

Breeder Hatching Egg Sanitization: The Missing Link in *Salmonella* Control

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Key Points:

- Reduce *Salmonella* on eggs without reducing hatch or chick quality
- Hydrogen peroxide and UV light process can improve pathogen reduction program
- Dietary DFMs (such as BacPack™) are effective in reducing pathogens at farm level

Salmonella Control: An Industry Challenge

As *Salmonella* control continues to be a challenge for the poultry industry, scientists are always looking for opportunities to put up another barrier or hurdle to stop it. Many reports indicate that the multi-hurdle intervention approach the industry has been implementing over the years is helping, and the incidence of *Salmonella* is on the decline. But, in spite of all the good those hurdles have done, egg producers still occasionally see outbreaks and recalls in both eggs and meat products. Scientists and producers throw vaccines, probiotics, prebiotics, antibiotics, essential oils, disinfectants, cold temperatures, high temperatures and the kitchen sink at *Salmonella*, and it still seems to find its way into the birds. So what is left?

There are probably several points in the production chain that could still use improvement to reduce *Salmonella*, but one place that has not been fully addressed in the battle against *Salmonella* is the hatchery. This is not to say hatcheries do not do a good job of keeping their facilities clean. On the contrary, hatchery managers clean, scrub, wash and disinfect every truck, tray, floor, machine and wall they can, and they generally do all that is humanly possible. But what about the eggs? If *Salmonella* was going to make its way into the hatchery (and research has shown it can be found there), how is it getting there?

Sanitize Hatching Eggs?

The reality is that many companies do not sanitize hatching eggs before they enter the hatchery because a practical and effective method to sanitize hatching eggs without reducing hatch or chick

quality has just not been available. So if there is *Salmonella* on the eggshells (let's hope it is not inside the egg because that is a whole separate issue), it has a clear path into the hatchery because nothing is being done to kill it from that point on. Once there, an incubator and hatcher is a perfect environment for the *Salmonella*'s survival and then the contamination of newly hatched chicks.

Experiments have shown that only a couple eggs contaminated with *Salmonella* are needed to result in almost all of the chicks in a hatchery being colonized with *Salmonella* at hatch time. Other studies have shown that the *Salmonella* serotypes found on broiler carcasses at processing are the same serotypes that can be found at hatcheries and in breeder flocks and very low levels of *Salmonella* can effectively colonize the intestinal tract of young chicks. So it does not take much contamination to go a long way in the hatchery environment. If chicks are contaminated before they ever leave the hatchery, then intervention strategies at the farms and processing plant will be put to the test to control *Salmonella*. Therefore, a way to sanitize hatching eggs prior to incubation and reduce the potential for pathogen transfer at the hatchery is greatly needed.

New Approach

After several years of research, a new approach to egg sanitization has been developed at Texas A&M University that may be the answer to the problem. The process involves misting the eggs with a dilute hydrogen peroxide solution followed by exposure to UV light. As the UV light interacts with the hydrogen peroxide, a process known as photolysis splits the hydrogen peroxide molecule to generate hydroxide ions (OH⁻). These ions are extremely reactive and only exist for fractions of a second before reacting with other materials. In the case of eggs, the hydroxide ions react with the microorganisms on the shell, causing cellular damage and inactivating them. Research has indicated that this process occurs almost instantaneously, thus allowing for the mechanization of the process to treat hatching eggs in a rapid manner. As a result, a



prototype egg sanitization machine has been developed to automate the process and is currently being field tested at commercial farms (see photo). This process is suitable for sanitizing fertile eggs from broiler breeders as well as table eggs from caged laying hens.



Hatching egg sanitizer developed at Texas A&M University.

The hydrogen peroxide and UV light process has the potential to meet all the criteria needed to be successfully implemented in the poultry industry. The process is rapid, easy to apply, cost effective, yields high microbial reductions, is safe for workers and the

environment, and research data indicates there are no adverse effects and some beneficial effects to hatchability or chick quality. Most eggs passing through the machine yield zero eggshell microbial counts, and the few eggs that do not have zero counts are very low. The user simply places the eggs on the conveyor, the eggs go through the machine, and the eggs come out the other end in about one minute. Commercialization of the egg sanitizer has begun and units will soon be ready for use in the field.

Impact on Hatch and Bird Performance

In addition to pathogen control, most managers will of course be interested in how the process impacts hatch and bird performance. Laboratory-scale trials at Texas A&M University have shown improvements in hatchability of sanitized eggs up to 4 percent compared to non-sanitized eggs. Chicks from sanitized eggs have fewer unhealed navels and there are fewer cull chicks, thereby substantially improving chick quality. In addition, several experiments have compared moisture loss from sanitized and nonsanitized eggs during incubation and have found no differences. Chick weights also are unaffected. These data indicate there is no damage to the cuticle or shell of the egg that would adversely affect moisture loss during incubation.

Field trials have also been conducted to test effectiveness of the process under commercial conditions at both breeder farms and the hatchery. While good results were obtained with eggs sanitized at the hatchery before setting in the incubators, the best results were obtained when eggs were sanitized immediately after collection at the breeder farm. Hatchability was not necessarily increased in

all field trials, but has also not been reduced by the treatment. The ability to improve hatch through microbial reduction is dependent on the fact that hatchability was reduced by microbes in the first place, and this may not always be the case with every set of eggs. One finding that has been consistent is the improvement in chick quality. Most notably, chicks from sanitized eggs have a significantly decreased 7-day mortality rate compared to chicks from non-sanitized eggs.

Synergistic Effect: Egg Sanitization and Direct-Fed Microbials

Another aspect of egg sanitization that could have important pathogen reduction implications for the poultry industry is a synergistic effect with direct-fed microbial (DFM) products. Direct-fed microbials (for example, BacPack™) are designed to introduce “good” bacteria into the gastrointestinal tract, and thus prevent pathogens like *Salmonella* from attaching and colonizing. But if the gut is already infected with the pathogen before the DFM is administered, then the DFM must work to dislodge the pathogen, making the DFM less effective. In some cases, this might be the scenario with non-sanitized eggs contaminated with the pathogen. However, if sanitized eggs result in chicks with “cleaner” GI tracts at the time of hatch, then application of the DFM will have a better chance to establish the good bacteria first and improve the effectiveness of the DFM even more. This concept was proposed by a group of highly respected *Salmonella* researchers from the USDA-ARS in a review paper in 2000 in which they stated, “Therefore, the combination of eliminating or dramatically reducing salmonellae from hatching eggs and hatcheries, followed by treatment of new hatchlings with an effective CE culture before exposure to environmental *Salmonellae*, presents a realistic opportunity to produce a *Salmonellae*-free broiler.” (Berrang et al., 2000; Journal of Applied Poultry Research, 9:279-284).

Until now, the first part of that equation has been missing. However, several years of data using the hydrogen peroxide and UV light process has shown that sanitized eggs can indeed be delivered to the hatchery without reducing hatchability or chick quality, and that has many potential benefits. If all the eggs entering a hatchery carried nearly zero microbial contamination, it is likely that overall hatchery sanitation would be improved and chick contamination would be reduced. The coupling of effective egg sanitization with the use of effective DFM products could be very successful in making life very hard for *Salmonella*. Most experts would agree that there is no single silver bullet that will eliminate *Salmonella* in poultry, but the use of intervention strategies and technologies at all stages of production and processing is needed to give us the best chance to beat it.

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