Contamination Routes of *S. Infantis* in food chain of broiler meat production and it's significance for public health

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Abstract

From each of three slaughterhouses, 50 samples of broiler neck skin were taken at slaughter line. A farm, from which the largest number of positive samples originated, was identified. In slaughterhouse 2, *Salmonella* was determined in 17 samples of which 11 samples originated from the same farm. At the beginning of broiler breeding, *Salmonella* presence wasn’t detected. However, after the second week *Salmonella* was found. All positive samples were identified as *Salmonella Infantis*. Comparing genetic similarity with the same strain originating from infected humans showed that ≥ 92 % of mutual genetics similarity was confirmed.

1. Introduction

*Salmonella* has been recognized as a major and important foodborne pathogen for humans and animals over more than a century, causing human foodborne illness as well as high medical and economical costs\textsuperscript{1}. However according to EFSA and ECDC report on trends and sources of zoonoses, zoonotic agents and food-borne outbreaks in 2013\textsuperscript{2} the decreasing EU trend in confirmed human salmonellosis cases observed in recent years was continued. Most
Member States met their *Salmonella* reduction targets for poultry. In foodstuffs, the reported EU-level *Salmonella* non-compliance in fresh poultry meat also decreased. In 2013, a total of 82,694 confirmed salmonellosis cases were reported by 27 EU MS, resulting in an EU notification rate of 20.4 cases per 100,000 population. This represented a 7.9 % decrease in the EU notification rate compared with 2012, confirming a declining trend of salmonellosis. However, *Salmonella* remained the most frequently detected causative agent in the food-borne outbreaks reported (22.5 % of total outbreaks). From 2008 to 2013, the annual total number of *Salmonella* outbreaks within the EU decreased markedly by 38.1 %, from 1,888 to 1,168 outbreaks. As in previous years, eggs and egg products were the most common identified food vehicles, associated with 44.9 % of these outbreaks. In United States approximately, 1.4 million human *Salmonella* infections occur annually with assumption of only 2% cases reported to Centers for Disease Control and Prevention (CDC), resulting in about 160,000 hospitalizations with nearly 600 deaths[^3-5]. Due to increasing population mobility and the wide distribution of feed/food products, *Salmonella* outbreaks and salmonellosis cases are occurring across state and national boundaries[^6]. Therefore, monitoring of *Salmonella* occurrence in the meat-food supply (in particular, raw meat at slaughterhouses), is necessary due to public health implications[^7].

### 1.1. *S. Infantis* prevalence in humans

*Salmonella enterica* subspecies *enterica* serovar *Infantis* (further in text *S. Infantis*) was confirmed as the cause of human salmonellosis in several countries and is the third most frequently isolated serovar of *Salmonella* (1.1%) after *S. Enteritidis* and *S. Typhimurium[^8,9]. For instance, in fowl (*Gallus gallus*) *S. Infantis* was the most commonly reported isolated serovar in 2013; in broiler meat, the most common serovars were *S. Infantis* and *S. Enteritidis*, while the *S. Senftenberg* was most commonly reported in feed intended for *Gallus gallus*, followed by *S. Typhimurium*. In Hungary *S. Infantis* is responsible for about 5% cases of salmonellosis[^10]. The results of research indicate that the most common serovars in humans, food and in poultry in Serbia are *S. Enteritidis, S. Typhimurium* and *S. Infantis[^11]*.

### 1.2. *S. Infantis* prevalence in broilers

In broiler flocks, 26 EU Member States met the reduction target set at ≤ 1 % for the two serovars (*S. Enteritidis* and *S. Typhimurium*). Hungary had the highest rate of *S. Infantis* in broilers (64% flock prevalence), followed by Poland with 8%, and Czech Republic with 2.5%, respectively[^12,13]. *S. Infantis*, was the 3rd most frequent serovar in human cases, and the most frequently detected serovar (29.2%) amongst contaminated broiler carcasses in the EU[^14].

### 1.3. Sources of contamination of humans and broilers

One of the current public health priorities in Europe is to improve the epidemiological surveillance of foodborne illness[^15]. The Salm-gene project, a European collaboration for DNA fingerprinting for food-related salmonellosis, was launched in 2003[^16]. Prevalence of *Salmonella* in fresh meat is directly related to the findings in animals and also depends on food processing in slaughterhouses[^17].

Broiler production (farm breeding) is considered the most critical place for *Salmonella* contamination. The most of contaminated samples related with poultry production were: delivery-box liners (32.0%), faeces samples (31.2%), dust samples (25.0%), farming boots (19.7%) and feed from feeders (16.0%). However, the most important risk factors for *Salmonella* contamination of the flocks, at the end of the rearing period, were *Salmonella* status of farm house after cleaning and disinfection, as well as *Salmonella* status of day-old chick flocks and feed from feeders[^18].

### 2. Biosecurity measures to control *S. Infantis*

Biosecurity measures encompass well-defined barriers aimed at preventing the entry of *Salmonella* on the farm[^19], and to avoid the spread of salmonellosis if it is already present[^20]. Such enhancement of biosecurity is the most effective way to minimize the risk of disease introduction[^21,22].
2.1. *S. Infantis* presence on farm and at slaughterhouse

The presence of *Salmonella* in broiler flocks can vary considerably, but is usually found within the range of 6-30\%\textsuperscript{23,24}. In other study, Thakur et al.\textsuperscript{25} established the presence of *Salmonella* in 70\% of broiler facilities. In primary poultry production (on farm), Velhner et al.\textsuperscript{26} states that a contaminated farm can hardly be rehabilitated, due to increase in labor effort and usage of disinfectants.

A study carried out by EFSA, on the prevalence of *Salmonella* in broiler meat, showed that *S. Infantis* is the most frequently isolated serovar in the EU, with an average of 55\%, while in some countries such as Hungary (96\%), Slovenia (55\%) and Austria (44\%), *S. Infantis* was the most important serovar\textsuperscript{27}.

2.2. *Salmonella* findings in Serbian poultry meat chain

The largest number of *Salmonella*-positive broilers (e.g. neck skin samples), were originated from farm 1. In second stage, on the farm 1, during the next breeding cycle, the strict application of biosecurity measures was carried out (additional desk barriers, disinfectant replacement, continuing education of employees, installation of cameras, etc.). After effective application of biosecurity measures, *Salmonella* findings in broiler carcasses at slaughterhouse, originating from farm 1, was reduced from 55\% to 10\%; it showed that consistent application of on-farm biosecurity measures greatly affected *Salmonella* presence in broiler carcasses.

PFGE (Pulse Field Gel Electrophoresis)-based DNA characterization of *S. Infantis* isolated in this Serbian study confirmed a total of 7 genetic profiles, including the infected people. The definition of `same genetic profile` included both, isolates from broiler neck skin and infected humans and genetic similarity degree of 100\%.

<table>
<thead>
<tr>
<th>Establishment</th>
<th>Number of samples (n)</th>
<th><em>Salmonella</em> positive (n / %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slaughterhouse 1</td>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td>Slaughterhouse 2</td>
<td>50</td>
<td>17</td>
</tr>
<tr>
<td>Slaughterhouse 3</td>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>150</td>
<td>17</td>
</tr>
</tbody>
</table>

3. Conclusion

*Salmonella* in primary poultry production represents a major public health concern, as well as the economic problem in countries where adequate control measures are implemented, but also in regions where the climate favors the survival and spread of this organism. On-farm *Salmonella* status may influence the prevalence of *Salmonella* at slaughterhouse, which will consequently determine the extent of consumer exposure. For example, it has been confirmed that presence of *S. Infantis* on broiler carcasses poses a risk to human health (≥ 92\% of mutual genetics similarity was confirmed between broiler carcasses and infected people). Therefore, a consistent application of effective on-farm biosecurity measures is essential in prevention and control of *Salmonella*-borne infections.
References


