

By William J. Kohley, Ph. D.

Effective Pathogen Protection Through Spray Control Technologies

The U.S. Department of Agriculture (USDA) continues to review compliance standards for eliminating food borne pathogens in meat products, having issued the “Interim Final Rule on Control of *Listeria monocytogenes* in Ready-to-Eat (RTE) Meat and Poultry Products” in October 2003. While final regulations will likely not be in place until 2006, the interim measures encourage RTE producers to use *both* post-lethality treatments *and* antimicrobials to significantly reduce the risk of *Listeria* presence and/or growth, in addition to maintaining aggressive sanitation practices throughout processing machinery and equipment.

While different compliance options exist for processors to choose from, it is very clear that enforcement of these regulations will not be taken lightly. Processors that do not conform will likely face heavy fines or be shut down indefinitely until compliance is achieved.

In response to the USDA’s ruling, the American Meat Institute Foundation (AMIF) developed four strategies to guide its members in controlling *Listeria*. Two of those key strategies—enhanced sanitation and improved post-lethality treatments—are the focus of this article. New spray technology available today can help processors by ensuring that:

- Machines and equipment are effectively cleaned with minimal water usage.
- Sanitizing and antimicrobial chemicals are properly applied.

The remainder of this article will address the “triangle of successful pathogen protection”—an approach to achieving success in these AMIF strategies featuring advanced spray technology. The fact that fully-optimized spraying applications can also help

processors improve product quality, decrease production costs and increase throughput are added bonuses and will also be addressed.

THE TRIANGLE OF SUCCESSFUL PATHOGEN PROTECTION

Successfully eliminating food-borne pathogens requires expertise in three key areas: food production processes, chemistry and application technology for chemical intervention. These three disciplines must work in unison to maximize the impact of anti-pathogen strategies (Figure 1).

Process Criteria. Production techniques are determined by the individual meat processor in accordance with Good Manufacturing Practices (GMPs), Sanitation Standard Operating Procedures (SSOPs) and their own Hazard Analysis and Critical Control Points (HACCP) plan. The design or upgrade of a processing line will ultimately be controlled by the processor because no one knows better than the processor the variables involved in manufacturing their product.

However, processors can benefit from partnering with chemical and application professionals before the physical structure of their line is complete or when upgrades are planned for a processing line. Such outside experts can provide valuable insight that can significantly improve advanced pathogen control and line efficiency.

Chemistry. The next point of the triangle is determining what types of chemicals are appropriate for your processing needs. Substantial progress has been made by food microbiologists and chemical suppliers in recent years to develop safe, effective and reliable chemicals to destroy pathogens. Factors such as chemical concentration, temperature and carrier all affect the “kill rate” of anti-microbial agents. Experts from chemical companies provide counseling to meat processors on the chemistry necessary to secure pathogen control on the line.

Application Technology. The final point of the triangle is one that is too often overlooked by meat processors. This involves the reliable delivery of effective

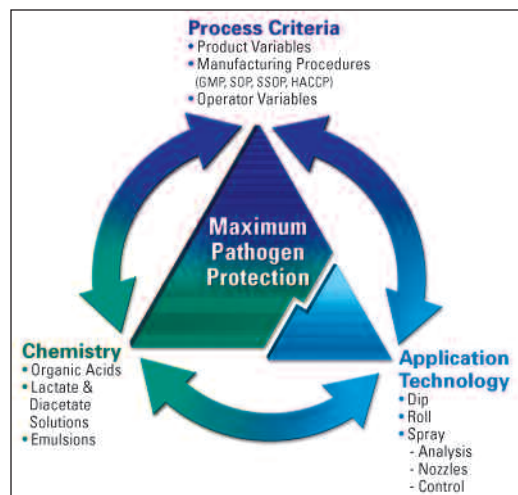


Figure 1.

chemicals; i.e., how chemicals are physically applied to equipment and to food before the product is packaged, sealed and delivered to customers. Even the most technically advanced chemicals cannot prevent pathogen “grow out” if they are not applied accurately.

Advanced spray technology is an ideal solution for many sanitation and pathogen protection applications. Proper nozzle selection allows effective sanitation and chemical application without overspray. Highly automated spray systems controlled by innovative software are now available to direct and verify the application of chemicals more precisely than ever before—a very important feature for processors validating their programs for “alternative” status.

SPRAY TECHNOLOGY FOR PATHOGEN PROTECTION SYSTEMS

Optimizing spray performance for meat processors involves proper spray nozzle selection, preventative maintenance, spray analysis and automated spray control. Choices in each of these areas address critical aspects of the sanitation and pathogen control challenge.

Spray Nozzles. Thousands of different products are available from spray nozzle manufacturers, and their value to anti-pathogen efforts depends on several performance factors:

- Flow rate: The volume of fluid sprayed at a given pressure.
- Spray pattern: The dimensions and uniformity of coverage on the desired target.
- Drop size and velocity: The particle size and speed.
- Cycle speed: An automatic nozzle’s ability to spray intermittently based on process variables such as line speed or product size.

A strong knowledge of spray technology is required for proper nozzle selection. The commonly held belief that simply increasing spray pressure and flow rate will improve cleaning effectiveness can be counterproductive in many cases. High pressure sprays may actually disperse pathogens and high flow may create a more hospitable environment for pathogen growth. Advanced spray technology provides methods for low pressure, low flow sanitation processes.

The physical condition of spray nozzles

also greatly impacts results. A worn nozzle can significantly affect the flow rate of the chemicals or water being sprayed long before a change in the spray pattern is visible. Over-application of chemicals or water can be expensive, therefore, establishing a preventative maintenance plan for your spray system is a critical step to effective sanitation and pathogen protection. Again, knowledge of spray nozzle operation is critical in establishing this plan.

Spray Analysis. In some cases, analyzing your spray application with sophisticated testing equipment can improve the performance of existing chemical programs. Spray analysis can help determine three key spray performance criteria:

- Particle size: The optimal size of individual droplets for chemical efficacy
- Spray velocity: The proper droplet speed, which, combined with drop size, affects the impact of the spray on the target.
- Nozzle positioning and spacing: The physical location of nozzles on the processing line.

Misting and overspray can result from droplets that are too small in size.

Excessive velocity caused by too much pressure may cause splashing or bounce-back of liquids. Improper placement of spray nozzles can result in poor coverage of the target area. Together, these factors have significant impact on the effectiveness of anti-microbial agents, and advanced spray analysis, can be helpful in optimizing your system.

Spray Control. After choosing the right nozzle and determining the right operating conditions, additional challenges face you as you seek to optimize your spray system. Monitoring and controlling your system so that it operates at peak efficiency can have significant impact on your product quality and food safety. But monitoring and controlling spray variables manually can be very difficult. This is a key reason why automated spray control technology is gaining increased recognition in the food industry, particularly from meat processors.

Dedicated spray controllers that monitor and operate spray nozzles can be an invaluable tool in assuring peak performance and compliance with USDA - pathogen reduction directives. Spray controllers are pre-programmed with nozzle performance data, are up to 10 times faster than basic PLCs and can provide excep-

tional timing and flow control in any spraying application used for food processing. An automated spray control system can usually be installed and placed into operation with minimal downtime and virtually no programming time. Once installed, ongoing maintenance and operation of spraying applications are greatly simplified.

EXAMPLES OF ADVANCED SPRAY TECHNOLOGY

Two simple examples will serve to demonstrate the value of an automated spray system in sanitation and pathogen protection.

Sanitation. Nightly spraying with quaternary ammonia (quat) using portable sprayers is a common method for sanitizing food and meat processing equipment. Manual spray application of quat requires sanitation labor and results in inconsistent application of chemicals by different operators. If too little chemical is used, food safety is at risk. If too much chemical is used, the equipment must be completely washed down before resuming production. Proper spray coverage is also dependent on the operator.

An automated fogging system with a dedicated spray controller and air atomizing nozzles suspended from the ceiling can dramatically improve this process, improving food safety while providing a quick payback. The fine mist provided by such systems can evenly coat the processing equipment and all exposed surfaces in the spray zones at the touch of a button, eliminating the need for manual spraying. The quat is atomized with consistent drop size and distribution.

A spray controller can monitor and operate dozens of spray zones throughout the plant, while providing independent control for each zone. In addition, the controller can ensure precise dilution and consistent application of the cleaning chemicals—factors that are critical to meeting governmental regulations. The status of any zone within the plant can quickly be checked and adjusted as necessary and data logging is an important step toward compliance.

Ascorbic Acid Spray. The application of ascorbic acid on meat products using hand-held spray devices is another operation that will show how advanced spray technology can benefit the meat processor.

Common challenges found in this operation include improper timing or misdirection of the spray patterns; under- or over-application due to operator error or worn spray nozzles; and misting due to excessive spray pressure.

The inconsistent chemical coverage, excessive chemical use, unsafe work environment and improper package sealing problems that can result are all significant threats to product quality, food safety and worker safety. An automated spray system with a dedicated spray controller can improve the ascorbic acid spray operation in several ways:

- Precise spray timing and proper nozzle positioning ensure spray coverage only on the target area—not on equipment or on packaging surfaces that could cause sealing problems.
- Accurate flow control is maintained for proper chemical dosage even when line speeds change.
- Operators can be notified or the entire system shut down if spray performance varies beyond acceptable ranges, such as when a nozzle wears or becomes plugged.
- Spray data logging can facilitate compliance.
- If necessary, standard communication protocols allow integration with existing plant control systems.

CONCLUSION

Meat processors have a common goal: ensure the highest level of food safety possible while minimizing labor and chemical costs. Optimizing your processes with advanced spray technology can help:

- *Increase product and process quality:* An automated spray control system can adjust for varying production conditions quickly and accurately, eliminating human error and reducing labor costs.
- *Reduce chemical usage and improve worker safety:* An automated spray control system can ensure optimal chemical usage and prevent overspray, for better working conditions in cases where overspray can cause slippery floors or misting that affects air quality.
- *Improve system monitoring and data logging:* An automated spray control system provides added assurance when chemical application is difficult to monitor and can track chemical usage for easier compliance.

Safe treatment of equipment and food during processing is, of course, smart business. The already stringent government standards will very likely be heightened in the years to come, making compliance the most significant challenge for meat processing companies. And nothing can affect sales more negatively than publicity stemming from a product recall. So while every food processor's goal is to produce the safest and highest quality food product at the lowest cost, it is easier said than done. QA, process engineering, production and maintenance staff must communicate to optimize operations. Without leading-edge performance in all three areas of the "triangle of successful pathogen protection"—process criteria, chemistry and application technology—food safety can suffer, perhaps with devastating results.

Spray technology is the ideal application method for many food safety challenges, but the required expertise is rarely found on the food processor's staff. Partnering with an experienced spray technology company is your shortest path to success. Look for decades of experience in design and production for specific applications, coupled with state-of-the-art technology and testing capabilities and you have a winning team for consistently defeating pathogens in your production process. □

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