PRACTICAL CONSIDERATIONS FOR SALMONELLA INTERVENTION IN LIVE PRODUCTION

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In 1996, the United States Department of Agriculture, Food Safety Inspection Service (FSIS) published what came to be known as the "Mega-Reg." This document laid out regulations that would institute three new programs in food inspection, namely Sanitation Standard Operating Procedures (SSOPs), HACCP guidelines, and Pathogen Reduction Performance Standards (PRPS). While most plants were able to implement the SSOPs and HACCP guidelines fairly easily, it was the Salmonella limits in the Pathogen Reduction Performance Standards that caused the most difficulty and controversy.

In June of 2006, a new Salmonella performance rule came on-line that was even more stringent than the first. Plants are now categorized as being in Category 1, 2, or 3. Category 1 plants are below 50% of the performance standard and are only sampled once every 2 years. Category 2 plants are at 50-99% of the performance standards and are sampled more than once every two years and have samples pulled from a variety of locations within the plant. Category 3 plants are above the performance standard, are sampled several times a year, and are sampled throughout the processing plant. In addition, plants that have salmonella isolates of human health concern also receive greater regulatory scrutiny. FSIS expects to have greater than 90% of the poultry processing facilities in category 1 in the near future or even greater regulatory constraints will be imposed upon the industry. Currently only about 45% of the broiler slaughter facilities are in Category 1.

The biggest hurdle in Salmonella reduction came in the necessity for the industry to accept the scientific fact that Salmonella contamination originates in live production and therefore must be controlled in live production. This reality highlights a number of weaknesses inherent in the structuring of our industry that many a live production manager can attest to. As any good General would tell you, the key to success in warfare is in knowing your enemy better than he knows himself. It also requires giving the Commander-in Chief a realistic expectation of the level of success that can be achieved and the proper timeframe in which to expect it to occur. The same can be said for Salmonella. Success in reducing post-chill numbers requires an intimate knowledge of how, when, and where Salmonella contamination occurs and intervening accordingly.

Salmonella-Where is it? How does it work?

The rationale behind salmonella control in live production is really quite simple. The MegaReg requires a plant to meet a post-chill standard of roughly 20% Salmonella-positive or less. Because the government monitoring occurs within the processing plant and focuses on fecal contamination, this is where

integrators usually place his or her intervention resources. However, salmonella does not originate inside the processing plant. It enters the plant on the skin and feathers (notice I didn't say feces) of contaminated chickens. Once a contaminated bird is inside the plant, there is little a plant can do to remove bacteria like Salmonella from that individual carcass. The plant can only work to prevent that carcass from spreading bacteria to the other carcasses around it. So, if your birds are entering the plant with a Salmonella incidence rate of greater than 20%, the likelihood of you passing the performance standard is slim. However, if you reduce the number of bacteria the bird comes in contact with on the farm or in the hatchery, you can help to prevent that bird from carrying Salmonella into the processing plant. Extensive research done by the USDA Agricultural Research Service and several poultry integrators indicate that on Salmonella positive farms, only 10-15% of the birds are intestinally infected with Salmonella while 50-75% of the birds are carrying Salmonella on their skin and feathers. This tells us that a small percentage of birds are truly infected with Salmonella yet are capable of contaminating their neighbors in live production.

Following the Fingerprint

Because Salmonella are fairly ubiquitous, the next issue that needs to be addressed is exactly what is the route of transfer? Many sources of Salmonella at the farm level can be identified all the way from the pullets to live haul. In addition, certain breeds tend to be associated more with specific serotypes of human health concern post-chill. If FSIS is putting pressure on you to eliminate or reduce specific serotypes in you complex, the only intervention that is serotype specific is the use of a killed vaccine in your breeder program targeted to that specific serotype. There is little cross-protection of salmonella.

In order to more effectively focus your limited resources and achieve success, you need to know of all the salmonellas that are present in the production environment, exactly which ones show up post-chill? Several years ago, the USDA-ARS undertook the largest epidemiology study of Salmonella to date that gave us many of those answers and really made the industry rethink the way it looked at Salmonella. The old data, which was not very specific, led us to believe that all of the isolations of Salmonella were potential sources of infection. The rodents, beetles, litter, feed, etc had equal chance of carrying salmonella to a new flock of chickens and had to be attacked equally. With the ability to "fingerprint" salmonella isolates, the ARS study showed very clearly that the salmonella isolates that showed up post-chill were the same ones isolated from the pullets, breeders, hatchery residue, and day-old chicks simply magnified at each stage in live production. The isolates pulled from rodents, feed, and litter prior to chick placement did not match the isolates in the processing plant. After chick placement, the isolates from the birds could be picked up in the litter showing that it did indeed play a role in transmission throughout the flock but that it was not the source of the infection. The incidence rate of salmonella does increase during live haul but the fingerprint shows simply more "sharing " of the salmonella the birds were already infected with rather than the live haul cages

being a separate source of contamination. This is why all of the cleaning and disinfection in the world does not eliminate or even reduce salmonella rates in the plant.

How much of an improvement can we expect?

While the results of this large commercial study have allowed us to narrow our focus onto a smalller number of parameters, it also made clear that rarely would we be able to reduce our post-chill numbers by focusing only on broiler houses. This means that significant reduction of salmonella incidence within a complex will be at best 6-8 weeks away from impacting plant numbers and more likely to be 20-30 weeks out. In other words, deciding to ignore your Salmonella numbers until you been placed in Category 3 will make it that much more difficult to get out of it. If you have just barely missed passing the plant tests you may be fine. But, if your incidence level is 45% or greater, you are going to need some serious time to turn that around. Even the best interventions available to the industry today only decrease incidence rates by one-third or one-half. So if you are running at 25% positive post-chill you can realistically expect to decrease your levels under the standard even if only barely but you will have a more difficult time being classified as a Category 1. However, if you know that 70% of your birds are coming into the plant positive, even going full guns on your interventions in the broiler house will only get you to 35%, which still fails. And still gets you called into the complex managers office to explain why you have spent all of this money on things that "didn't work." Never mind that going from 70% positive to 35% positive is a major biological accomplishment.

Interpretation of Salmonella Numbers

So what do you need to do when your salmonella numbers start creeping up in the plant? How can you tell if it is a seasonal "spike" or the sign of some serious trouble? The first thing to do is to take a good hard look at your salmonella numbers over the last five years and overlay the graphs. Does that brief spike occur every August? Have your numbers slowly but surely been inching up over the last 6-8 months? Did everything just explode after a major weather event that disrupted production?

Many people see a summer spike in their salmonella numbers with the levels becoming critical in late July or early August. In order to tell if this means real trouble or is purely seasonal, you need to know what your E. coli numbers are doing as well. If your salmonella is increasing because birds are entering the plant wet and dirty from being fogged in the houses or hosed down in the lot, your E. coli numbers will also go up sharply. After the weather cools off and the birds are no longer wet, the numbers for both usually come down fairly quickly. Given the length of time it takes to collect a complete sample set in the plant, you will most likely be okay. However, if your salmonella numbers go up but your E. coli numbers stay flat, you are most likely running into some serious trouble that should not be ignored. Your numbers are not up because your birds are wet and therefore they will not go down once the weather cools off. The same goes for

gradual increase in salmonella numbers or spikes that do not occur in late summer. They either indicate a growing problem in live production or could be the result of a salmonella "explosion" due to major stress all at once in many areas of live production like you would see with a major ice storm.

This is the point where you need to begin some selective sampling to determine where Salmonella is being magnified the most. Culturing chicks from a wide variety of breeder flocks can be very helpful. Chicks should always be held for 2-3 days in a warm place with water but no food. This will stress the birds and enhance shedding of salmonella. If your incidence rate is less than 5% then you know a very large part of your magnification is occurring in the broiler house. If you are running around 25% or more, it tells you that you are going to need to really work hard on your breeder /hatchery operation as well. Incidence rates in between are a little grayer but will still usually require work in both areas as well. If this sampling indicates that the majority of the issue is with the broilers, then you can tell your complex manager he should see some improvement fairly quickly but that it will take at least one full grow out cycle to see the full benefits of any intervention. If your incidence rate is high, then upper management will have to expect a good 4-6 months to begin seeing major improvements and the costs would obviously be greater because intervention will be required in more areas.

Application of Interventions

Once you have a handle on where Salmonella amplification is occurring, you have to choose the interventions that are most appropriate for your situation. This is where we switch from a population perspective to an individual bird perspective. It will be important to remember that all of the interventions available only work when preventing infection in an uninfected bird. They are not capable of removing salmonella from a bird that is already positive. When is an infected bird shedding the highest numbers of salmonella? When is an uninfected neighbor most susceptible to contamination? An individual chick that is infected will begin shedding salmonella during hatch. The process of pipping can aerosolize enough salmonella to infect an entire hatch cabinet. From there the infected chick begins to shed salmonella in its feces. As its neighbors begin to preen themselves after hatch or begin pecking at the meconium in the chick boxes, horizontal transmission begins. As you can imagine, if only one chick out of 100 is infected, the process is quite slow. This is typical of what we see in parent chicks. This is why a killed vaccine program in your pullets can be successful in reducing the amount and type of Salmonella that your breeders are shedding. Because amplification is so slow in parent birds, a vaccination program has time to be effective. However, if 50 out of the 100 chicks in the chick box are positive, horizontal transmission to the entire flock occurs much more quickly and interventions at the broiler farm will have a much more limited impact. Those birds that are infected in the first week of life will shed salmonella in their feces intermittently with the highest rate of shed occurring when the birds are 18-21 days old.

The most effective interventions influence the rapid establishment of normal gut flora while actively suppressing salmonella that is being shed into the environment whether in the pullet house or the broiler farm. This is where the layering of interventions becomes necessary. For example, water acidification to a pH of 3.5 or below will selectively promote gut colonization with good, healthy bacteria while suppressing salmonella in the crop. The same occurs with litter acidification at placement. The low-pH, high sodium environment in the litter will favor growth of lactic acid-producing bacteria (LAPBs) while restricting the establishment of the salmonella being shed from positive birds. Live salmonella vaccines administered at day of age are also helpful as long as the serotype of salmonella in your complex is compatible with the vaccine being chosen. Because negative birds are most susceptible to colonization in the first 7 days, brood chamber application of interventions is very important. Because the highest shedding of salmonella occurs from days 18-21, the off-chamber cannot be overlooked.

It is also very important to employ interventions at any time the normal crop or gut flora is disrupted. This occurs most commonly when the birds are off-feed, whether intentional or not, or when they have been given therapeutic antibiotics. During any feed withdrawal for more than 6 hours, the normal LAPBs in the crop and gut begin to die off and crop/gut pH increases. This allows for survival and proliferation of any salmonella that already is in the gut or that the bird is exposed to during this time. Interventions need to be immediately available and immediately protective in order to work. Competitive exclusion products need at least two days of replication in order to get good coverage in the gut and therefore are never adequate when used alone. Water acidification to a 3.5 or below works well at these times to reduce salmonella exposure by maintaining crop pH. At the broiler level, this is the only intervention that can be applied at the very beginning of trouble in the plant when you already have 6 weeks worth of birds in the field. As with all times of water acidification, the key is to select a product that does not affect consumption at a pH low enough to be biologically effective (3.5 or below). Pullets on restricted feeding programs experience these same changes in crop and gut flora and need to be protected on those days off feed and when being moved into the breeder house.

The Big Picture

As you can tell by now, successful salmonella intervention can take a long time before maximum results are achieved. More focus needs to be given on long-term prevention rather than waiting for the situation in the plant to become dire. Pullet chicks are delivered from the primary breeders with salmonella incidence rates well below 5%. Focus on salmonella intervention at the pullet level would be far more fruitful than waiting for your broilers to become 70% positive in the plant and then panicking. We also need to remember that chickens are now a natural host for salmonella. Interventions need to be applied continuously for

them to be most effective. Passing a single set of salmonella testing in the plant does not mean that salmonella has disappeared from your complex. Targeted, long-term interventions focused at keeping salmonella levels low from the beginning will be less expensive and less disruptive to a complex than instituting anything and everything in fits and starts. Most plants were getting along fairly well at the PRPS level of 20% for Salmonella but now that the standard has been adjusted downward complexes will have to redouble their efforts to get into Category 1.