FSE-X-07

Extension FactSheet

Food Science and Technology, 2015 Fyffe Road, Columbus, OH-43210-1007

Post-Packaging Pasteurization Procedures for Smaller Meat Processing Plants to Prevent Survival of *Listeria monocytogenes*

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What is *Listeria monocytogenes* and why should meat processors worry about it?

L. monocytogenes is a serious biological hazard for ready-to-eat (RTE) meat products, as it is most often introduced onto the surfaces of meat products after the products are fully cooked, but before they are packaged. *L. monocytogenes* is tolerant of refrigerated temperatures and the anaerobic environment of the vacuum package, and will continue to grow throughout the long refrigerated storage times of modern RTE meat products. The problem becomes serious when young children, pregnant women, immunocompromised individuals, and elderly consumers eat RTE meat products directly from the package without reheating the product, or improperly reheat such products.

What steps can I take to reduce Listeria risk?

Cooked meat products can become contaminated with *L. monocytogenes* by environmental sources, such as air, and contact surfaces (table tops, slicers, knives, workers aprons, etc.), particularly when the product is exposed to the environment between cooking and packaging.

You can minimize post-cooking contamination by good cleaning and sanitizing procedures, addition of anti-microbial compounds (such as sodium lactate, sodium diacetate, etc.) to the product formulations to prevent growth of Listeria in the product, proper separation of raw and cooked products, and use of a post-packaging pasteurization process.

What is the advantage of post-packaging pasteurization for small processors?

As a result of the USDA FSIS RTE Interim Final Rule, RTE meat processing procedures were categorized according to relative risk to final consumers. USDA requires the processors of RTE meat and poultry to adopt one of the following three alternatives to control Listeria.

Alternative 1, the processor uses a post-lethality treatment that reduces or eliminates L. monocytogenes AND an antimicrobial agent or process that suppresses or limits *L. monocytogenes* growth throughout product shelf-life.

Alternative 2, the processor uses either a post-lethality treatment that reduces or eliminates *L. monocytogenes* OR an antimicrobial agent or process that suppresses or limits *L. monocytogenes* growth throughout product shelf-life.

Alternative 3, only sanitation measures are relied upon to control *L. monocytogenes*.

What are the regulatory requirements for post-packaging pasteurization?

The minimum requirements for post-packaging pasteurization, according to the USDA FSIS RTE Final Rule, is between a 1 and 2 log reduction of *L. monocytogenes.* Validation of a post-lethality treatment is expected to show that the process is working as intended. Validating the level of reduction of *L. monocytogenes* is likely to be more difficult for smaller processors than the actual reheating process. To validate this process, processors would need to monitor the heating time, the water temperature, and the product surface temperature during reheating to validate that sufficient heating has occurred on the surface to destroy all surface *L. monocytogenes.*

How does post-packaging pasteurization work?

Post-package pasteurization is commonly used by meat processors to prevent *L. monocytogenes* survival in RTE products and to allow them to operate in Alternative 1 or 2 of the USDA FSIS RTE Final Rule. The process involves applying heat to the packaged product surface to destroy organisms that may be there as a result of cross contamination. Heat can be applied by exposing the packages in hot water or steam for a predetermined time.

How can the post-packaging pasteurization process be done by smaller meat processors?

Post-packaging pasteurization is typically done using hot water or steam with equipment designed specifically for this purpose. However, post-packaging pasteurization can also be accomplished by using a water tank that many smaller processors have in their operation. Water needs to be preheated, often to at least 185°F, to which the vacuum packaged RTE products are submerged until adequate surface heating occurs.

Processor should consider a number of factors when using post-packaging pasteurization, including:

- Type of packaging film: film composition and thickness
- Mass and shape of product
- Type of meat: lean vs. exterior fat, beef vs. chicken, etc.
- Capacity of hot water tank and amount of water in the tank
- Ratio of product to water in the tank
- Temperature of the water in the tank
- How long the product is treated in the tank

OSU research established time and product surface temperatures for achieving a 7-log reduction of *L. inocua*. This additional lethality (7-log vs. the targeted 2-log reduction of the Interim Final Rule) provides a margin of safety, in the event that the processing conditions of smaller processors do not exactly duplicate those at OSU. These results can be found in the Validation of Post-packaging Pasteurization in a Vacuum-Packaging System to be used in Small and Very Small Meat Establishments (Ahn et al., 2007).

How can a smaller processor validate their post-packaging pasteurization process?

To properly validate such a process, processors would need to monitor the heating time, the water temperature, and the product surface temperature during reheating.

Figure 1. Placement of thermocouple (through the packaging film) beneath the surface of the packaging film, using silicone caulk to prevent loss of vacuum.

Research at OSU, funded by USDA FSIS has evaluated several options that smaller processors have available to them that make this process simpler. Appreciating that it would be difficult for smaller processors to monitor the temperature of the product surface (under the vacuum package) as done at OSU, additional, relatively inexpensive methods were developed that would allow

smaller processors to determine what that product surface temperature would be during post-packaging pasteurization.

Processors can use a hand-held infra-red thermometer. An infrared thermometer is a non-contact temperature sensor. These sensors detect the infrared energy emitted by the materials and converts the energy factor into a temperature reading. These thermometers can be purchased from vendors who sell temperature sensors (such as Omega Engineering (www.omega.com)

This method requires some training, as the reading must be taken immediately after raising product from the hot water or from the smoke house. However, errors in reading would most likely be on the conservative side, since the product surface chills very rapidly once the product is removed from the hot water or steam environment. Examples of target package surface temperatures (using the infra-red thermometer) can be found in the OSU Process Lethality Results, at: http://www.ag.ohio-state.edu/~meatsci/PostPackResults6.07.doc

An additional method for small processors to use would involve the application of self-adhesive temperature indicators to the surface of products, so that after the processors had followed the validated time-temperature recommendations from this study, that they could verify that their products had reached the targeted surface temperature. These temperature indicators could be removed from the product surface before selling the products. Realizing the temperature difference between the outside of the package (where temperature indicators would be applied commercially) and the more critical product surface temperature (under the package), the required outside surface temperature was determined to provide the required lethality to the product surface. In other words, if the product surface (under the package) temperature needs to be 157ºF to achieve adequate surface lethality, the outside surface temperature indicator would need to show a minimum of (e.g.) 172°F (See the OSU Process Lethality Results, at: http://www.ag.ohio-state.edu/~meatsci/PostPackResults6.07.doc)

Figure 2. Self-adhesive temperature indicator, placed on the surface of packaged products.

How could a smaller processor do a challenge study to validate the safety of their post-packaging pasteurization process?

Following the normal cooking/smoking process, products were inoculated with 7-logs of *L. inocua*, which is a non-pathogenic type of Listeria which has similar heat resistance to *L. monocytogenes.* Whereas we inoculated our cooked products with *L inoccua* in our own lab, this could be done by private laboratories. It is also recommended that a cocktail of multiple strains

of Listeria be used instead of only *L. inocua*. Following inoculation, product was vacuum packaged a second time, before the post-packaging pasteurization procedure was applied. Any processor attempting to repeat this process in their own establishment needs to consider the risks of vacuum packaging a product which has been inoculated with Listeria, even a non-pathogenic type of Listeria. Any Listeria, which might get out of the inoculated package, could show up on your environmental Listeria test results. It is recommended that processors use a small packaging machine (which is to be used only for this purpose) outside of the inspected RTE area (e.g., slaughter floor, maintenance area, etc.) Some testing laboratories may also have vacuum packaging equipment, which would allow them to do the vacuum packaging outside of your inspected facility. Following the vacuum packaging, it is recommended that each sealed package be dipped in a solution of 100% alcohol or a commercial sanitizer that is known to be effective against Listeria. This is to prevent cross contamination during the post-packaging pasteurization process. If an inoculated package breaks during the reheating process (in the water), it is assumed that the Listeria would be destroyed in the water. However, if a package should be dropped on the floor, it would be wise to have a solution of an anti-Listeria agent close at hand, to clean up the spill, to minimize the chances of contaminating the environment of your establishment with *L. inocua*.

Once packaged, inoculated product would need to be heated treated in a water tank to simulate your process (consider water temperature, amount of product to be treated in each batch, etc.)

References

Ahn, J., Knipe, C. L., and B. Balasubramaiam. 2007. Validation of Post-packaging Pasteurization in a Vacuum-Packaging System to be used in Small and Very Small Meat Establishments. J. Food Protection (In Progress)

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