Bulletin of Pharmaceutical Research 2014;4(2):100-3
An Official Publication of Association of Pharmacy Professionals
ISSN: 2249-6041 (Print); ISSN: 2249-9245 (Online)

REVIEW ARTICLE

INCIDENCES ON DETECTION OF *SALMONELLA* SPP. AS CONTAMINANT IN POULTRY MEAT: A REVIEW

Subha Ganguly*

AICRP on Post Harvest Technology (ICAR), Department of Fish Processing Technology, Faculty of Fishery Sciences, West Bengal University of Animal and Fishery Sciences, Chakgaria, Kolkata-700 094, WB, India

**E-mail*: ganguly38@gmail.com
Tel.: +91 9231812539.

Received: August 20, 2014 / Revised: August 29, 2014 / Accepted: August 30, 2014

The present review documents the incidences and recovery of *Salmonella* spp. isolated, identified and characterized from carcass meat and egg wash of poultry. *Salmonella* spp. were identified as the predominant pathogens in the chicken samples in the various relevant and documented investigations carried out by various researchers from time to time in India and abroad. The virulent genes present in the pathogenic bacteria are the mainly responsible factors eliciting the enteric infections in hosts after consumption of the contaminated/infected meat.

Key words: Chicken, Meat, *Salmonella* spp, Poultry.

INTRODUCTION

Poultry rearing is a booming industry in India. Broilers and layers are raised by the farmers to get rapid returns due to their fast growth on account of efficient utilization of feed during early growth period. Genetically improved broilers are however very much prone to diseases. Disease prevention is backbone of poultry industry. To make the poultry industry economically viable, sound knowledge of disease management, their detection, quick and accurate diagnosis, disease monitoring and mass immunization are the general approaches which may be employed for prevention of diseases.

The total poultry meat production in India has risen to a whopping 17,15,000 tonnes in 2005 from 14,40,000 tonnes in 2003. Likewise, egg production has also increased from 37 billion in 2003 to 41 billion in 2005. The per capita availability of meat has also increased from 1200 g in 2003 to 1350 g in 2006 (Sherikar and Tarwate, 1998). The average annual growth rate of the total meat production is 3.60%. In poultry production, dietary prebiotics are mainly used in order to enhance live body weight gain, dressing percentage, weight of vital organs and muscles and mean villus lengths in digestive tract of poultry birds (Ganguly, 2013a). In addition, *β*-glucan from an edible mushroom (*Pleuratus florida*) has pharmaceutical and physiological effect as an immunomodulator on the innate immune responses in broiler (Ganguly, 2013b).

Special attention in poultry meat production is given because live birds are host to large number of different microorganisms residing in their skin, feathers and in the alimentary tract. The practice of keeping live caged birds at the same premises where slaughter of birds are also goes on leads to fecal contamination of raw meat. Microorganisms from the environment, equipments and from the operator's hands can also contaminate meat. Contamination could also occur due to infected sick birds which have been sold off. Epidemiological reports suggest that poultry meat is still the primary cause of human food poisoning (Selvaraj *et al* 2010). Microflora present in chicken meat is heterogeneous and originates from slaughtering premises, operator's hands, equipments, outfits, contaminated water and surrounding air.

Pathogenic organisms are associated with pyogenic infection, necrotic dermatitis and bumble foot in domestic poultry along with ulcerative keratitis, tonsillitis, endocarditis and

the enterotoxin causes food poisoning in humans.

Importance of the pathogen as food contaminant for consumers

Salmonellosis is one of the most common infectious diseases in animals and one of the major causes of food poisoning in humans. *Salmonella* spp. cause wide range of diseases such as enteric fever, gastroenteritis and bacteriemia in the infected hosts. Food borne infections caused by Salmonella serotypes mainly through contaminated meat occurs at high frequency in industrialized nations and developing countries (**Figure 1**).

Fig. 1. Salmonella infections from poultry

In poultry, fowl typhoid is a septicemic contagious bacterial disease with acute and chronic courses and mortality varying from moderate to high depending upon the strain of the causative bacterium *i.e. Salmonella gallinarum*. Early detection of the disease outbreaks, quick and accurate diagnosis, disease monitoring and mass immunization are the general approaches employed for prevention of poultry diseases.

The incidences of fowl typhoid have now increased in India (Ramanatha *et al* 1990). Fowl typhoid affects almost the entire flock within short period causing severe economic losses to poultry farm owners due to complete depopulation of the affected flocks. Both antibody and cell mediated immune responses are operative in providing protection against *Salmonella gallinarum* infection (Prasad *et al* 2010).

Research findings on the serovars of the pathogen involved in infection

Approximately, 50% Salmonella infections in human are caused by only three serovars, specifically Typhimurium, Enteritidis and Newport. In India, Typhimurium and Enteritidis are the two most common serotypes identified from different sources. Salmonella serotype Enteritidis is currently the main cause of human Salmonellosis in most industrial countries where human infections are generally associated with the consumption of contaminated food. Salmonellosis, because of its immense significance, has become one of the most important bacterial disease affecting poultry Epidemiological studies have shown the outbreaks of *S. enteritidis* food poisoning to the consumption of contaminated eggs, egg products or meat (St. Louis *et al* 1998). For this reason, presence of Salmonella in foodstuffs has always been the most significant indicator of their hygienic acceptability or their unsuitability for human consumption. Comparison of Salmonella isolates from different sources helps in ascertaining the origin of infection.

Salmonella spp. is Gram negative, usually motile rods. The bacterial genus Salmonella is divided into two species *Salmonella enterica* and *Salmonella bongori*; *Salmonella enterica* itself is comprised of 6 subspecies. They are *S. enterica* subsp. *enterica*, *S. enterica* subsp. *arizonae*, *S. enterica* subsp. *diarizonae*, *S. enterica* subsp. *indica*, *S*. *enterica* subsp. *houtenae* or I, II, IIIa, IIIb, IV and VI respectively (Popoff and Minor, 1997).

Salmonella is a group of bacteria of more than 2,300 serotypes commonly known as Paratyphoid Bacteria. Salmonella inhabit in the intestine of clinically healthy man, animal and birds and are also pathogenic to them. Salmonella can exist in feces or on pastures for considerable period. They are not destroyed in carcass or offal maintained at chilling or freezing temperature. Salmonella can also grow well on meat at ordinary temperature. It is probable cause of 75% of outbreaks of food poisoning. *S. typhimurium* is found in rat, mice, cattle, sheep, goat, pig fowl and duck. *S. enteritidis* also cause meat food poisoning and it is commonly found in rat, cattle, pig, goat and duck (Kendall, 2008).

Salmonellosis in human beings

Typical food poisoning commences within 7-72 h after ingestion of the organisms. The food involved includes egg, meat and milk which are being derived from infected animals and birds, as well as those

contaminated during processing and storage. Food borne salmonellosis is characterized by nausea, vomiting, chills, abdominal pain and diarrhea. Salmonella must be controlled during processing and manufacturing of animal and

poultry feeds, by frequent disposal of excreta in livestock farms and by transportation of livestock in convenient manner to reduce stress (Jay, 2000; Kendall, 2008).

For effective control of food borne Salmonellosis in human beings concentrated efforts are to be made regarding development of immuno-diagnostic tools for rapid diagnosis of the disease and suitable immunoprophylactic agents for mass immunization of the birds to prevent its occurrence. In spite of rigid sanitary procedures, the disease occurs and in those cases it should be aimed at accurate diagnosis followed by implementation of appropriate control measures to combat it.

Survey reports on the incidences of the disease in India and abroad

Ghosh (1992) surveyed on 1249 sample from diseased and healthy animal and poultry birds in North Eastern Hill regions in India. He isolated *S. virchow* 6, 7 : r :1, 2, *S. typhimurium* and *S. brunei*. He carried out the serological identification of 243 isolates of Salmonella spp. in which *S. gallinarum* (23.04%), *S. typhimurium* (18.10%), *S. enteritidis* (9.87%), *S. bovismorbificans* (5.34%) isolates were identified. Zivkovik *et al* (1997) surveyed on the level or extent of salmonella contamination in poultry meat in which liver detected the highest among all the organs 23.11% and spleen revealed 6.90-10.70% level of contamination levels respectively. Prakash *et al* (2005) investigated on 40 samples of poultry carcasses examined for isolation of Salmonella spp. He isolated serotypes were *S. gallinarum* (69.60%), *S. enteritidis* (21.70%), *S. typhimurium* and *S. worthington*. Arora *et al* (2013) carried out the study on total of 150 samples were collected from broiler birds suspected of fowl typhoid from different parts of Haryana state, India. Isolation of the causative pathogen was done and subsequently the obtained isolates were characterized biochemically and for culture characteristics. Serotyping and antibiotic sensitivity pattern was also drawn. Results revealed that 126 (84%) isolates were *Salmonella gallinarum*, 15 (10%) were *Salmonella enteritidis*, and 9 (6%) were *Salmonella typhimurium*. Antibiograms of isolates revealed that most of the isolates were sensitive to gentamicin (76%) followed by amikacin (72%) and kanamycin (71%). Maximum resistance was obtained against Nalidixic acid (68.0%) followed by Carbenicillin (56%). All the isolates of *S. typhimurium* and *S. enteritidis* were 100% resistant against Nalidixic acid. The detection of *S. enteritidis* and *S. typhimurium* from fowl typhoid cases assumed significance from public health point of view and their emerging antibiotic resistance indicated a major concern for which effective prevention and control measures need to be carried out timely. PCR was used by Chen *et al* (1997) for the detection of Salmonella from food using specific gene sequences. He developed a universal protocol of PCR detection for Salmonella. Guo *et al* (2000) designed a primer for targeting *hil* A gene based PCR assay. This was found to be sensitive and specific for rapid detection of Salmonella in fresh products. Prakash *et al* (2005) analysed the plasmid profile of 23 strains of *Salmonella* spp. All the isolates of *S. gallinarum* and *S. pullorum* had common plasmids of 26.5 kb, 11.8 kb and 4.5 kb. Isolates of S. Typhimurium and *S*. Worthington had 21.1 kb and 6.6 kb plasmids. The technique of Restriction Fragment Length Polymorphism (RFLP) was developed based on PCR as an alternative to serotyping for identifying Salmonella serotypes. Sengupta *et al* (2011) carried out the study to determine the microbial quality of chicken meat and its public health implications. The standard plate counts and coliform counts from chicken meat procured from urban markets were higher than those from semi-urban markets. The Staphylococcal counts were higher in chicken meat from urban markets. All the positive isolates of *E. coli* and *Staphylococcus spp*. have been studied morphologically, physiologically and bio-chemically which proved to be confirmatory. Sengupta *et al* (2012) studied the microbial quality of chicken meat and its public health implications. Positive isolates of *E. coli* and *Staphylococcus* spp. have been studied morphologically, physiologically and biochemically which proved to be confirmatory. Mean standard plate count (SPC), coliform count and *Staphylococcus* count of chicken meat obtained from semi-urban markets was higher (243.90×10^4 CFU/g, 32.30×10^2 CFU/g and 49.70×10^2 CFU/g, respectively) as compared to urban markets. It was concluded that bacteriological quality of chicken meat obtained from semi-urban markets was objectionable in comparison to urban market meat. It was attributed due to low level of hygienic handling of birds and chicken carcass. Selvaraj *et al* (2010) investigated on the characterization and antibiotic sensitivity pattern of the *Salmonella*

spp. found as contaminants in chicken carcass. The overall incidence of *Salmonella* contamination of poultry carcass was found to be 4.90% with the higher percentage of *Salmonella* being isolated from chicken meat (8.00%) followed by liver and spleen (6.25%). The isolates were identified as *Salmonella typhimurium*, *Salmonella paratyphi* B and *Salmonella* (Rough). Eight *Salmonella* isolates obtained from poultry were confirmed as *Salmonella* spp. according to their biochemical profile and their sensitivity to different antimicrobial agents. Amikacin, kanamycin and ciprofloxacin were found to be the most effective antibiotics against *Salmonella* spp. *Salmonella* spp. were isolated from 4.90% of the 163 samples comprising of different poultry organs. The majority of the isolates belonged to *S. typhimurium* serotype. Antibiogram suggested that amikacin, kanamycin and ciprofloxacin showed the maximum potential to be used as promising antimicrobial agents against salmonella infections. Selvaraj *et al* (2014) performed the documents the molecular characterization and speciation of Salmonella spp. Isolated from carcass and egg wash of poultry. Out of the different species of Salmonella isolated, majorly *Salmonella paratyphi* B, *S. typhimurium*, and *Salmonella* (Rough variant) were identified as the predominant pathogens in the chicken samples in the present investigation. The virulent genes and particularly the enterotoxin (stn gene) were identified and characterized by RFLP technique and plasmid profiling.

CONCLUSION

In the present review, it can be summarized that *Salmonella* spp. isolated from poultry samples can be categorically identified and characterized by molecular techniques including the specification of the virulent genes present in them responsible for causing enteric/ enterotoxemic infection in host.

REFERENCES

Arora D, Kumar S, Singh D, Jindal N, Mahajan NK. Isolation, characterization and antibiogram pattern of Salmonella from poultry in parts of Haryana, India**.** *Adv. Anim. Vet. Sci.* 2013;1(5):161-3.

Chen S, Yee A, Griffiths M, Wu KY, Wang CN, Rahn K, De Grandis SA. A rapid sensitive and automated method for detection of Salmonella species in foods using AG-9600 AmpliSensor Analyzer. *J. Appl. Microbiol.* 1997;83(3):314-21. [DOI: 10.1046/j.1365-2672.1997.00226.x]

Ganguly S. Nutraceutical and pharmaceutical implication of prebiotics in livestock and poultry feed. *Bull. Pharm. Res.* 2013a;3(2):71-7.

Ganguly S. Pharmaceutical and immunomodulation effect of yeast and mycotic extracts as feed additives for livestock and poultry. *Bull. Pharm. Res.* 2013b;3(3):125-7.

Ghosh SS. Salmonella serotypes in animals and poultry in North-Eastern hill region. *Indian J. Anim. Sci*. 1992;62: 1141-3.

Guo X, Chen J, Beuchat LR, Brackett RE. PCR detection of *Salmonella enterica* serotype Montevideo in and on raw tomatoes using primers derived from hilA. *Appl. Environ. Microbiol.* 2000;66(12):5248-52. [DOI: 10.1128/AEM.66.12.5248-5252.2000]

Jay JM. Modern Food Microbiology, 6th edition, Aspen Publishers, Gaithersburg, MD: 2000.

Kendall P. Bacterial food-borne illness, Colorado State Univ. Press, Fort Collins, US: 2008.

Popoff MY, Minor LL. Antigenic formulas of the Salmonella serovars, 7th revision. World Health Organization Collaborating Centre of Reference and Research on Salmonella Institute de Pasteur, Paris, France: 1997.

Prakash B, Krishnappa G, Muniyappa L, Santhosh Kumar B. Epidemiological characterization of Avian *Salmonella enterica* serover infections in India. *Int. J. Poult. Sci*. 2005;4(6):388-95. [DOI: 10.3923/ijps.2005.388.395]

Ramanatha KR, Keshavamurthy BS, Gopal T. Characterization of *Salmonella gallinarum* isolates from poultry. *Indian J. Comp. Microbiol. Immunol. Inf. Dis*. 1990;11(3-4):156-7.

Selvaraj R, Das R, Ganguly S, Ganguli M, Dhanalakshmi S, Mukhopadhayay SK. Characterization and antibiogram of *Salmonella* spp. from poultry specimens. *J. Microbiol. Antimicrob.* 2010;2(9):123-6.

Selvaraj R, Das R, Ganguly S, Mukhopadhayay SK. Molecular characterization of *Salmonella* spp. isolated and identified from chicken samples. *Int. J. Pharm. Res. Bio-Sci*. 2014; 3(4):507-17.

Sengupta R, Das R, Ganguly S, Mukhopadhayay SK. Survey on microbial quality of chicken meat in Kolkata, India. *Int. J. Res. Pure Appl. Microbiol.* 2011;1(3):32-3.

Sengupta R, Das R, Ganguly S, Mukhopadhayay SK. Commonly occurring bacterial pathogens affecting the quality of chicken meat. *Int. J. Chem Biochem. Sci.* 2012; 1:21-3.

Sherikar AG, Tarwate BG. Processing of animal products. *Indian J. Anim. Sci.* 1998;68(8):855-9.

St. Louis ME, Morse DL, Potter ME, DeMelfi TM, Guzewich JJ, Tauxe RV, Blake PA. The emergence of grade A eggs as a major source of *Salmonella enteritidis* infections. New implications for the control of salmonellosis. *JAMA* 1988; 259(14):2103-7. [DOI: 10.1001/jama.1988.03720140023028]

Zivkovic J, Jaksic S, Miokovic B. Salmonella serovars in chicken meat and chicken meat products in Zagreb, Croatia. *Vet. Archiv.* 1997;67(4):169-75.

http://www.healthaim.com

*****