

Controlling *Salmonella* in Poultry Plants

For the FSIS “How to” Workshops

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Presented by

Dr. Patricia Curtis and Ms. Jessica Butler

Auburn University



Objectives

- By the end of this workshop, you will be able to
- Understand the characteristics of *Salmonella* and its serotypes
 - Identify practical tools and methods to control *Salmonella*
 - Develop and implement controls for *Salmonella* in your operations



Salmonella

- Rod-shaped, motile bacterium
- Non-spore forming
- Gram negative
- Found on animals and in the environment
- Grows well at body temperature



Salmonella (con't)

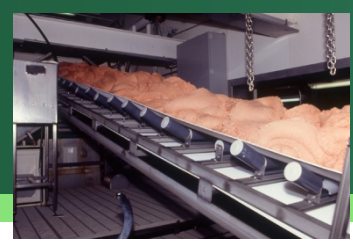
- Optimum temperature for growth is between 35°C and 37°C
- Slow growth has been observed at 5°C, with a maximum growth between 45°C and 47°C
- Growth may occur between pH 4.0 (depending on the acid) and pH 9.0; optimum pH is between 6.5 and 7.5
- D-value of 4 to 5 minutes at 60°C has been reported for *Salmonella*



Salmonella (con't)

- Over 2,000 different *Salmonella* serotypes
- All serotypes are now being compared to the CDC list of top 30
- 75% of all “A” sets have fewer than four serotypes linked to CDC list

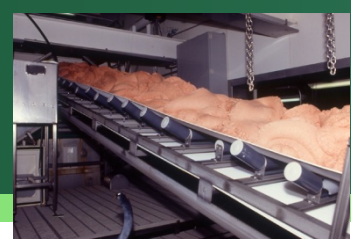




It is important to know which serotypes of *Salmonella* you have!



Top 30 Serotypes in 2005



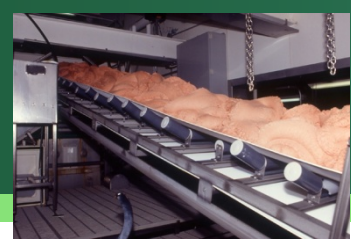
Human 2005			
Rank	Serotype	Reported	Percent
1	Typhimurium *	6982	19.3
2	Enteritidis	6730	18.6
3	Newport	3295	9.1
4	Heidelberg	1903	5.3
5	Javiana	1324	3.7
6	I 4,[5],12:i:-	822	2.3
7	Montevideo	809	2.2
8	Muenchen	733	2.0
9	Saintpaul	683	1.9
10	Braenderup	603	1.7
11	Oranienburg	590	1.6
12	Mississippi	565	1.6
13	Infantis	505	1.4
14	Paratyphi B var. L(+) tartrate+	460	1.3
15	Thompson	428	1.2

Human 2005			
Rank	Serotype	Reported	Percent
16	Agona	367	1.0
17	Typhi	348	1.0
18	Hartford	239	0.7
19	Stanley	224	0.6
20	Berta	209	0.6
21	Hadar	205	0.6
22	Bareilly	201	0.6
23	Anatum	197	0.5
24	Poona	196	0.5
25	Mbandaka	190	0.5
26	Panama	148	0.4
27	Litchfield	141	0.4
28	Sandiego	138	0.4
29	Schwarzengrund	138	0.4
30	Brandenburg	134	0.4
	Sub Total	29507	81.5

http://www.cdc.gov/ncidod/dbmd/phlisdata/salmtab/2005/SalmonellaTable1_2005.pdf

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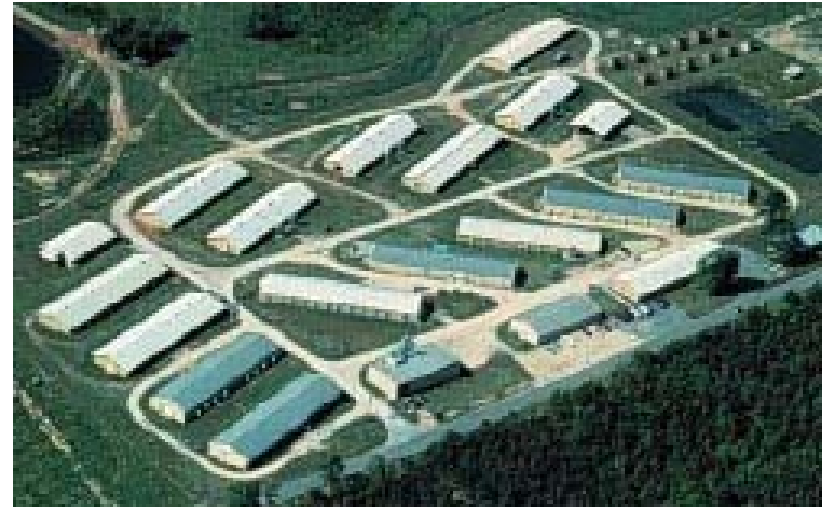
Preharvest *Salmonella* Control



Preharvest *Salmonella* Control



- Restricting access
 - Vehicles
 - People
 - Animals
- Biosecurity
 - Dedicated clothing and boots
 - Disinfectant boot dip



Preharvest *Salmonella* Control (con't)

- Feed
 - Heat treated
 - Pelletized
- Litter
 - Maintain low water activity



ARS Photo by Stephen Ausmus



Recommended Preharvest Best Practices

- Implement biosecurity measures
- Use good sanitation practices
- Control litter moisture
- Use well-timed feed withdrawal
- Use acids in drinking water during feed withdrawal



ARS Photo by Stephen Ausmus



Discussion Questions



ARS Photo by Rob Flynn



- What do you know about the live birds from which you are producing product?
- Do you know the level of *Salmonella* contamination?



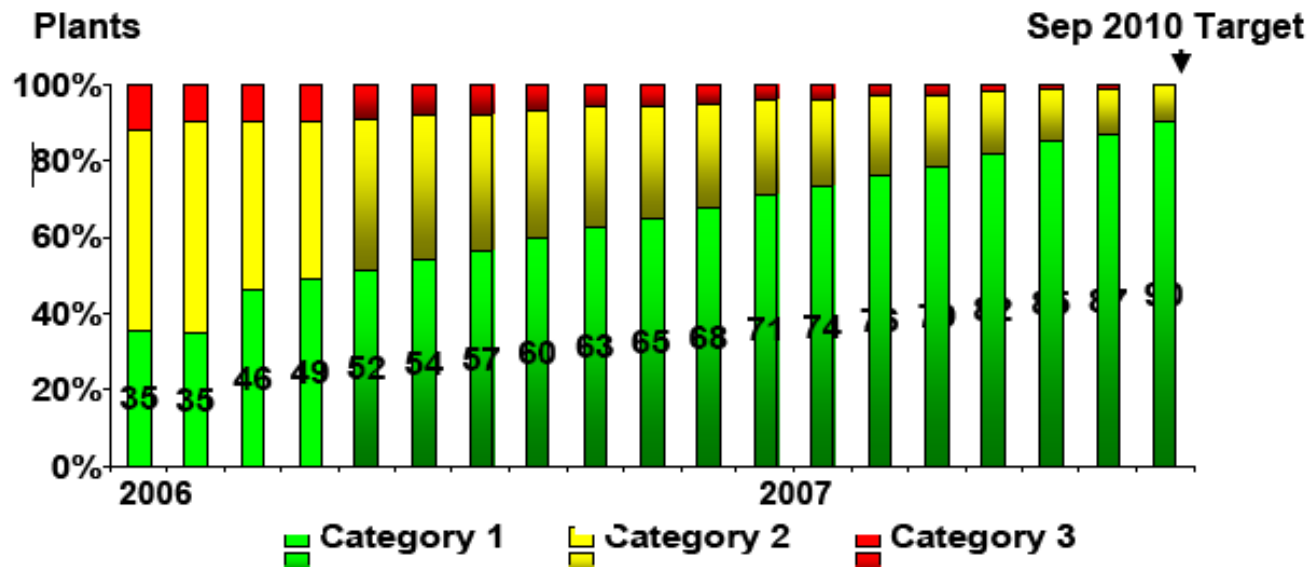
FSIS Category Levels for Serotypes

- Samples containing 1 of the top 30 serotypes identified by CDC
 - Low level
 - 0–1 samples per set
 - Medium level
 - 2–4 samples per set
 - High level
 - Greater than 5 samples per set

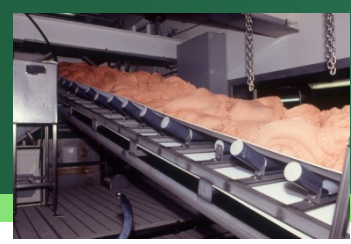


Target for *Salmonella* Reduction

FSIS performance measure: 90% of plants in Category 1 by October 2010



Salmonella and HACCP Plans



- A poultry HACCP plan MUST have a critical control point (CCP) to address *Salmonella*
- Support documentation is required
- Verification of the HACCP plan's ability to control *Salmonella* is required



Sanitation



What role does sanitation play in controlling *Salmonella*?



Sanitation (con't)

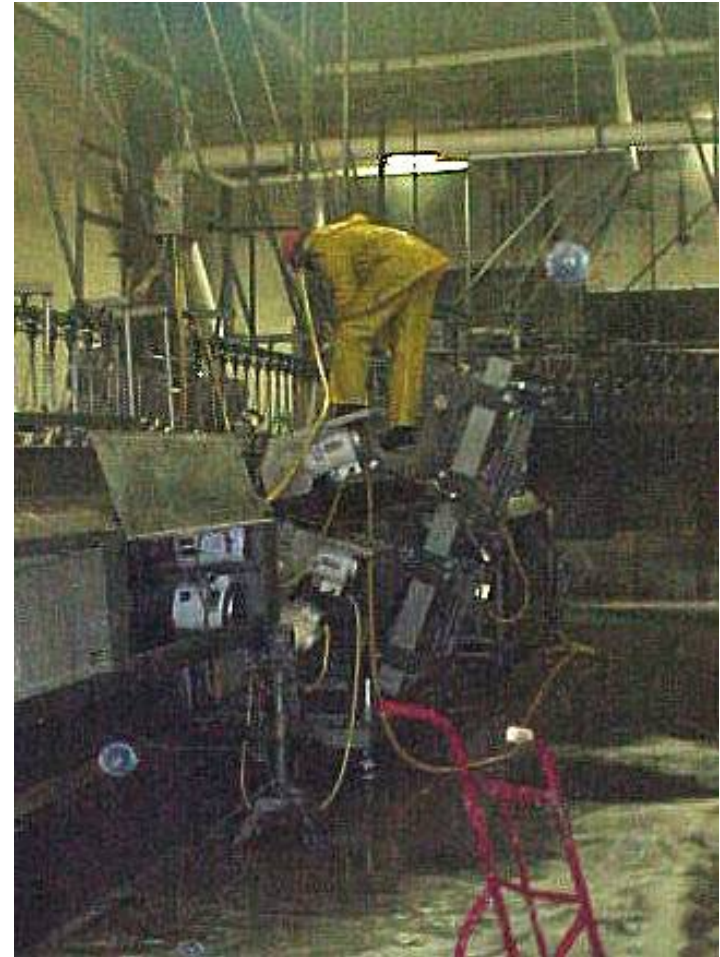


- Plants may address *Salmonella* control in their sanitation standard operating procedure (SOP) or other prerequisite program
- How effective is YOUR sanitation program in controlling *Salmonella*?



Sanitation and Hygiene

- Clean before sanitizing
- Enforce employee hygiene



Sanitation and Hygiene (con't)



Alkaline Detergents

- Sodium hydroxide
- Nitrous oxide
- Sodium silicate
- Trisodium phosphate

Note: Frequently used and vary in strength

Acid Detergents

- Hydrochloric acid
- Sulfuric acid
- Phosphoric acid
- Acetic acid

Note: Vary in strength



Sanitation and Hygiene (*con't*)



- Sanitizers
 - Quaternary ammonia*
 - Industrial strength bleach
 - Iodine compounds
 - Peracetic acid
 - Steam
 - Ozone
- Some sanitizers work better in certain parts of the plant
 - Iodophors
 - Aluminum equipment, rubber belts, tile walls
 - Active chlorine
 - Walls (other than tile), wooden crates, concrete floors

*Quaternary ammonia is a type of synthetic detergent.



Live Receiving and Live Hanging



- Recommended best practices
 - Sanitize and dry cages thoroughly
 - Maintain positive air flow from inside to outside the plant
 - Provide SOP and employee training
 - Schedule flocks for slaughter based on pathogen loads



Stunning and Bleeding

- Recommended best practices
 - Consider electrical stunning
 - Cheapest and most effective method
 - Use well-timed feed withdrawal to reduce feces release



Scalding



- Recommended best practices
 - Use counter-flow water movement
 - Use high flow rates with agitation to help dilute dry matter and bacteria
 - Use multi-stage tanks
 - Maintain pH above 7.5 or below 6.5
 - Use pre-scald brushes to help clean birds before entering scalder
 - Use post-scald rinse to help remove debris
 - Maintain scalding temperature



Picking



- Recommended best practices
 - Prevent feather buildup on equipment
 - Rinse equipment and carcasses
 - Use 18–30 ppm chlorine rinse post-picking



Evisceration

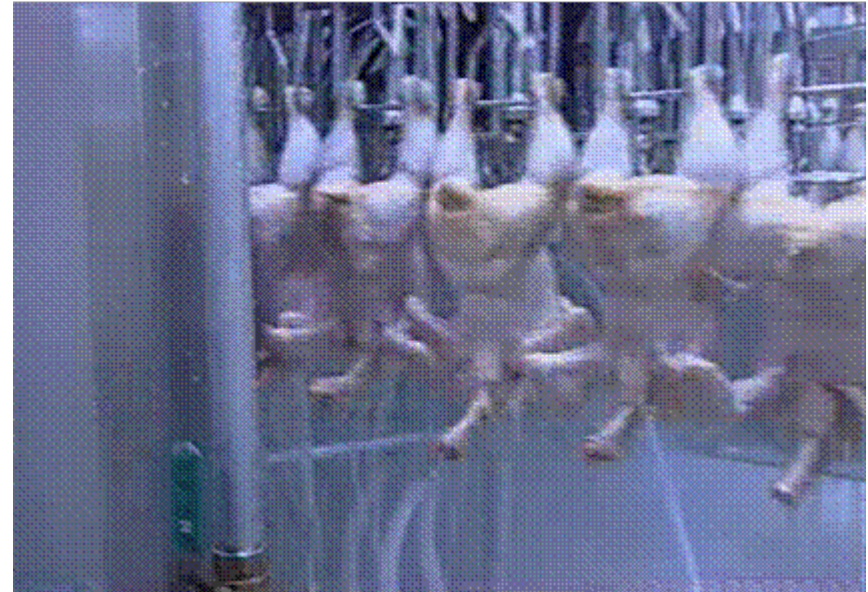
- Recommended best practices
 - Adjust and maintain equipment regularly and as needed
 - Use 20 ppm chlorine for whole-carcass rinses
 - Enforce employee hygiene standards

Note: Feed withdrawal practices affect process control at this step.



Evisceration (con't)

- Carcass rinses
 - 23 ppm free available chlorine
 - 10% TSP (trisodium phosphate)
 - 2% lactic acid
 - 5% sodium bisulfate
 - 5% cetylpyridinium chloride
- Be aware how chemical residues can impact pH of chiller



Immersion Chilling



- If using chlorine, maintain chill water at pH between 6.0 and 6.5 and at a temperature of less than 40°F
- Use high water flow rate and counter-current flow
- Use 20–50 ppm free available chlorine in the potable water measured at intake
- Use oxidation reduction potential pH with pH monitors



Immersion Chilling (con't)

- 10 ppm free available chlorine can eliminate *Salmonella* in 120 minutes
- 30 ppm free available chlorine can eliminate *Salmonella* in 6 minutes
- 50 ppm free available chlorine can eliminate *Salmonella* from the water in 3 minutes

Note: Organic matter in the chiller binds the free chlorine and thus makes it unavailable.



Factors Affecting Chiller Water Quality



- High flow rate (1 gallon per bird)
- Counter-current water flow
- 20–50 ppm free available chlorine measured at intake
- Red water (recycled water) may contain up to 5 ppm free available chlorine measured at intake
- Water pH 6.0–6.5
- Water temperature less than 40°F



Air Chilling



- Meet regulatory requirements for chilling
- Clean and oil chains regularly
- Inspect and replace shackles as needed
- Maintain tension on chain to prevent carcass-to-carcass contact
- Sanitation is important—no chemical interventions



Reprocessing



- Use post-chill antimicrobial dips to reduce *Salmonella* loads
- Heated water, agitation, application under pressure, and calibrating pH can enhance *Salmonella* reduction



Reprocessing: Approved Substances

- Chlorine, chlorine dioxide, and acidified sodium chlorite
 - Water soluble
 - Spray or dip
 - Agitation and application under pressure enhance effectiveness



Reprocessing: Approved Substances (con't)

- Chlorine
 - Primarily used to treat processing and chiller water
 - Heat and pH above 6.5 decrease its effectiveness
- Chlorine dioxide
 - Can be used in water
 - Leaves no residue
 - Should NOT exceed 3 ppm residual chlorine dioxide



Reprocessing: Approved Substances (con't)

- Acidified sodium chlorite
 - Combination of citric acid and sodium chlorite
 - Can be used as spray or dip at 500 to 1,200 ppm singly or in combination with other generally recognized as safe (GRAS) acids to achieve a pH between 2.3 and 2.9 as an automated reprocessing method
 - In chiller water, it is limited to 50 to 150 ppm singly or in combination with other acids to achieve a pH between 2.8 and 3.2



Reprocessing: Approved Substances (con't)

- Trisodium phosphate (TSP)
 - Approved for on-line reprocessing
 - Acts as a surfactant (high pH)
 - Residual TSP carries over into chiller
 - Must monitor pH of chiller water
 - Rinsing carcasses after TSP but prior to chiller decreases its effectiveness
 - More effective with air chilling than with immersion chilling



Reprocessing: Approved Substances (con't)

- Cetylpyridinium chloride
 - Quaternary ammonium compound
 - Approved for processing in ready-to-cook poultry products
 - Produces no adverse organoleptic effects
 - pH is near neutral
 - Stable, non-volatile, and soluble in water



Reprocessing: Approved Substances (con't)

- Inspexx 100
 - Peroxyacetic acid
 - Approved as a carcass spray for OLR
 - Must not exceed 220 ppm
- Spectrum
 - Peroxyacetic acid and a proprietary substance
 - Can be used in process, scalding, and chiller water and as a carcass spray, wash, or dip



- Other organic acids
 - Lactic acid
 - Most commonly used organic acid
 - Applied as rinse
 - Has an organoleptic effect on raw product
 - Acetic acid
 - Decreases pH and enhances the washing effect of scalding tank water
 - Has an organoleptic effect on raw product



Web Sites for Most Currently Approved Substances

- Safe and Suitable Ingredients Used in the Production of Meat and Poultry Products
 - <http://www.fsis.usda.gov/OPPDE/rdad/FSISDirectives/7120.1Amend13.pdf>
- Proprietary Substances
 - <http://www.fsis.usda.gov/Frame/FrameRedirect.asp?main=http://www.fsis.usda.gov/OPPDE/larc/ProprietarySubstances.htm>



Further Processing

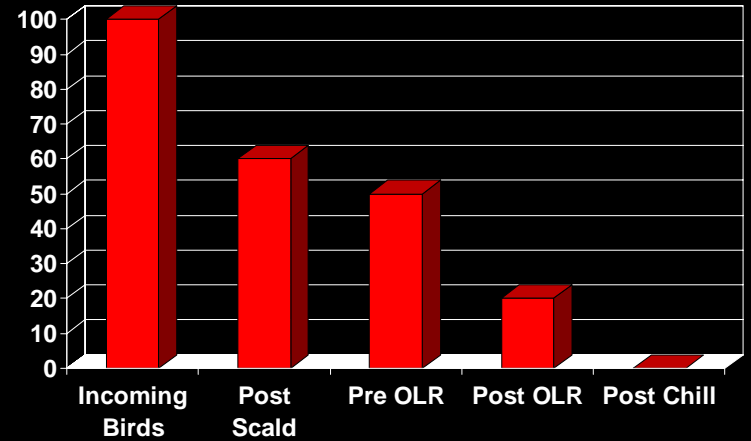
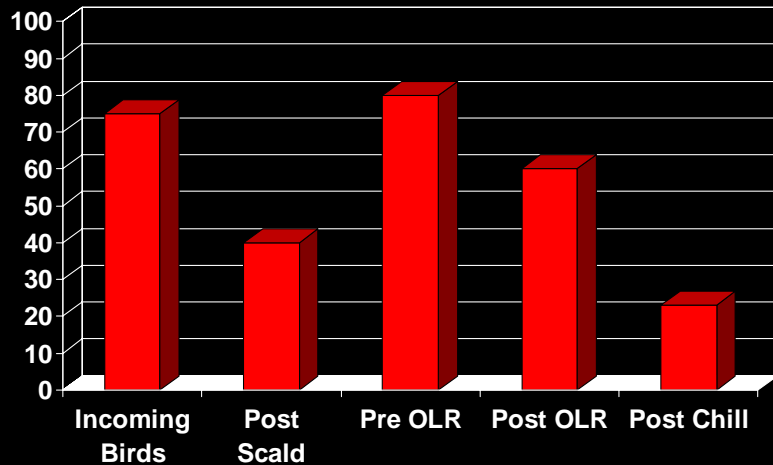
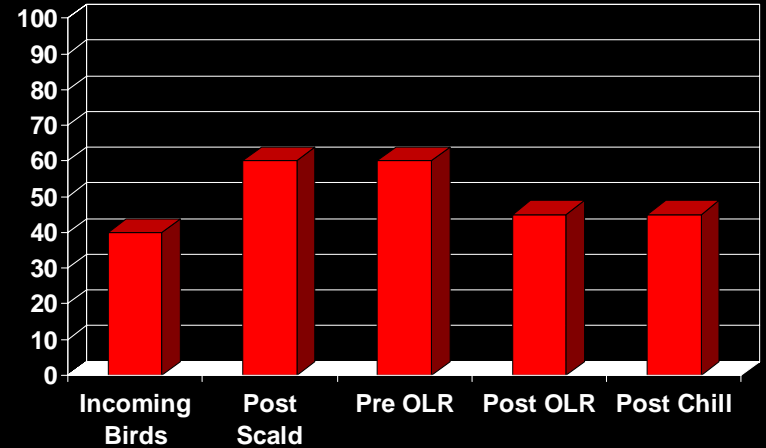
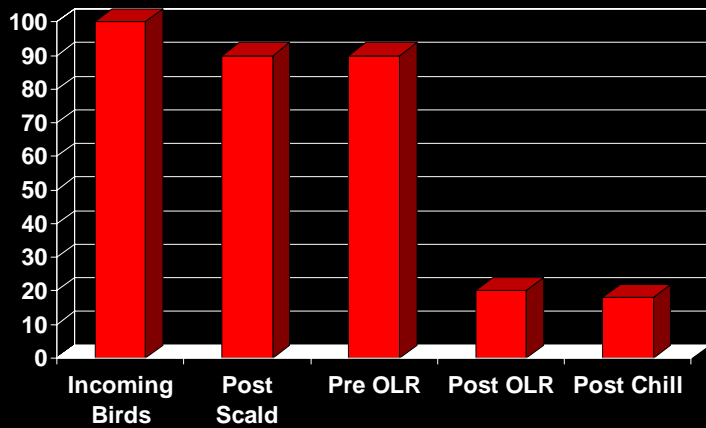


To prevent cross-contamination:

- Sanitize well
- Practice good hygiene
- Keep poultry meat below 40°F
- Consider air flow and traffic patterns



Plant Variation



Validation

- 9 CFR 417.4
- Validation verifies the effectiveness of interventions
- Establishments must validate their intervention processes



Acceptable Validation Methodologies

- Scientific articles
- Process mapping
- Validation study



Summary

- *Salmonella* continues to be an issue in poultry processing plants
- Each plant is unique and must determine the best way to control *Salmonella* in their operation
- Bio-mapping provides a way to identify critical areas where control measures should be applied



Summary (con't)

- Multiple hurdles are better at controlling *Salmonella* than single control measures
- *Salmonella* testing should be done on a regular basis to validate control measures are working
- Sanitation effectiveness should be monitored



Salmonella Summary

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