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A Brief Review on Salmonellosis in Poultry

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A B S T R A C T

Salmonellosis caused by *Salmonella* spp., a gram negative bacterium, is an important disease of poultry all over the world. *Salmonella gallinarum* (*S. gallinarum*) and *Salmonella pullorum* (*S. pullorum*) are avian host specific Salmonellae which causes fowl typhoid and pullorum disease in poultry and they are transmitted in between birds by both vertical and horizontal transmission. This article briefly reviews about epidemiology, clinical signs, diagnosis of avian salmonellosis.

Salmonellosis

Definition

Salmonellosis caused by *Salmonella* spp., a gram negative bacterium, is an important disease of chicken all over the world. Avian host specific salmonellae include *Salmonella gallinarum* (*S. gallinarum*) and *Salmonella pullorum* (*S. pullorum*) which causes fowl typhoid and pullorum disease (Rajagopal and Mini, 2013) respectively.

Occurrence

Global scenario

Fowl typhoid and pullorum disease are distributed in many countries of the world, and have economic significance (Barrow *et al.*, 1992). They are mainly distributed in Latin America, the Middle East, Africa and perhaps other parts of the world (Bouzoubaa *et al.*, 1992; Shivaprasad, 1997). Salmonellosis has also been reported in many countries of South-East Asia including Bangladesh (Bhattacharjee *et al.*, 1996), India (Saha *et al.*, 2012), Nepal (Jha *et al.*, 1994) and Pakistan (Javed and Hameed, 1989).

Indian scenario

Salmonellosis is a hyperendemic disease in India affecting both man and animals (Kumar *et al.*, 1997). From 1996 to 2008, fowl typhoid was diagnosed several times in India, but pullorum disease was reported once during 2002 (Barrow and Freitas Neto, 2011).

Over all prevalence of avian salmonellosis was 2.7 per cent in Uttar Pradesh (Menghistu *et al.,* 2011). Although, Indian poultry industry is evolving and emerging as the world's second largest market, fowl salmonellosis is increasingly rampant if not endemic with a huge bearing on the economy as well as the future development of poultry sector. There is relatively less number of reports of salmonellosis from India despite its high prevalence, which can be attributed to limited diagnostic facilities under field conditions and underreporting (Rajagopal and Mini, 2013).

Tamil Nadu

Assessment of carrier status of *S.* Pullorum and *S. gallinarum* infection in healthy flocks of chicken found to be 16 per cent of positivity from northern part of Tamil Nadu by rapid serum agglutination test (Selvam *et al.,* 2010).

A total of 23 *Salmonella enterica* subsp. *enterica* isolates were obtained while screening of poultry tissue samples including liver, yolk, ovary, intestinal contents, spleen and pooled organs collected from layer farms in and around Namakkal, Tamil Nadu, India during 2010-11 by Saravanan *et al.*, (2012).

Epidemiology

Agent

Salmonella are gram negative, short plump shaped rods, non - spore forming, non – capsulated, aerobic and facultative anaerobic organisms and classified under the family Enterobacteriaceae (OIE, 2006). More than 2300 serotypes of Salmonella have been identified, only about 10 per cent of these have been isolated from poultry (Gast, 1997a). Currently over 2500 serovars are recognized (Grimont and Weill, 2007).

The most important pathogenic members of avian salmonellosis include *Salmonella enterica* subsp. *enterica* serovar Gallinarum and *Salmonella enterica* Subsp. *enterica pullorum* (Nazir *et al.,* 2012). There are host specific and represent a major concern for the poultry industry causing fowl typhoid and pullorum disease (Rosu *et al.,* 2007) respectively.

Host

Pullorum disease is usually confined to the first 2-3 weeks of age in chicks and occasionally occurs in adults (Shivaprasad, 1997). Historically, Fowl typhoid was thought to be primarily a disease of growing and adult chickens and turkeys, whereas pullorum disease was primarily a disease of chicks and poults. However, growing and mature chickens and turkeys are probably most susceptible to fowl typhoid (Shivaprasad, 2000).

Epidemiological measures of causal association

Age

Age wise prevalence of avian salmonellosis showed highest infection rate in adult layers (53.25%) in comparison with brooding (14.55%), growing (16.10%) and pullet (16.10%) (Rahman *et al.,* 2004). Salmonellosis outbreaks were recorded maximum at the age of 7-9 days, while the mortality was found in chickens of 1-2 weeks of age (Rajagopal and Mini, 2013).

Breed

White leghorns appear to be more resistant than heavy breeds such as Rhode Island Red, New Hampshire, or crosses between the two (Hutt and Crawford, 1960). Significant differences also exist in susceptibility to

pullorum disease among chicken (Bumstead and Barrow, 1993).

Management

Persistent *Salmonella* infection in the poultry farms mainly by contaminated day old chicks and feed (Oystein *et al.*, 1996).

Clinical signs

Clinical signs in fowl typhoid and pullorum disease in chicks and poults include moribund and dead birds in the incubator and affected birds may manifest depression, somnolence, anorexia, huddling together, droopy wings, dehydration, laboured breathing, diarrhoea, ruffled feathers, weakness and adherence of faeces to the vent (Shivaprasad, 2000).

Clinical signs of fowl typhoid and pullorum disease may not be apparent in some cases and non specific clinical signs including a decline in feed consumption, a droopy appearance, or ruffled feathers and pale and shrunken combs may be observed (Shivaprasad, 2000).

Gross lesions

Gross lesions due to fowl typhoid and pullorum disease in chicks and poults include hepatitis, splenitis, typhilitis, omphalitis, myocarditis, ventriculitis, pneumonia, synovitis, peritonitis and opthalmitis. In mature fowl, lesions include oophoritits, salphingitis, orchitis, peritonitis and perihepatitis (Shivaprasad, 2000).

The characteristic gross lesions in salmonellosis affected birds include friable liver with bronze discoloration, white focal necrosis on liver, congested, haemorrhagic and discolored egg follicles with stalk formation, haemorrhagic to catarrhal enteritis, severely congested pneumonic lungs, enlarged and discolored spleen (Saha *et al.*, 2012).

Diagnosis

A definitive diagnosis of fowl typhoid and pullorum disease requires the isolation and identification of *S. gallinarum* and *S. pullorum*, respectively. However, a tentative diagnosis can be made, based on the flock history, clinical signs, mortality and lesions. Positive serological findings can also be of great value in detection of infection (Shivaprasad, 2000).

Collection of samples

Since fowl typhoid and pullorum disease are systemic diseases, especially in young chicks and poults, these bacteria can be isolated from most of the body tissues. Liver, spleen, yolk sac, caeca are preferred organs for culture and lesions may also occur in the heart, gizzard, pancreas and lungs which are also suitable specimens for isolation (Shivaprasad, 2000). Cloacal swabs, fresh faeces from live birds, intestinal contents, egg shells, egg contents, embryos can also be used for isolation of *S. pullorum* and *S. gallinarum* (OIE, 2012).

Isolation and Identification

Samples collected from birds were inoculated into non selective enrichment (buffered peptone water) or selective enrichment broths such as tetrathionate, selenite cysteine and F broths. Enriched samples were cultured into selective media such as MacConkey agar, Xylose lysine deoxycholate (XLD) agar, Brilliant green agar (BGA) for isolation (OIE, 2012).

Colonies of *S.* Gallinarum on non-selective media are round, translucent, glistening, domed, smooth, and 1-2 mm in diameter after 24-48 hours incubation. *Salmonella pullorum*

colonies are slightly smaller and translucent. On selective media their appearance varies with the medium (OIE, 2012).

Salmonella pullorum and *S. gallinarum* are non-motile and usually stained as gram negative, rod shaped appearance on Gram staining (Islam *et al.,* 2006 and Saha *et al.,* 2012). Biochemical tests such as urea hydrolysis, lysine decarboxylation, ornithine decarboxylation, maltose fermentation, dulcitol fermentation, inoculation into Triple sugar iron (TSI) agar for acid and gas production were carried out for identification of *S. gallinarum* and *S. pullorum* (OIE, 2012). Both organisms can ferment arabinose, dextrose, galactose, mannitol, mannose, rhamnose and xylose to produce acid with or without gas production (Christensen *et al.,* 1992).

Molecular diagnosis

Plasmid profiling and ribotyping of *S. gallinarum* isolated from commercial layers and scavenging local chickens revealed prevalence of 18.4 and 2.6 per cent respectively (Mdegela *et al.,* 2000). Oliveira *et al.,* (2002) used polymerase chain reaction combined with Rappaport-Vassiliadis selective enrichment broth (PCR-RV) for detection of *S. gallinarum* and *S. pullorum* in poultry.

Inv A gene specific PCR (Malmarugan *et al.,* 2011) and Multiplex PCR (Saravanan *et al.,* 2012) were used for detection of Salmonella spp. in chicken samples. Prevalence of *Salmonella* infection in poultry tissue and egg samples by PCR revealed 2.7 per cent in Ethiopia (Menghistu *et al.,* 2011).

Economic losses

Pullorum disease and fowl typhoid are economically important diseases, without their effective control through organised national regulatory programs, the profitable production of poultry is impossible (Willams, 1978). Principal current economic significance of *S. pullorum* in developed nations is the cost of testing programs, reminders of the potential for catastrophic losses have been provided by occasional appearance of pullorum disease in commercial flocks (Gast, 1997 b).

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