Salmonella Control in Poultry

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***Salmonella* infections in commercial poultry have long been an industry concern. The approach taken to *Salmonella* control depends on the type of infection. More than 2 400 serotypes of *Salmonellae* bacteria (family Enterobacteriacea) have been identified, but only two serotypes are true poultry pathogens (*S. G*allinarum and *S. P*ullorum). *Salmonella* infections with other serotypes (*S.* Enteritidis, *S.* Typhimurium, *S.* Hadar, etc.) seldom cause disease in poultry, but are of major concern to public health.**

The following paper discusses the different categories of *Salmonella* infections in poultry and the relevant control measures.

Introduction

Distinction is made between two categories of *Salmonella* infections in poultry; *Salmonella* infections that have a direct negative impact on bird health (fowl typhoid and pullorum disease) and *Salmonella* infections of importance to public health (paratyphoid *Salmonellae*).

Salmonellae have a worldwide distribution and generally the goal is to rear poultry *Salmonella* free. This has been achieved in most major poultry producing regions for the poultry specific *Salmonella* pathogens (*S.* Gallinarum and *S.* Pullorum); however the task to eliminate paratyphoid salmonellae has proved more challenging. The paratyphoid *Salmonellae* strains have a very wide host range resulting in a large and continuous source of infection to poultry. This requires a much broader approach to control.

Host Specific *Salmonellae*

S. Gallinarum and *S.* Pullorum are host specific *Salmonella* primarily affecting chickens and turkeys. *S.* Pullorum is the cause of pullorum disease, an acute systemic disease of chicks and poults which results in mortality of up to 100%. *S.* Gallinarum is the cause of fowl typhoid, an acute or chronic septicaemic disease that most often affects mature birds, also causing high mortality. Both these diseases have in the past been responsible for serious economic losses to poultry producers.

The implementation of extensive testing and eradication programs has greatly reduced the impact of fowl typhoid and pullorum disease in commercial flocks. The pathogens do however still circulate in backyard poultry flocks. As a result a low incidence of disease outbreaks, of especially fowl typhoid, in commercial flocks is still reported from several European countries, Canada, Mexico, Central and South America, Africa and the Indian subcontinent.

The infected bird is by far the most important source of infection for fowl typhoid and pullorum disease. The bacteria is transmitted from generation to generation via the egg, or transmitted from infected to non infected flocks by direct contact or mechanical transfer by people, contaminated equipment, water or feed. Recovered birds remain carriers perpetuating the disease, especially on multi-aged layer sites where there is a continuous introduction of susceptible pullets. Recovered cull birds or spent hens sold on live bird markets are another source for spread of the bacteria.

An outbreak of fowl typhoid in layers is usually characterized by an acute onset of mortality. Treatment with antibiotics (such as sulphonamides, tetracyclines, aminoglycosides, or quinolones) is successful in reducing mortality and clinical symptoms; however no antibiotic treatment is capable of eliminating the infection from a flock.

Paratyphoid *Salmonellae*

Paratyphoid *Salmonellae* can infect a wide variety of hosts, including humans. Poultry are usually asymptomatic carriers of paratyphoid *Salmonellae.* These bacteria can however cause symptoms of food poisoning in humans. Clinical disease in infants, the elderly or immune compromised individuals can be fatal. Contaminated poultry meat and eggs are among the most frequently implicated sources of human salmonellosis outbreaks, thus controlling paratyphoid *Salmonellae* infections in poultry has become a public health issue.

S. Enteritidis and *S.* Typhimurium are the two paratyphoid *Salmonellae* most commonly associated with poultry. The outcome of an infection in poultry is dependant on the initial challenge dose and the age of the bird, young chicks being far more susceptible than older birds. A low dose challenge in a mature bird is most likely to pass through the intestine with no consequence. At higher doses a consistent observation is intestinal colonisation and spread to internal organs, which may be accompanied by mild transient diarrhoea. During the first two weeks post infection *Salmonellae* generally can be isolated from the intestinal tract and faeces. The incidence of intestinal colonisation and faecal shedding steadily declines thereafter. However, some *S.* Enteritidis strains have been shown to persist in the intestinal tract of laying hens for several months.

Because of the wide host range of paratyphoid *Salmonellae*, infection can be introduced into commercial poultry flocks from various sources. Poultry feeds, especially those containing animal protein, are considered a high risk infection source. However, wild birds, rats, pets and people can all be potential sources of infection.

Control Strategies

Salmonella is transmitted via the egg from parent to chick, thus an obvious starting point for any *Salmonella* control strategy is to ensure poultry breeding flocks are kept *Salmonella* free. There is a zero tolerance level to *Salmonella* infections in genetic stock (pure lines and grandparent flocks); positive flocks are culled and vaccination is not permitted. In many countries however the vaccination of breeder flocks and commercial layer flocks using approved live or inactivated *Salmonella* vaccines is permitted[1].

The primary source of infection for *S.* Gallinarum and *S.* Pullorum is other infected poultry; thus introduction of these organisms into a poultry flock can be effectively controlled by standard biosecurity measures. Minimise the risk of contact with infected flocks or people, equipment and other fomites that may have originated from an infected site. However, in high risk areas with no official eradication policy vaccination with a live attenuated *S.* Gallinarum vaccine[2] presents an additional effective control measure.

The diversity of sources from which paratyphoid *Salmonellae* can be introduced into flocks requires a much broader control strategy. There is no one single control

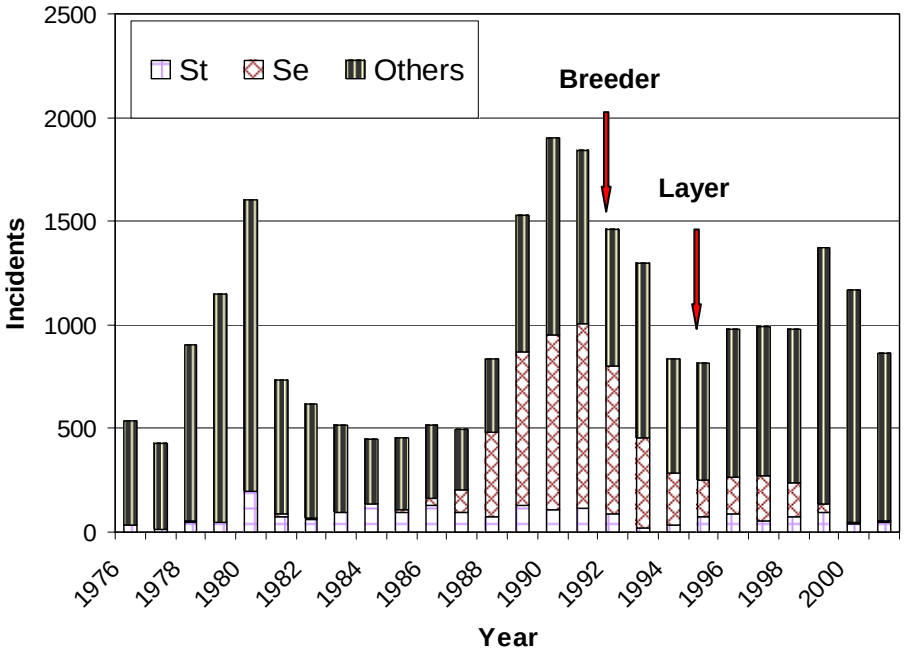
[1] United Kingdom, United States of America, The Netherlands, Germany, Italy, Spain, France, Argentina, Brazil, Thailand

[2] Nobilis SG 9R, Intervet, The Netherlands

measure that can be implemented to successfully keep flocks *Salmonella* free. However the cumulative effect of establishing specific critical control points to prevent infection greatly reduces the risk.

The first control point is monitoring. If there is no routine surveillance schedule the whereabouts of the enemy is unknown, a dangerous situation considering paratyphoid *Salmonellae* seldom cause disease in a flock. Serological monitoring (ELISA or RSPA) is most commonly used as a screening test in unvaccinated flocks and bacteriological monitoring of the environment (drag swabs) for vaccinated flocks. A clear strategy should be in place outlining actions to be taken if a flock is found salmonella positive. The most desirable action is to cull infected flocks. However, if this is not financially feasible at least all possible measures should be taken to quarantine the flock, to minimise the risk of infection to other flocks and prevent the introduction of contaminated eggs or meat into the human food chain.

Secondly we need to guard against the introduction of *Salmonella* from the environment; biosecurity! This however extends beyond a fence, shower block and controlling the movement of people. The well cleaned poultry house should be a *Salmonella* free environment; everything introduced into the house is a potential source of infection. Day old chicks must be sourced from *Salmonella* free parents; this can be confirmed by bacteriological screening of chick box liners. Only pelleted feed or feed containing no animal protein, sourced from a reputable feed supplier, should be used to minimise the risk of introducing salmonella through contaminated feed. Water provided should come only from sources treated to ensure purity. Houses must be properly bird proofed and there must be an effective rodent control schedule.



Graph 1: Salmonella incidence in poultry in the United Kingdom. Arrows indicate the year in which salmonella vaccination (Nobilis Salenvac) was introduced to breeders and layers respectively.

Finally the bird's own resistance to *Salmonella* infection can be enhanced. Vaccination with either killed[3] or live vaccines[4] has been found to effectively reduce

[3] Nobilis Salenvac and Nobilis Salenvac T, Intervet, The Netherlands

the susceptibility of poultry to *Salmonella* infection. Nowhere in the world has this been better documented than in the United Kingdom. In the late 1980's the UK egg industry was facing a *S.* Enteritidis crisis. Improved biosecurity and management practices saw a reduction in the incidence of *S.* Enteritidis, but it was only after the introduction of an inactivated salmonella vaccine that the outbreak was really brought under control (Graph 1). In 1998 egg producers in the UK initiated the "Lion Code of Practice" an auditing scheme with the primary objective of providing safe food to the consumer. One of the conditions of the Lion Code is that all participating commercial layer flocks are vaccinated against *S.* Enteritidis.

Summary

S. Gallinarum and *S.* Pullorum are bacterial infections specific to poultry. Control measures thus focus on preventing contact between commercial flocks and other poultry. Vaccination of commercial flocks with a live attenuated *S.* Gallinarum vaccine is suggested in case of infected multi-age farms, or in high risk regions were the organism is endemic.

Paratyphoid *Salmonellae* (*S.* Enteritidis, *S.* Typhimurium, *S.* Heidelberg, *S.* Hadar, etc.) are not poultry specific pathogens, but have a wide host range. Public health is the primary concern of paratyphoid *Salmonella*. The poultry industry has a responsibility to keep flocks *Salmonella* free, limiting the risk of supplying contaminated eggs and meat to the consumer. The prevention of paratyphoid *Salmonella* infections requires a comprehensive control strategy including regular monitoring, strict biosecurity, sourcing feed containing no animal protein, and vaccination.

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Salmonella website: www.safe-poultry.com

[4] Nobilis SG 9R, Intervet, The Netherlands