American Meat Science Association

INTERVENTIONS AND MITIGATION STRATEGIES FOR THE POULTRY INDUSTRY

Salmonella enterica is a bacterial species that causes salmonellosis, which is one of the most significant foodborne illnesses worldwide. It is found across a wide variety of foods including poultry, produce, red meat, eggs, and other products.[1] Approximately 2,600 serotypes of *Salmonella* exist and can vary in their pathogenicity or ability to cause illness.[2] Because of these inherent attributes, risk-based mitigation strategies for *Salmonella* must include a multi-hurdle approach to reducing pathogen prevalence from farm to fork. In the poultry industry this means that multiple and sequential antimicrobial interventions should be implemented in order to apply a cumulative effect to reduce pathogenic presence. Due to the complexity of *Salmonella*, the more information gained about the particular serotype through testing, the more targeted intervention can be applied since not all serotypes react the same (Figure 1).[3] The effort to control *Salmonella* within the poultry industry is shared by the producers, processors, and consumers to ensure a safe product is consumed.

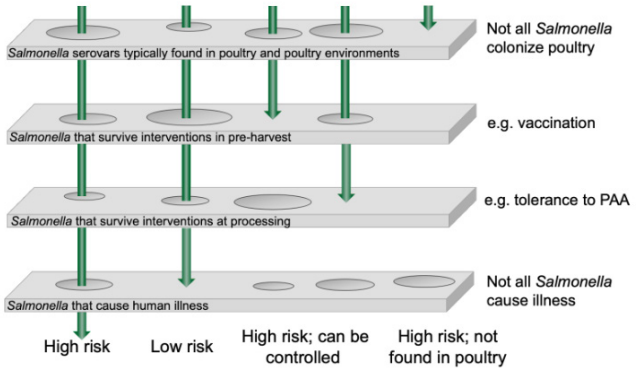

Figure 1. Interventions and survival of *Salmonella* serovars (serotypes).[3]

Pre-Harvest

There are various transmission routes for the spread of *Salmonella* in the pre-harvest environment, including transmission through eggs, transmission among birds, exposure to contaminated water, feed, and bedding, and environmental exposure due to inadequate biosecurity and pest control practices.[4] There is no single prevention strategy to mitigate *Salmonella* at the pre-harvest stage, so a multi-hurdle approach is necessary.

Pre-harvest controls include a variety of measures including strict biosecurity plans, vaccination of breeder flocks for *Salmonella*, pathogen-free feed components, litter management and acidified water. Other pre-harvest interventions that may be considered include probiotics, such as Bifidobacterium, Lactobacillus, and Bacillus. These probiotics may inhibit bacterial growth in the gut and reduce *Salmonella* prevalence and spread. Probiotics, alone or combined with vaccines, enhance their efficacy in mitigating *Salmonella* in poultry. The selection of probiotics should be inhibitory to *Salmonella*.

Prebiotics selectively enhance the growth of beneficial gut bacteria for an overall health benefit by the host. Synbiotics, the combination of probiotics and prebiotics, aid in the survival and implementation of administered probiotics in the gastrointestinal tract.[5]

Processing

One of the first lines of defense that should be considered to reduce pathogenic prevalence within processing facilities is the implementation of good manufacturing practices (GMPs) and Standard Sanitation Operating Procedures (SSOPs) to ensure a clean facility and hygienic employees. Facilities must also ensure employee health and processing area cleanliness to protect the employees, products, and consumers.[4] In addition to GMPs and SSOPs, facilities can implement additional intervention strategies to ensure a safe product for consumers. Various interventions can be implemented during poultry processing which are both physical and chemical methods.

Antimicrobials are key in minimizing contamination in poultry processing through a multi-hurdle approach. They can be applied at multiple steps, including equipment spraying, carcass washing, reprocessing, immersion chilling, and post-chill treatment. Regular bio mapping of the processing plant helps decision makers assess the efficacy and identify antimicrobial use sites which enhance process control.

Food Service & Consumer Handling

Once a product enters the food service chain or is purchased by a consumer, it is important to follow proper handling procedures. By adopting proper measures, such as thorough handwashing before and after handling raw poultry, utilizing separate cutting boards and utensils for raw and cooked foods, not washing raw poultry which may spread bacteria and maintaining a sanitized kitchen environment, individuals can significantly reduce the risk of cross-contamination.

Cooking poultry to the recommended internal temperature, of 165°F (74°C) as recommend by USDA-FSIS,[6] provides an added layer of protection for consumers.

The temperature should be taken at the thickest part of the meat to verify that the innermost part of the meat is cooked to the minimum required temperature. Table 1 outlines various cooking times and methods for poultry products to reach a safe minimum internal temperature.

Summary of Best Practices for *Salmonella* Control

Multiple interventions are needed as part of risk-based mitigation strategies to control *Salmonella* in poultry from farm to fork. Figure 1 shows how different serotypes respond differently to interventions which supports the need to identify the specific serotypes present in a product, not just presence or absence of *Salmonella*, to fully understand public health risk. Strict biosecurity measures, including sanitation and hygiene, are highly important in pre-harvest stages of production to prevent and control *Salmonella*. Vaccines, probiotics, and prebiotics offer a mitigation strategy to reduce *Salmonella* prevalence before birds are transported to slaughter by improving the gut and overall health of the bird. In processing facilities, a combination of GMPs, facility sanitation, and chemical interventions should be utilized to control *Salmonella* and other pathogens within the facility. Post-processing, there should be a strong emphasis on consumer education for the handling and cooking of raw poultry products. Mitigation and control of *Salmonella* is complex, requiring additional factors to be considered for the control of *Salmonella* throughout the poultry industry. Factors include changes in environment, pathogenic serotypes, emerging technologies, consumer awareness and education of possible cross-contamination and proper handling methods.[7] As scientific data and emerging technology are continuously updated, risk-based mitigation strategies will evolve, allowing for new routes to controlling *Salmonella*.

Key Points

- Multiple interventions are needed to control *Salmonella* in poultry from farm to fork.
- Different serotypes respond differently to interventions.
- Identifying specific serotypes, not just presence or absence is important to fully understand public health risk of a product.
- Biosecurity measures are very important in pre-harvest to prevent and control *Salmonella*.
- Vaccines, probiotics, and prebiotics may provide a mitigation strategy to reduce *Salmonella* at the farm.
- A combination of GMPs, facility sanitation, and chemical interventions should be utilized to control *Salmonella* and other pathogens within the facility.
- Proper handling and cooking of raw poultry is essential. Continuing consumer education is also important.

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Table 1. Approximate Chicken Cooking Times Required to Reach 165°F Minimum by Various Cook Methods[6]

Type of Chicken	Weight	Roasting 350° F	Simmering	Grilling
Whole broiler-fryer*	3 to 4 lbs.	1 ¼ to 1 ½ hrs.	60 to 75 min.	60 to 75 min.**
Whole roasting hen*	5 to 7 lbs.	2 to 2 ¼ hrs.	1 ¾ to 2 hrs.	18 to 25 min./lb.**
Whole capon*	4 to 8 lbs.	2 to 3 hrs.	Not suitable	15 to 20 min./lb.**
Whole Cornish hens*	18 to 24 oz.	50 to 60 min.	35 to 40 min.	45 to 55 min.**
Breast halves, bone-in	6 to 8 oz.	30 to 40 min.	35 to 45 min.	10 to 15 min./side
Breast halves, boneless	4 oz.	20 to 30 min.	25 to 30 min.	6 to 8 min./side
Legs or thighs	4 to 8 oz.	40 to 50 min.	40 to 50 min.	10 to 15 min./side
Drumsticks	4 oz.	35 to 45 min.	40 to 50 min.	8 to 12 min./side
Wings or wingettes	2 to 3 oz.	30 to 40 min.	35 to 45 min.	8 to 12 min./side

*Unstuffed. If stuffed, add an additional 15 to 30 minutes.

** Indirect method using drip pan.

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