along with mold spores and bacteria. Because dust is wet and heavy, it does not typically travel far from the poultry house to become a nuisance to neighbors. However, exposure to this dust can be dangerous for both human agricultural workers and livestock. Poultry workers are at risk for irritation of the respiratory system, bronchitis, occupational asthma and zoonotic diseases carried by chicken feces.



RICK KRECZMER

- Odor from poultry operations is a complex mixture of ammonia from animal waste, volatile organic compounds, esters, aldehydes, amines and other substances. The most offensive odors are those created by anaerobic decomposition of manure and feed spoilage. Ammonia may be the strongest odor detected near the building, but because it is light and volatile, it tends to be diluted quickly as you move away from the farm. Other odors, especially those from feed spoilage or dead animals, may cause more problems downwind.

INDUSTRIAL VENTILATION SOLUTIONS FOR DUST AND ODOR CONTROL IN POULTRY OPERATIONS

Ventilation is required in all poultry buildings to maintain an adequate supply of fresh air for livestock, remove excess moisture and combustion gases from heaters in cold weather, and control temperatures in warmer weather. In a modern poultry house, the ventilation system generally combines natural ventilation (from the movement of wind through openings in the structure) and mechanical ventilation. A mechanical ventilation system has three basic components:

- Properly sized and placed exhaust fans to pull dirty air out of the building.
- Fresh air inlets to allow clean air in. (In some facilities, a make-up air system may be recommended to pull clean air in mechanically.)
- Controls to adjust the speed of the exhaust fans. Ventilation rates will vary by season. A minimum airflow rate must be maintained in the winter that prevents buildup of dangerous gases and odors while retaining as much heat as possible. In hotter months, airflow may need to be ten times or more the minimum rate to vent excess heat along with dust and gases.

A mechanical exhaust ventilation system removes both airborne dust and odors from inside the building, creating a much more comfortable environment for both humans and chickens. For effective dust control, the ventilation system must be combined with proper housekeeping and other measures to reduce the airborne dust load, such as water/oil spraying or electrostatic space charge systems (ESCS). Ventilation system design should also factor in elements such as local climate and prevailing winds, facility layout and natural ventilation openings, temperature and humidity control concerns, and the location of the facility in relation to residential neighbors.

THE USE OF STACK DISCHARGE VENTILATION TO REDUCE ODOR CONCERNS IN POULTRY FACILITIES

One option for poultry operations concerned about odor complaints from neighbors is to install a stack discharge ventilation system. In a stack discharge system, a ventilation stack is placed on the roof to exhaust airborne contaminants. The stack is typically 30%-50% higher than the building peak. The exhaust system is set to a very high discharge rate, up to 4,000 – 5,000 FPM (Feet Per Minute). The combination of the tall stack and high discharge rate pushes contaminated air much higher into the atmosphere than a typical exhaust ventilation system.

This system design helps with odor control, because odor is diluted more effectively this way. Airborne dust and gases are mixed with fresh air high in the atmosphere and are carried a longer distance before falling back towards the ground in a much diluted form. This method can provide enough dilution to avoid noticeable odors for neighbors.

Of course, the system will need to be carefully designed to meet other priorities for the operation, including livestock health and comfort, energy efficiency, and proper temperature and humidity control. An industrial ventilation engineer can help you decide whether a stack ventilation system is right for your facility.

When combined with proper housekeeping and other measures, a well-designed ventilation system can go a long way towards improving relations with neighbors and protecting the health and comfort of both humans and animals in the barn.

For more information, visit https://www.robovent.com.





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PREVIEW

INTERNATIONAL PRODUCTION & PROCESSING EXPORETURNS TO A LIVE EVENT IPPE IS SCHEDULED FOR JANUARY 25-27, 2022, IN ATLANTA

Until the disruption of COVID-19, the meat and poultry industry came together every January at the Georgia World Congress Center in Atlanta. That tradition will return in 2022, as IPPE will once again be live and in-person from January 25-27 at the GWCC. More than 500,000 square feet of exhibit space will be filled with the latest technological innovations and processing improvements for the industry.



The International Production & Processing Expo (IPPE) is a collaboration of three shows - International Feed Expo, International Meat Expo and the International Poultry Expo - representing the entire chain of protein production and processing. The event is sponsored by the American Feed Industry Association (AFIA), North American Meat Institute (NAMI) and U.S. Poultry & Egg Association (USPOULTRY).

"We are excited about offering an in-person 2022 IPPE and are encouraged by our strong exhibitor participation," remarked show organizers. "It demonstrates that our exhibitors are enthusiastic about reconnecting and showcasing the latest technologies and services that will continue to drive the industry forward."

More than 1,000 exhibitors will be displaying their equipment, supplies and services. For attendees who are interested in learning more about latest developments in processing and production, an Innovation Station/New Product Showcase will provide attendees with an outstanding opportunity to see the newest products or innovations offered by exhibitors. TechTalks will take place on the show floor throughout exhibit hours. They are short educational presentations by exhibitors regarding operations and technical issues critical to all aspects of the feed, meat and poultry industries.

In addition, there will be more than 120 hours of education sessions, covering meat and poultry processing, animal production and the feed industry. Paid programs, which require a separate registration fee, include the International Poultry Scientific Forum, Latin American Poultry Summit, and Pet Food Conference. Free programs that are included with registration at IPPE include the Animal Agriculture Sustainability Summit, the Poultry market Intelligence Forum and the Future of Work and Workforce Issues.

For more information, or to register for IPPE, please visit https://www.ippexpo.org/.





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