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Serovar diversity of *Salmonella* among poultry

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***Background & objectives*: Salmonellosis due to the consumption of contaminated poultry products is a well-known public health concern, and assessing the distribution of *Salmonella* serovars among poultry becomes important for better prevention and control. The objective of the present study was to assess the distribution of *Salmonella* serovars among poultry.**

***Methods*: The isolates received at National Salmonella and Escherichia Centre during 2011-2016 were subjected to biochemical identification, followed by serological characterization to identify the *Salmonella* serovars, and the data were presented to exhibit the distribution of *Salmonella* serovars among poultry.**

***Results*: *Salmonella* was found to be present in poultry in all the regions included in the study. *Salmonella* Typhimurium, *S.* Gallinarum and *S.* Enteritidis were the most prevalent serovars accounting for 96.2 per cent of isolates. *Salmonella* was identified in poultry from all major egg-producing and egg-consuming States. Other serovars which were scantly identified included *S.* Infantis (2.7%), *S.* Montevideo (0.64%), *S*. Newport (0.26%) and *S*. Pullorum (0.13%).**

***Interpretation & conclusions*: Diverse distribution of *Salmonella* serovars in poultry in India, with known potential to infect human population and/or other poultry flocks, requires urgent nationwide stringent control measures.**

Key words Distribution - poultry - *Salmonella* - serovars

Salmonellosis has become a major public health concern worldwide and emerged as an important food-borne disease resulting in considerable public health and economic burden[1,2]. Salmonellosis is generally acquired through food-borne exposure, although direct contact with infected animals has also been reported[3,4].

Contaminated poultry products, especially undercooked meat and raw eggs, have been reported as important sources of food-borne salmonellosis due to non-typhoidal *Salmonella*[5,6]. India's poultry industry has got transformed from a mere backyard activity into a major commercial activity in just four decades and placed India as the world's third largest egg producer and the seventh largest producer of broiler[7]. Different *Salmonella* serovars have been reported from poultry in several localized studies in different parts of the country earlier[8-12]. However, the diversity of *Salmonella* serovars among poultry needs to be determined from time to time to assess the distribution trends. This may help veterinary and public health authorities in formulation of prevention strategies

to control salmonellosis in poultry flocks to reduce economic losses which may further help to hinder the transmission of these serovars to humans. Therefore, an effort was made to generate and compile data on the distribution of *Salmonella* serovars among poultry.

Material & Methods

Bacterial isolates: Seven hundred and seventy eight suspected *Salmonella* isolates from poultry origin received at National Salmonella and Escherichia Centre (NSEC), Central Research Institute, Kasauli, India, from various research, veterinary and academic institutes throughout the country, during January 2011 to October 2016 constituted the material for the study.

Bacterial identification and serotyping: Bacterial isolates were identified on the basis of culture characteristics, Gram staining, and biochemical tests[13]. The isolates confirmed as *Salmonella* were further subjected to serotyping[14] using an array of pooled and factor *Salmonella* antisera (Statens Serum Institute, Copenhagen, Denmark; Denka Seiken Co. Ltd., Tokyo, Japan).

Results & Discussion

Salmonellae were identified on the basis of characteristic biochemical results with catalase-positive, oxidase-negative, motility-positive (except *Salmonella* Gallinarum and *S.* Pullorum), glucose-positive, lactose-negative, mannitol-positive, sucrose-negative, salicin-negative, indole-negative, methyl red-positive, Voges-Proskauer negative, citrate utilization positive and H_2S positive. *S.* Gallinarum and *S.* Pullorum were differentiated on the basis of gas production, dulcitol fermentation, maltose fermentation, and ornithine decarboxylation. Seven serovars were identified with *S.* Gallinarum (43.7%), being the most frequent, followed by *S.* Enteritidis (30.6%), *S.* Typhimurium (21.9%), *S.* Infantis (2.7%), *S.* Montevideo (0.64%), *S.* Newport (0.26%) and *S.* Pullorum (0.13%). Majority of identified *Salmonella* isolates were from poultry meat (71%), followed by blood (17.7%), faeces (7.7%) and eggs (3.6%) (Table I). The serovars exhibiting high proportion, namely *S.* Gallinarum, *S.* Typhimurium and *S.* Enteritidis, were found to be distributed uniformly in almost all States (Table II).

Salmonellosis is one of the most common infectious diseases in animals and one of the major causes of food poisoning in humans. Food-borne infections caused by *Salmonella* serovars mainly through contaminated meat, eggs, and egg products occur at high frequency in industrialized nations and developing countries[15-18]. *Salmonella* infections in poultry are also very common[8,9,19-22] which not only leads to heavy economic loss to egg and broiler producers and people associated with poultry industry but also poses a threat of transmission of salmonellae to human beings.

In India, data on the distribution of *Salmonella* serovars in poultry have been generated at various localized geographical areas during different time periods[8,19-21,23].

S. Gallinarum, the causative agent of fowl typhoid[24,25] and a leading cause of morbidity and mortality in commercial poultry resulting in significant economic losses to the poultry farmers[26], was found to be in the highest proportions during 2011-2016, contributing 43.7 per cent of the total *Salmonella* isolates of poultry origin. *S.* Enteritidis and *S.* Typhimurium which are not only known to infect poultry but also act as potential agents of human gastroenteritis, were found to be the second and third most prevalent serovars during the study period. Outbreaks of *Salmonella* food poisoning due to the consumption of contaminated eggs, egg products or meat have been documented[10,15,27].

Table I. Distribution of *Salmonella* serovars in various poultry specimens

Source	Year wise, n (%)						Total, n (%)
	2011	2012	2013	2014	2015	2016	
Poultry meat	122 (79.2)	221 (81.5)	71 (38.2)	75 (100)	48 (62.3)	15 (100)	552 (71)
Heart blood	-	21 (7.7)	115 (61.8)	-	2 (2.6)	-	138 (17.7)
Faeces	19 (12.3)	14 (5.2)	-	-	27 (35.1)	-	60 (7.7)
Egg	13 (8.4)	15 (5.5)	-	-	-	-	28 (3.6)
Total	154	271	186	75	77	15	778

Table II. Distribution of *Salmonella* serovars from poultry received at National Salmonella and Escherichia Centre from different States

Serovar	Haryana	Uttarakhand	Himachal Pradesh	Jammu and Kashmir	Tamil Nadu	Andhra Pradesh	Telangana	Karnataka	Kerala	Bihar	West Bengal	Maharashtra	Gujarat	Chhattisgarh	Assam	Sikkim	Mizoram
Salmonella Gallinarum	270	7	-	3	2	7	3	2	-	1	13	22	2	2	6	-	-
S. Enteritidis	67	18	5	7	40	4	-	20	15	1	14	19	8	11	4	-	5
S. Typhimurium	36	27	9	11	3	2	1	8	13	1	3	12	5	8	4	11	17
S. Infantis	-	1	-	-	2	17	-	-	-	1	-	-	-	-	-	-	-
S. Montevideo	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-
S. Newport	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S. Pullorum	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Total	373	55	14	21	52	30	4	30	28	4	30	54	15	21	14	11	22

Due to increasing share of poultry industry in Indian economy and more concentration of poultry farms near human habitats, with known public health concerns for salmonellosis of poultry origin, well-planned surveillance and control programmes at national level with regular surveillance of *Salmonella* and stringent biosecurity measures in poultry industry may result in significant reductions in its prevalence in polutry[28-30]. Considering the wide distribution of different *Salmonella* serovars in poultry, interventions from public health authorities and policymakers are required to control the spread of salmonellae. The strategies should include stringent farm management programmes using interventions at multiple stages of egg production including storage at lower temperatures and implementation of stringent control and food standards in the meat industry. Although studies have been conducted in different geographic areas of the country to assess the distribution of *Salmonella* serovars among poultry, there is a need for an integrated national-level surveillance programme including all States for delineating the diversity of *Salmonella* serovars among poultry.

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