

## CHAPTER 5

### DISCUSSION AND CONCLUSIONS

#### 5.1 Discussion

This study reveals that *Salmonella* prevalence in broiler flocks was detected at 2 different stages: overwhelmingly already at one-day-old chicks and, to a much smaller extent, within 3 weeks before leaving for slaughtering. The prevalence at one-day old chicks already was 91.6% and cumulated to 98.6% prior to slaughter. These prevalences are in the range of those previously reported elsewhere in Thailand. Sasipreeyajan *et al.* (1996) reported that the prevalences of *Salmonella* were 100%, 87% and 100% in broiler, layer and breeder parents flocks, respectively. However, the criteria to consider a flock positive were different from our study; in their studies a flock was classified as a positive flock if *Salmonella* was isolated from any samples such as cloacal swabs, water, feed, litter etc.). Furthermore, various estimates of *Salmonella* colonization have been reported in other countries, like 50% in Canada (Arsenault *et al.*, 2007) by culturing pooled caecal contents from about 30 birds per flock in 81 broiler flocks and 23.7% (EFSA, 2007a) in the EU studies in 7,120 flocks in 23 member states by the boot swab technique. The latter technique was similar to this study. For Denmark, 5.5% of 8,911 investigated broiler flocks (during 1998 and 1999 ) were classified *Salmonella*-positive according to the country's National surveillance programme (Wedderkopp *et al.*, 2001). In Denmark, this prevalence was the result of a targeted national program, after the rapid incidence of human salmonellosis was attributed to the spread of *Salmonella* in broiler chickens: as a result of the control program, the contamination rate of broiler flocks dropped from more than 65% during the 1988/1989 period to lower than 5% in 2000, and the broiler associated salmonellosis incidence per 100,000 inhabitants has been concomitantly reduced from 30.8 in 1988 to 0.5 in 2001 (Wegener *et al.*, 2003).

The present study demonstrates that the major cause leading to the high prevalence of *Salmonella* in one-day-old chicks may come from the breeder flock. A companion study on the prevalence of *Salmonella* spp. in the broiler breeding flocks

during production in the same poultry compartment in northern Thailand found that the overall *Salmonella* prevalence (at least 1 pair of boot swab faecal samples positive) of the breeding flocks was 82.8% (95% CI=64.2-94.1) (Boonprasert, 2009). Infected breeder flocks do transmit *Salmonella* to their progeny by vertical transmission. Primary vertical transmission involves the passage of agents through the oviduct or by contact with infected peritoneum or the air sac, and secondary vertical transmission involves contact with infected or contaminated egg contents as a result of the faecal contamination of eggshells from cloaca and/or contaminated nests, floors or incubators, leading to penetration of agents into the eggs (Hafez and Jodas, 2000). Furthermore, even a single infected breeder flock can cause the widespread distribution of *Salmonella* contamination before it is detected (Giessen *et al.*, 1991). Consequently, infected chicks will cause widespread distribution of contamination through their faeces into the farm (Renwick *et al.*, 1992; Van Immerseel *et al.*, 2004; Kim *et al.*, 2007; Namata *et al.*, 2009). Since young chicks are very susceptible to become infected with *Salmonella*, they can shed bacteria in large quantities via their faeces (Poppe, 2000).

In our study, the prevalence of *Salmonella* contamination in broiler flocks at flock age within 3 weeks before slaughter was 7 percent higher than in age one-day-old chicks. Some, but minimal horizontal transmission of infection is likely to have occurred. *Salmonella* can persist in infected chicks through the rearing period. Gast and Holt's (1998) reported on the persistence of *Salmonella enteritidis* from the one-day-old chicks until layer chickens demonstrated that after oral inoculation of chicks at 1 day of age, *Salmonella enteritidis* persisted in the intestinal tract and nearly half of these birds were still shedding organisms in their faeces at 24 weeks of age. The authors concluded that infected one-day-old chicks can lead to frequent intestinal colonization and occasional egg contamination when these birds mature into laying hens. Moreover, in Phillips and Opiz (1995) study on the pathogenicity and persistence of *Salmonella enteritidis* in Leghorn some chicks were infected with *Salmonella enteritidis* (SE) at 2 days of age, and they remained *Salmonella*-infected for even up to 64 weeks. In this study, 5 out of the 6 initial negative flocks had turned positive at re-sampling within 3 weeks before slaughtering, at weeks 3-4 of the total production cycle of 5 weeks. Such later *Salmonella* infection detections may come

from several potential sources. They can originate from chicks themselves, who may already have been infected but at the first time of sampling were not shedding. Some contamination from the farm environment, a further major source of *Salmonella* infection, is possible, particularly as contamination can persist inside poultry houses as reported by Rose *et al.* (1999). The *Salmonella* contamination of a house before placing day-old chicks was found to be a significant risk factor for a flock to be *Salmonella* contaminated at the end of the rearing period. Several factors are reported to play an important role in *Salmonella* contamination to broiler flocks in farms such as litter, feed, water, equipment, rodents, insects, etc. Contaminated litter is an important source and means of transmission of *Salmonella* as poultry often ingest large numbers of *Salmonella* by picking faecal and caecal droppings of littermates (Poppe, 2000); rodents, pet animals and insects are potential reservoirs for the transmission of infections between houses (Hafez and Jodas, 2000). Other farm animals, waterfowl, wild birds, and even humans also can be reservoirs for this bacterium (Hafez, 2008).

This study was conducted as part of a poultry production chain project, which included investigations on the breeder flocks and on the efficacy of cleaning and disinfection procedures for *Salmonella* spp. in the specified Production Compartment of Broiler Farms in Northern Thailand. Data of the latter study show that highly contaminated sample sites in houses were water troughs, floors of entrances of houses, floors of feed storage rooms, feeding troughs, dust and feeding carts (Awaiwanont., 2009). These sources may have contributed to the *Salmonella* occurrence of 5 flocks during the end of the rearing period in the farms. Questionnaire data further suggest that water may be a potential source of *Salmonella* contamination, as most of the water used for cleaning of equipments and poultry houses was from surface and deep wells which may have *Salmonella* contamination. As reported by Sasipreeyajan *et al.* (1996)., 28% of water samples from surface wells of broiler farms were contaminated with *Salmonella*, and underground water for layer flocks was *Salmonella* contaminated in 11% of cases.

In this study, among the *Salmonella*-positive samples, the most frequent serovar was *S. Enteritidis* (92.9%) which was different from the previous studies

conducted in Thailand. Sasipreeyajan *et al.*,(1996) reported that the most common serovars associated with the broiler, layer and parent breeder flocks in their study were *S. Blockley*, *S. Weltevreden* and *S. Amsterdam* respectively. As reported by the study of Padungtod and Kaneene (2006) which was conducted in Chiangmai and Lamphun provinces of northern Thailand during 2000-2003, the most common serotype of *Salmonella* found in live chickens were Emek, Enteritidis and Rissen while as *S. Weltevreden* was the most common serotype of *Salmonella* in chickens at slaughter and at the market. In contrast to our study, their study found *S. Enteritidis* only in a small proportion of isolates from chicken. It may be because of the fact that the source of *Salmonella* infections in human and chicken may have change overtime (Padungtod and Kaneene, 2006).

Our study indicates that there was high percentage of *S. Enteritidis* infected poultry flock. Since we found the large percentage of *Salmonella* of serotypes enteritidis from the flock age one-day-old chicks, thus it can be concluded that the most important route of *S. Enteritidis* infected flock was the transmission from infected breeding flocks to their progeny. Furthermore, according to the invasive character of *S. Enteritidis*, the organisms can easily enter the egg contents. In consequence, the organisms are protected against disinfection treatments of eggs before and during hatching. However, *S. Enteritidis* may also easily be transmitted to new flock horizontally from infected flocks, contaminated environment, and infected vectors such as rodent, bird (Giessen *et al.*, 1994).

The results of our study show that almost 100% of flocks were *Salmonella* positive. For this reason, anticipated analyses on risk factors for *Salmonella*-positive versus negative flocks could not be carried out.

## 5.2 Conclusions

In conclusion, the results demonstrate that in the present study the source of *Salmonella* infection in broiler flocks is not due to the persistence of the *Salmonella* on the farms themselves, but probably, due to the introduction of infection with one-day-old chicks. The first control measure to prevent such *Salmonella* contamination, already at the start of the broiler production flocks, is to use *Salmonella* free breeding flocks. Hence, the major strategy to control *Salmonella* in this poultry system should

be directed to evaluate the entire production chain from the top, particularly at the stage of the breeding flock complex, including feed hygiene, feed and water treatment, vaccination and farm bio-security measures (Hafez, 2008).



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