



# OPTIMIZING THE EFFICACY OF ANTIMICROBIAL APPLICATION ON MEAT & POULTRY

When it comes to food safety, there is no room for risk-taking. The challenge isn't whether to protect products against pathogens; it's to identify the best approach for your processing operations. There are many options available and technology is changing rapidly. In this white paper, you'll learn a bit about the different approaches to pathogen control and a lot about one technology that is highly effective, versatile and lower cost than other options: applying antimicrobials to processed meats/poultry prior to packaging.

## INTERVENTION OPTIONS

There are four equipment options for treating meat and poultry for pathogen protection and each relies on different technology.

- 1. Ultra pasteurization**
- 2. High-pressure pasteurization**
- 3. Modified Atmosphere Packaging (MAP)**
- 4. Spray application of antimicrobials**

### 1. ULTRA PASTEURIZATION

Ultra pasteurization is the process of thermally treating packaged meats at elevated temperatures. Exposure to these temperatures must be at the surface of the meat for a length of time such that all potential contamination is exposed to the treatment. Under the right conditions, this method can be effective. Typical equipment cost is about US\$500,000 and installation costs are comparable bringing the total to US\$1 million.

This method doesn't work with overlapped products because it requires a prolonged exposure to heat. Depending on the type of product, organoleptic properties also become a concern.

### 2. HIGH-PRESSURE PASTEURIZATION (HPP)

High-pressure pasteurization (HPP) utilizes high pressure, 15,000 to 88,000 psi (1034 to – 6067 bar) to kill pathogens. This method is extremely effective and typically achieves 4-8 log reductions. Equipment for HPP can range from US\$500,000 to US\$2.5 million. The equipment includes a large chamber where the product is placed for processing. HPP, while highly effective, can limit production because it is a batch process.

Cost in use is 3 to 10 cents per pound. The effect of HPP on organoleptic properties with RTE meat is not usually an issue, but some products may undergo some changes.



### 3. THE MODIFIED ATMOSPHERIC PACKAGING (MAP) PROCESS

The MAP process uses specific packaging in which the internal atmosphere of the package is flushed with  $N_2$ ,  $CO_2$ , CO or a mixture of those elements. MAP is effective for shelf life extension and has no effect on organoleptic properties. MAP equipment typically costs approximately US\$300,000.

However, the effectiveness of the process is dependent on packaging. Keep in mind that only bacteriostatic effects are possible with MAP, so processors are limited to Alternative 2 status when using this equipment. The use cost of MAP is generally twice the cost of traditional vacuum packaging.

### 4. SPRAY APPLICATION OF ANTIMICROBIALS

Spray application of antimicrobials is the fourth option. The antimicrobials are often applied in the package but can occur prior to packaging as well. The system enables easy adjustment of the volume of antimicrobial being applied. The equipment cost is generally about US\$150,000 and major line/plant modifications are not required for installation.

Alternative 1 status can be obtained with some antimicrobials that contain bacteriostatic and bacteriocidal properties since both are applied in one step. Use cost ranges from ½ to 3 cents per pound. Keep in mind that certain antimicrobials must be contained well when sprayed, so factor that in when evaluating antimicrobials.

## SELECTING THE BEST ANTIMICROBIAL

Antimicrobials come in a variety of forms and options must be carefully evaluated. Factors such as ingredients, efficacy and handling, shelf life, clean labeling requirements, application requirements and cost can vary widely, and will drive the ultimate selection. Keep in mind that the application equipment can have a significant impact on the effectiveness of the antimicrobial. Be sure to closely consider how the equipment controls volume and placement.

Most antimicrobials are shipped in a concentrated form and require mixing on-site with water at a determined ratio. The storage temperature of the concentrate and mixed solution may differ so be sure to understand the requirements early in the evaluation process. Also, keep in mind that most antimicrobials have a shelf life after being mixed, usually one to five days.

Some antimicrobials must be listed on product labels; some do not. It depends on whether the antimicrobial is considered a processing aid. This classification is often dependent on the regulatory limits of the application level of the antimicrobial.



## WHERE AND WHEN TO APPLY?

Throughout meat and poultry processing plants there are a number of locations where antimicrobials can be applied. The most common application points are just after slaughter and as close to packaging as possible.

While antimicrobial systems can be effective at various stages in the process, a very well-established application point is in the package. This process was developed and established by the United States Department of Agriculture/ Agricultural Research Service (USDA/ARS). In May of 2006, the Food Safety and Inspection Service (FSIS) released the compliance guideline for Controlling *Listeria Monocytogenes* in Post-Lethality Exposed Ready-to-Eat Meat and Poultry. The *Listeria* Rule Alternatives 1 or 2 can be achieved depending on the antimicrobial agent. At the point the roll stock or whole muscle product is loaded, an antimicrobial is also dispensed into the package.

For other products, a variety of other locations for application of the antimicrobial can be targeted.

## BEST PRACTICES IN SPRAYING ANTIMICROBIALS

- Applying antimicrobials in the package is ideal. The package is the last point of intervention after exposure to other potential sources of contamination, such as conveyors, tables and personnel
- If spraying just prior to packaging, choose a point where contact surfaces of the product are accessible. If the product comes in contact with other surfaces after the antimicrobial application, be sure those surfaces have been sanitized. For example, conveyors should be sanitized to eliminate potential contamination
- Trim and other products that are going to be ground should be sprayed with antimicrobial prior to grinding. Exposed product surfaces that could have potential contamination are lowest at this point. The antimicrobial is typically sprayed into a blender or mixer
- Any type of equipment that comes in contact with the products should be sprayed periodically with sanitizers to limit the spread of contaminants
- Consult with experts. Spraying antimicrobials requires a high-level of precision and is not attainable with workers using spray bottles or holes drilled in pipes





## GUIDELINES FOR EQUIPMENT SELECTION

While spray systems may seem simple, they are not. Even slight problems can cause reductions in product produced, downtime, and excessive antimicrobial usage. Properly designed equipment will ensure the antimicrobial is applied properly and without waste.

### DILUTION, MIXING AND DOSING

Nearly every antimicrobial comes in a concentrated form and requires dilution. Antimicrobials can be mixed manually. However, because manual mixing is operator dependent, it isn't very precise or repeatable. Automated mixing/refill equipment eliminates the variations found in manual mixing and reduces the potential for contamination. When antimicrobials are exposed to airborne bacteria and surfaces such as containers, the opportunity for contamination exists.

Most processors run a variety of products on a single line. Each product may require a different volume of antimicrobial. Spray equipment should be able to easily and quickly accommodate different products. In fact, it should be as easy as a couple of taps on a touch screen. If physical changes to the equipment are required, quality control is typically compromised.

The efficacy of antimicrobials is based on the concentration and volume applied. As discussed earlier, an automated refill system can help ensure the proper concentration is achieved. The volume of antimicrobial applied is just as important. Applying the proper volume ensures the kill required for the process occurs.

### OPERATION AND OPERATOR REQUIREMENTS

Understanding how the system operates before any decisions are made is important. Daily tasks and operation should be simple. Actions to change volume, change antimicrobials and calibration should be easy to learn. Wear parts and any other items that may require service should be easily accessible.

### CONSTRUCTION

Consider the materials used in the system. Will they withstand wash down, high pressure fluid exposure, cold temperatures, high temperature shock, humidity, and corrosive chemicals? Be sure to check and make sure all components are stainless steel including electrical covers, caps, seals and lids and that sanitary connections are used throughout the system. Although some antimicrobials are capable of killing most undesirable bacteria, threads are difficult to clean and should be eliminated.

### OVER-APPLICATION OF THE ANTIMICROBIAL CAN CAUSE A VARIETY OF NEGATIVE EFFECTS:

- Customer satisfaction may decrease as over-application can create unpleasant smells or liquid in packages
- Regulatory limits can be exceeded and result in fines or recalls
- Costs can spiral out of control. If a plant produces ten million pounds of product in a year, and the cost/lb of the antimicrobial is \$0.01/lb, the annual cost of antimicrobials is approximately US\$100,000. If antimicrobials are over applied by 20%, the annual cost of antimicrobials jumps to US\$120,000





## CONCLUSION

Determining the best approach to food safety is dependent, of course, on the types of products being processed, the processing facility and equipment, annual production and more. Applying antimicrobials with spray equipment offers many advantages over other technologies. Cost, ease-of-use and precision application are attractive to processors of all sizes. Depending on which antimicrobials are used, shelf-life extension, cleaner labels, improved customer satisfaction, Alternative Status 1 or Alternative Status 2 are also possible benefits.

## ABOUT THE AUTHOR:

Josh DeVoll is a Director of Market Solutions at Spraying Systems Co. and specializes in food safety and coating applications in the food industry. Josh has extensive experience in meat processing and has worked with many of the leading companies in the industry. A graduate of Saint Louis University with a mechanical engineering degree, Josh has been with Spraying Systems Co. for nine years. Prior to that, he designed temperature-sensitive packaging and shipping containers for a leading manufacturer of hygienic products.



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