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PROCESSING TIP . . .



CONTROL OF *SALMONELLA* IN BREEDER CHICKENS

Part I

It is often difficult to ascertain how *Salmonella* issues in poultry begin and what measures should be implemented to prevent them. Chickens may become colonized through both vertical (from parent stock) and horizontal (environmental) means. This purpose of this Poultry Tip is to detail how *Salmonella* colonize breeder chickens and to explain effective measures for preventing or controlling vertical colonization.

Many scientists have implicated breeder chickens as vehicles for vertical transmission of *Salmonella* from the breeder chickens to the fertile egg. In 1991, Cox et al. evaluated egg fragments, paper pads from chick boxes, and chick fluff from six commercial broiler breeder hatcheries for the presence and level of salmonellae. Overall, 42 of 380 samples (11.1%) from those hatcheries were contaminated with salmonellae. *Salmonella* were detected in 22 of 145 (15.2%), 5 of 100 (4.6%), and 15 of 125 (12%) samples of egg fragments, chick fluff, and paper pads, respectively. The percentage of salmonellae-positive samples from each of the six hatcheries were 1.3, 5.0, 22.5, 11.4, 36.0, and 4.3% respectively (Cox et al., 1991). Of the 140 samples randomly selected for enumeration, salmonellae were found in 11 samples. Four of these 11 samples had greater than 10^3 salmonellae per sample, 3 others had greater than 10^2 but less than 10^3 , and the remaining 4 had less than 10^2 . *Salmonella* serotypes isolated were *S. berta*, *S. californica*, *S. give*, *S. hadar*, *S. mbandaka*, *S. senftenberg*, and *S. typhimurium*, all of which have previously been isolated from poultry. The authors found that, the incidence and extent of salmonellae-positive samples found in the breeder hatcheries were much less than that previously found in broiler hatcheries, meaning that overall, the industry is reducing *Salmonella* in breeder chicken populations. Cox et al. (1991) concluded by stating that the cycle of salmonellae contamination will not likely be broken until contamination at these critical points is eliminated.

Cox et al. (2000) reported that numerous publications show that *Salmonella*-contaminated eggs can be produced by artificially inoculating breeding chickens. Timoney et al. (1989) reported that oral inoculation of laying hens resulted in infection of the reproductive tract. Challenging the breeder hen with 10^6 *Salmonella* cells caused the ovary and oviduct to become infected. Cox et al. (2000) observed that the egg production rate for infected chickens was unaffected, and *Salmonella* was not detected in all fecal samples; therefore breeders infected with salmonellae may not always be easily detectable on the farm. For the contaminated breeder hens, the yolks of 10% of the eggs laid were contaminated with *S. enteritidis*. However, when

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hens were inoculated with *Salmonella* at levels of 10^8 cells, a noticeable drop in egg production and signs of pathogenesis occurred (Cox et al., 2000).

In 2002, Bailey et al. stated that, although the widespread presence of *Salmonella* (Photo 1) in all phases of broiler chicken production and processing is well documented, little information is available to indicate the identity and movement of specific serotypes of *Salmonella* through the different phases of an integrated operation. In the study by Bailey et al. (2002), samples were collected from the breeder farm, the hatchery, the previous grow-out flock, the flock during grow-out, and carcasses after processing. *Salmonella* were recovered from 6, 98, 24, 60, and 7% of the samples, respectively, in the first trial and from 7, 98, 26, 22, and 36% of the samples, respectively, in the second trial. Seven different *Salmonella* serotypes were identified in the first trial, and 12 different serotypes were identified in the second trial (Bailey et al. 2002). Interestingly, for both trials, there was poor correlation between the serotypes found in the breeder farms and those found in the hatchery.



Photo 2. Picture of attached *Salmonella* with flagella.

(<http://upload.wikimedia.org/wikipedia/commons/thumb/b/b4/SalmonellaNIAID.jpg/715px-SalmonellaNIAID.jpg>)

Studies have been conducted to determine how vertical transmission from the breeder to the baby broiler chick occurs. In 1995 Reiber et al. conducted three experiments to determine the bacteriological quality of rooster semen. The most frequently isolated genera of bacteria from rooster semen included *Escherichia*, *Staphylococcus*, *Micrococcus*, *Enterococcus*, and *Salmonella*. Most of the bacteria that were isolated were endemic to poultry and were commonly found in the environment of chickens (Reiber et al., 1995). Thus, during mating, female breeders may become inoculated with *Salmonella* during semen transmission.

Buhr et al. (2005) reported the recovery of *Campylobacter* (naturally colonized) from the ductus deferens of 5 of 101 broiler breeder roosters, and four of those five positive roosters had previously produced *Campylobacter*-positive semen samples. Those results prompted further evaluation to determine if inoculation route influenced the prevalence or level of *Campylobacter* contamination of semen, the digestive tract, or reproductive organs. Individually caged roosters, confirmed to be feces and semen negative for *Campylobacter*, were challenged with a marker strain of *Campylobacter jejuni* either orally, by placing *Campylobacter* onto the everted phallus immediately after semen collection, or by dip coating an ultrasound probe in *Campylobacter* and inserting the probe through the vent into the colon. Six days after inoculation, individual feces and semen samples were again collected and cultured for *Campylobacter*. Seven days postinoculation, roosters were killed, the abdomen aseptically opened to expose the viscera, and one cecum, one testis, and both ductus deferens were collected. *Campylobacter* was recovered 6 days after challenge from feces in 82% of samples ($\log_{10}4.1$ colony-forming units [CFU]/g sample), 85% of semen samples ($\log_{10}2.9$ CFU/ml), and on the seventh day after challenge from

88% of cecal samples ($\log_{10} 5.8$ CFU/g sample). These results demonstrate that male breeders exposed to *Salmonella* and *Campylobacter* may pass these bacteria on to the female during mating. This helps to explain how vertical transmission with these pathogens occurs.

These studies show that *Salmonella* transmission from breeders to broiler chickens via vertical means is significant. Efforts should be made to break this process by vaccinating breeders, using competitive exclusion cultures in breeders, and disinfecting hatching eggs.

References:

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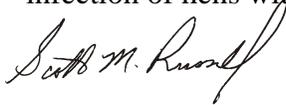
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“Your local County Extension Agent is a source of more information on this subject.”