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Evaluation of *Salmonella* cross contamination at retail chicken meat outlets in Kandy, Sri Lanka

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Abstract : This study was carried out to evaluate the *Salmonella* cross contamination at retail chicken meat outlets in Kandy, Sri Lanka and to identify the risk factors for *Salmonella* contamination at retail chicken meat outlets. Fifteen retail chicken meat outlets in Kandy area were randomly selected. Pre-tested questionnaires were used to collect data for identifying risk factors of *Salmonella* cross contamination at retail outlets and swab samples from meat contact surfaces/utensils were obtained. Out of 57 swab samples collected from meat contact surfaces/utensils, the overall prevalence of *Salmonella* cross contamination was 21%. Weighing scale (33%), meat containing trays/buckets (27%) and cutting board (25%) showed the highest percentage of *Salmonella* prevalence whereas knife and showcase showed relatively low percentages, 14% and 9%, respectively. Retail chicken outlets with slaughtering facilities had a significantly higher prevalence of *Salmonella* cross contamination than those without slaughtering facilities. This higher rate of *Salmonella* cross contamination at retail chicken meat outlets could be attributed to lack of proper cold chains and minimal facilities, and poor level of hygiene in those outlets.

Key words **:** *Salmonella*, Retail outlets, Chicken meat, Cross-contamination, Sri Lanka

I. Introduction

Foodborne illness is an important public health problem worldwide. Paratyphoid serotypes of *Salmonella* and *Campylobacter jejuni* are mainly responsible for the largest number of foodborne illnesses attributed to poultry and poultry products (White et al., 1997). While numerous potential vehicles of transmission exist, commercial chicken meat has been identified as one of the most important food vehicles for these types of organisms (Hassanein et al., 2011). *Salmonella* spp. is frequently isolated from chicken meat and the main cause of *Salmonella* infections related to poultry products is attributed to the consumption of undercooked chicken or cross-contamination of other cooked food with raw chicken (Boer and Hahne, 1990; Cortez et al., 2006). International outbreaks associated with different food stuffs contaminated with different *Salmonella* serotypes have been reported. Most serotypes of *S. enterica* result in self-limiting gastroenteritis characterized by diarrhea, abdominal cramps and sometimes vomiting and fever. Two serotypes, *S. typhi* and *S. paratyphi*, cause systemic fevers that can be fatal without therapy. Typhoid and paratyphoid fevers are associated with poor sanitation and primarily diseases of developing countries (Hassanein et al., 2011). Reporting outbreaks of infections related with poor hygiene and consumption of contaminated meat does not reflect real scenario due to lack of proper disease surveillance systems in these countries.

The risk of *Salmonella* contamination varies among the countries due to differences in control measures and practices implemented throughout the production chain from the primary production to final preparation of meat for consumption (FAO/WHO, 2010). The prevalence of *Salmonella* contamination in poultry

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meat purchased at retail outlets is a better indicator of the public health risk. It is at the point of the retail outlets that the consumer typically first comes into contact with the poultry meat. Retail meat may serve as a source of direct hand-to-mouth exposure and cross-contamination exposure to pathogens. In addition, the presence of bacterial pathogens in meat processing equipments and associated surfaces may contribute to the contamination of meat (Ali et al., 2010). Adequate sanitation and chilling may result in an actual decline in the level of viable microorganism isolates in poultry products (Myint, 2004). However, each of the postmortem step including dressing, evisceration, handling, transportation, storage, additional processing and re-packaging may provide a new opportunity for bacterial contamination or growth. According to Myint (2004), the overall *Salmonella* prevalence was 23% for poultry meat products at the retail outlets in Maryland. This level of contamination is much lower than USDA estimate of 43% in 1990, but consistent with some findings from England (25%; Myint, 2004). Further, Ruban et al. (2010) reported that *Salmonella* prevalence was in the range of 32-39% in traditional meat shops with minimal facilities and poor hygiene in Bangalore, India.

The quality and safety of retail chicken meat is important as it is one of the main animal protein sources in the country. The prevalence of bacterial contamination of poultry products is generally tested at the processing plants through food safety inspections by the standard certification institutes and government sector during their annual plant audits. Routine surveillances at retail outlets, however, are not conducted by these agencies. Inspection and testing of raw meat products at retail outlets come under the jurisdiction of local Departments of Health. Unfortunately, the testing of raw meat products from retail outlets is not conducted unless an outbreak emerges. This lack of uniform surveillance protocols for raw poultry products at the retail outlets constitutes an important gap in the farm-to-fork spectrum of food safety protection in Sri Lanka. Additionally, not much literature has been available on the prevalence of *Salmonella* at retail chicken meat outlets in Sri Lanka

Therefore, it is important to concentrate on evaluating the existing levels of safety, and microbiological quality based on the prevalence of *Salmonella* cross contamination at retail chicken meat outlets. The objectives of the current study were to evaluate the *Salmonella* prevalence and cross contamination at retail chicken meat outlets in Kandy, Sri Lanka and to identify the risk factors associated with *Salmonella* contamination at those outlets.

II. Materials and method

Fifteen retail chicken meat outlets in Kandy area were randomly selected for the study. A total of 57 swab samples (50 mm × 50 mm) were collected from knives (14), cutting boards (12), weighing scales (9), meat containing trays/buckets (11) and display showcases (11) from retail outlets and used for *Salmonella* isolation.

1. Swab sampling process

Sterilized swabs were lightly moistened in saline water and swabbed along the area of contact surfaces/ utensils to recover the microbes. Swabs were then placed in the labeled containers and returned to the laboratory in an iced styrofoam box (4°C). All swab samples were processed immediately after receiving at the laboratory.

2. *Salmonella* isolation protocol

Salmonella isolation was done as described by microbiology laboratory guidebook of Food Safety and Inspection Service (USDA, 2011). Each swab sample was pre-enriched in 5 mL of buffered peptone water (BPW) and placed in an incubator at 37°C overnight.

Each sample (0.1 mL) of this stock was transferred to 10 mL of Rappaport Vassiliadis (RV) medium. The RV media was then incubated at 42°C for 24 h. One loopful of RV media from each sample was streaked onto Xylose Lysine Deoxycolate (XLD) agar plates and the plates were incubated at 37°C for 24 h. Presumptively positive black colonies were sub-cultured on Brilliant Green (BG) agar plates and incubated at 37°C for another 24 h. Presumptively positive pink colonies were bio-chemically confirmed with Triple Sugar Iron (TSI) agar, Simmons Citrate agar, Urease and SIM (Sulfide Indole Motility test) medium based on the laboratory manual for identification of bacterial pathogens (VRI, 1990).

3. Data collection

A pre-tested questionnaire was used to collect information on *Salmonella* cross contamination. Information including type of sales, scales, type of products, nature of sales, type of meat display, storage conditions of meat, way of handling meat, and source of hygienic condition were collected.

4. Statistical analysis

Collected data were analyzed using Microsoft Excel spreadsheets. The Chi-square test was performed in Minitab 14 to test the hypothesis; retail shops with slaughtering facility have a higher risk of *Salmonella* cross contamination than those without slaughtering facility.

III. Results

1. Prevalence of *Salmonella* cross contamination in retail chicken meat outlets

Out of 57 swab samples collected, 12 swab samples of *Salmonella* suspected isolates from selective media were bio-chemically identified as *Salmonella*. Therefore, the overall prevalence of *Salmonella* cross contamination was 21% (Table 1). Weighing scale (33%), meat containing trays/buckets (27%) and cutting boards (25%) showed the highest percentages of *Salmonella* prevalence whereas relatively low percentages were observed in knives (14%) and showcases (9%).

Retail outlets without slaughtering facilities represented 60% of the samples and those with slaughtering facilities represented 40% of the samples. Retail outlets with slaughtering facilities had a significantly higher ($p<0.05$) prevalence of *Salmonella* positive samples than retail chicken outlets without slaughtering facilities (Table 2). The retail outlets without cooling facilities during raw chicken meat display had a significantly higher risk of *Salmonella* prevalence than those outlets with cooling facilities during meat display ($p=0.041$).

2. Details of retail chicken meat outlets

1. Type and nature of sales

Selling whole chicken without skin was the most common type of sale at the retail shops in Kandy area (46.7%), whereas whole chicken with skin was less

Table 1. Prevalence of *Salmonella* in different meat contact surfaces/utensils.

Meat contact surface/utensil	Sample No	No of Positive samples	%
Knives	14	2	14.3
Cutting boards	12	3	25.0
Weighing scales	9	3	33.3
Trays/ Buckets	11	3	27.3
Showcases	11	1	9.1
Total	57	12	33.3

Table 2. Prevalence of *Salmonella* in different types of retail outlets.

Type of retail outlets	Sample No	No of Positive samples	%	p value
Without slaughtering facility	9	1	11.1	0.025
With slaughtering facility	6	4	66.6	
Total	15	5	33.3	0.025

common (13.3%). Only 40% retail shops represented selling chicken parts. The average daily sale was 44.33 kg.

Two types of retail outlets were identified during the study. Retail outlets without slaughtering facilities sold pre-dressed chicken carcasses. Birds were slaughtered and dressed in the farm and only the dressed meat was delivered to these outlets. Shop owners got their products either from their own farms (46.7%) or from other farms (13.3%). These retail outlets showed only 11% prevalence of *Salmonella* cross-contamination (Table 2). Other retail outlets had been designed with minimal slaughtering facilities where a small area was allocated for slaughtering, cleaning and evisceration. No lairage facility was available and the birds were kept within the same space either in crates or in small reserved area. This type of retail outlets showed 67% prevalence of *Salmonella* cross-contamination.

2. Type of display

Majority of the outlets (73%) used showcases as the type of display, and the rest 27% used plastic buckets or aluminum trays to keep the chicken meat. Cooling temperature (10-15°C) was maintained inside the showcases during the display of raw meat products. However, this condition was not much efficient because these showcases were kept in front of the shops with the direct exposure to sunlight. Hence, these conditions may not adequate enough to protect the microbial quality of the products. The retail outlets with no showcases stored their products at room temperature (25-30°C). Only 2-5 birds were killed in these outlets at a time. Once all meat is sold, another couple of birds were killed and dressed. Lack of proper cold chain, and inadequate power supply could greatly affect the higher prevalence of *Salmonella* in these retail outlets.

3. Salability of the products

Majority of the outlets (73.3%) were able to sell all the products (either meat or live birds which they brought to the shop) at the end of the day and 26.7% were unable to sell all the products. Nearly two third (60%) of these outlets stored the remaining stock for the next day sales. The remaining live birds were kept in the same crates for the next day and remaining meat was stored either in refrigerators or freezers. Other outlets (40%) had different options for the remaining meat at the end of the day such as using for home consumption, returning to the farm or delivery for special customers and hotels.

4. Hygienic condition

According to the current study, 53.3% of the retail outlets cleaned the meat contact surfaces/utensils less than twice a day whereas the rest of them cleaned twice a day, primarily in the morning and in the evening (Table 3). Only 60% of the retail outlets used any kind of detergent (usually soap or detergent powder) to clean the surfaces and utensils. The rest of the outlets used only water for cleaning. In addition, 33.3% of the outlets used a disinfectant and the others used no disinfectants.

5. Way of handling meat

Meat was handled by hand without any protective gloves in all outlets studied during this study. Therefore, personal hygiene during meat handling is very important to prevent cross-contamination at these retail outlets.

Table 3. Association of risk factors for *Salmonella* contamination at retail chicken meat outlets.

Criteria	Category	No of outlets	%
Frequency of cleaning	2 times per day	7	46.7
	< 2 times per day	8	53.3
Use of detergents	Yes	9	60.0
	No	6	40.0
Use of disinfectant	Yes	5	33.3
	No	10	66.6

IV. Discussion

The present study demonstrated an overall 21% *Salmonella* prevalence of cross contamination in the retail chicken meat outlets in Kandy area, Sri Lanka. Similar kind of study conducted by Ali *et al* (2010) to find out microbial contamination of raw meat and its environment in retail shops in Karachi, Pakistan reported 29% distribution of *Salmonella* in meat samples but zero detection of *Salmonella* from meat cutting surfaces (knives, wooden boards, weigh scales and meat mincers) and environmental surface swabs. This finding was not compatible with the current study of *Salmonella* prevalence in meat contact surfaces and utensils in retail meat outlets in Kandy area, Sri Lanka.

Similarly, Myint (2004) reported that overall prevalence of *Salmonella* in raw chicken meat at the retail grocery outlets in Maryland was 23%. The levels of contamination in European countries were reported as 25% in England, 35% in Spain, and 36% in Belgium. All these results were much lower than USDA estimate of 43% in 1990 (Myint, 2004). Ruban *et al* (2010) showed average 24.88% and 31.99% prevalence of *Salmonella* spp. in chicken breast and thigh meat, respectively from retail chicken meat under different processing conditions in Bangalore, India. In addition, higher levels of prevalence were reported in Vietnam (53.3%; Coloe et al., 2007) and Canada (30%) for raw chicken legs (Bohaychuk et al., 2006), and in India for raw chicken breast and thigh meat, 65.71 and 71.43%, respectively (Ruban and Fairoze, 2011). Additionally, Cortez et al. (2006) reported a 10 % occurrence of *Salmonella* spp. in chicken abattoirs from Sa˜o Paulo State, Brazil. This isolation of *Salmonella* spp. in chicken abattoirs with estate inspection service (SISP) was lower ($p \leq 0.05$) than *Salmonella* isolation in abattoirs with federal inspection service (SIF; Cortez et al., 2006).

Comparing to these findings which directly evaluate the *Salmonella* prevalence in meat samples rather than meat contact surfaces, the contamination status of retail chicken meat with its surrounding environment in local scenario was obvious. It was interesting that this level of poor hygiene in retail chicken meat outlets which might ultimately result in local infectious disease outbreaks was not much significant in the country. This may be due to cooking habits of the people who use lot of spices and higher cooking time to cook meat. However, the findings of this study are really important as this level of hygiene is not accepted. Furthermore the risk of public health is still same due to changes in eating habits, mass catering and more complex food supply system through modernization and globalization.

The differences in the prevalence of *Salmonella* in raw poultry may be due to country of origin, type and size of sample analyzed, and methodology (Bohaychuk et al., 2006). The differences in the media used for enrichment, selective enrichment, and isolation can also affect estimates of prevalence (Myint, 2004). The different rate of contamination in different countries can also be related to climate and temperature of storage of raw meat at retail meat outlets. According to the study, higher rate of *Salmonella* cross con-tamination observed at retail chicken meat outlets in

the current study could be attributed to lack of proper cold chains, minimal facilities and poor level of hygiene in retail outlets.

Better equipments in slaughterhouses, advanced processing practices including the use of dry chilling of carcasses, and more effective use of refrigeration in meat transportation in developed countries could also help to reduce cross contamination of meat (Coloe et al., 2007). The conditions during slaughtering, processing, transportation, holding at retail outlet, and opportunities for cross-contamination at retail outlets can result in large changes in the risk of salmonellosis. Slaughtering of chicken at the same place is a greater potential risk which can lead to cross contamination of meat prior to sale to consumers.

V. Conclusions

The overall prevalence of *Salmonella* cross-contamination at retail chicken meat outlets in Kandy, Sri Lanka was 21%. Weighing scale, meat containing trays/buckets and cutting board showed the highest percentage of *Salmonella* prevalence than knife and showcase. Retail chicken meat outlets with slaughtering facilities had a significantly higher prevalence of *Salmonella* cross contamination than those without slaughtering facilities. The findings of this study are vital regarding the public health risk of the country. Therefore, Sri Lanka needs its own unique model to assure the quality and safety of poultry products at retail outlets. This should be concentrated on evaluating the existing levels of safety, microbiological quality and prevalence of foodborne pathogens in poultry products and making recommendations on improved quality assurance to mitigate the risk to consumers.

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