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THE ROLE OF PUBLIC HEALTH LABORATORY IN THE PROBLEM OF SALMONELLOSIS IN SÃO PAULO, BRAZIL.

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SUMMARY

From 1950 to 1990 a total of 45,862 strains (31,517 isolates from human sources, and 14,345 of non-human origin) were identified at Instituto Adolfo Lutz. No prevalence of any serovars was seen during the period 1950-66 among human sources isolates. Important changing pattern was seen in 1968, when *S.*Typhimurim surprisingly increased becoming the prevalent serovar in the following decades. During the period of 1970-76, *S.*Typhimurium represented 77.7% of all serovars of human origin. Significant rise in *S.* Agona isolation as well as in the number of different serovars among human sources strains were seen in the late 70' and the 80's. More than one hundred different serovars were identified among non-human origin strains. Among serovars isolated from human sources, 74.9%, 15.5%, and 3.7% were recovered from stool, blood, and cerebrospinal fluid cultures, respectively. The outbreak of meningitis by *S.* Grumpensis in the 60's, emphasizes the concept that any *Salmonella* serovars can be a cause of epidemics, mainly of the nosocomial origin. This evaluation covering a long period shows the important role of the Public Health Laboratory in the surveillance of salmonellosis, one of the most frequent zoonosis in the world.

KEYWORDS: *Salmonella* serovars; Salmonellosis; *S.* Typhimurium.

INTRODUCTION

The elucidation by Adolpho Lutz of the etiology of "febres paulistas" (as was known the typhoid fever), very controversial matter among physicians, is an example how from its very beginning, 1892, the Public Health Laboratory of São Paulo State, was closely connected with the problem of salmonnelosis[2,10,18,25].

Until the 40's, the magnitude of salmonellosis in São Paulo State was difficult to evaluate due to the lack of an adequately equipped laboratory to identify different serovars[13]. The implementation of the Enteric Laboratory in Instituto Adolfo Lutz, formerly Instituto Bacteriológico, represented a considerable progress which encouraged the laboratory staff to study this wide group of microorganism, frequently associated with enteric and systemic infections. Brazilian earliest reports on salmonellosis are from that decade[11,12,24].

In contrast to *Salmonella* Typhi, which is a human pathogen (specific host), other non-host-adapted *Salmonella* serovars (more than 2,300), potentially pathogenic for man and widely distributed among many animal species, are the cause of widespread diseases in developing countries.

This study reports the patterns of incidence of different serovars over the period of 40 years (1950-90) in São Paulo State, Brazil.

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MATERIAL AND METHODS

Methods of isolation and serotyping of *Salmonella* described by NOVAES et al.[11], and TAUNAY[26] were used during the period of 1950-70. Since the 70's the isolation and identification of strains were performed as proposed by PESSOA et al.[17]. Subspecies of *Salmonella enterica* were distinguished according to POPOFF & LE MINOR[19].

Records on *Salmonella* serovars, already published[1,3,17,20,26] were compared with the data obtained during the period 1983-90. Among 45,862 strains, 31,517 were from human sources, and 14,345 from non-human origins. Data of *Salmonella* serogroups (except *S.* Typhimurium), corresponding to the period of 1967-69, were not evaluated.

RESULTS AND DISCUSSION

In Table 1A and 1B we can have a general picture of the frequencies of different serovars identified in São Paulo State over a period of 40 years. More than one hundred different serovars were recovered from man, by far the majority of them were from intestinal infections (Table 2).

The changing patterns of the serovars of human sources over the four periods are seen in Figure 1 (A,B,C,D).

The period of 1950-66 (Figure 1A) is characterized by a scattered distribution of some serovars. Nosocomial outbreaks caused by *S.*Typhimurium, occurred in São Paulo during the period of 1968-69, caused the first

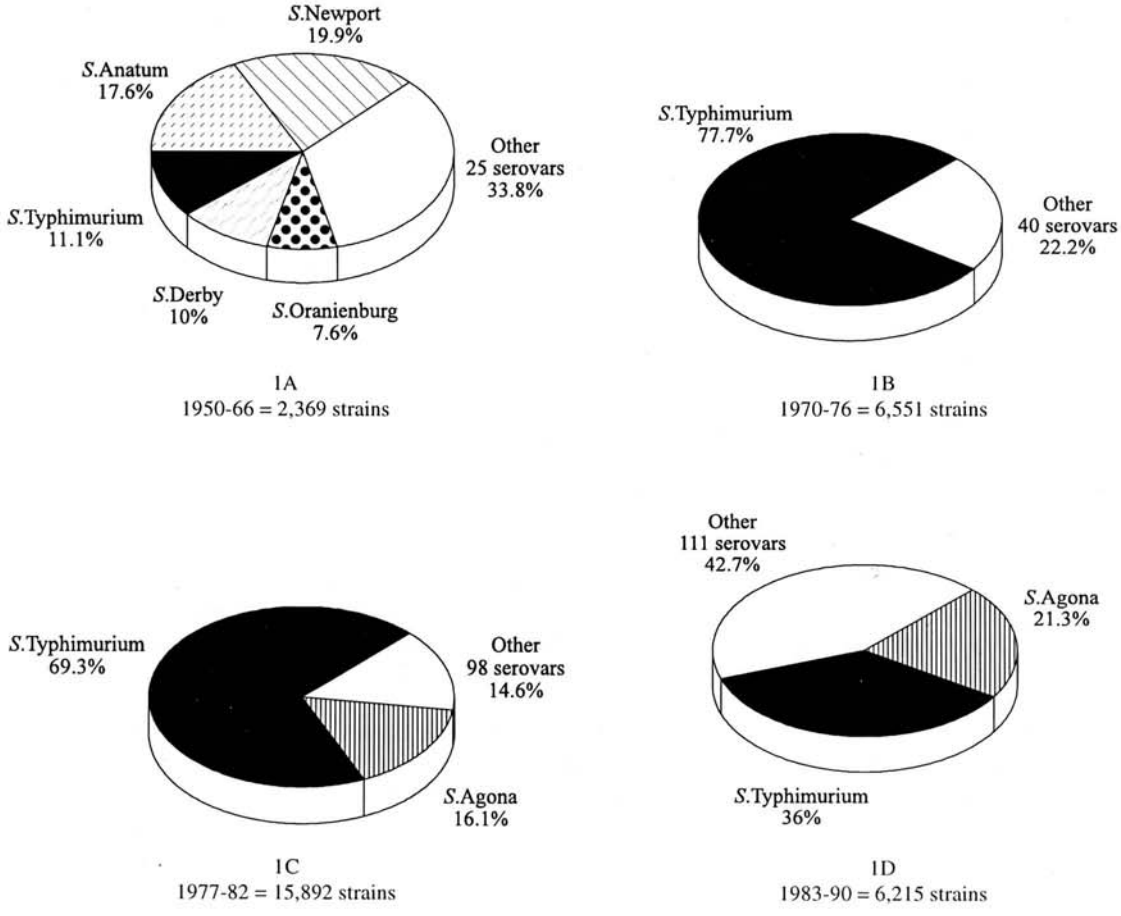

Fig. 1 – Most common serovars isolated during the period 1950-90 from human sources

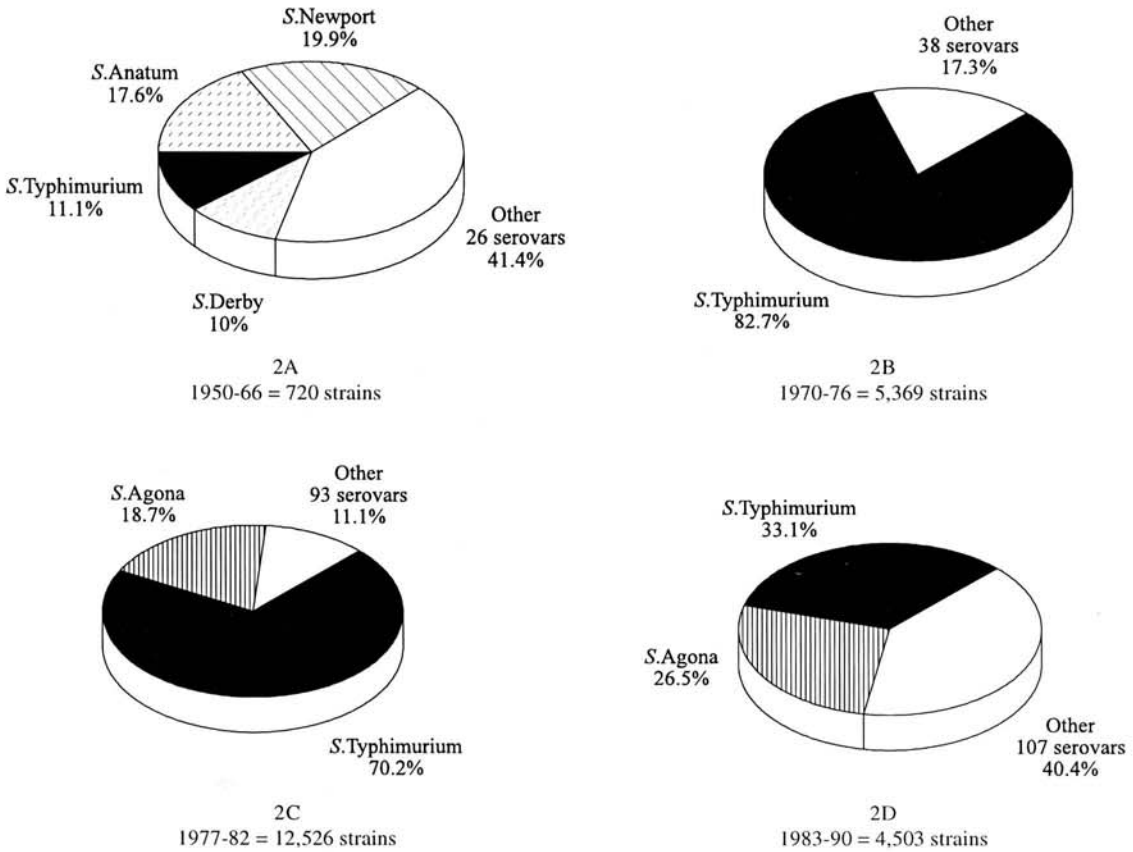

Fig. 2 – Most common serovars isolated from stool during the period 1950-90

main changing in the frequencies of serovars. Those outbreaks detected in pediatric hospitals were responsible for substantial rise in *S.* Typhimurium which accounted for 85.9% of all serovars identified in that period[22], in contrast to the period 1950-66[26].

Increase in the isolation of this serovar changed significantly the patterns in the 70's. During the period 1970-76 (Figure 1B). *S.* Typhimurium accounted for 77.7% of all serovars of clinical sources, and presented an epidemic feature.

Lactose fermeting *S.* Typhimurium strains were detected in 1971[15], which showed a lasting predominance for several years. It is still in the 70's that rapid lactose fermenting strains were replaced by late lactose fermenting ones[16] which represented the prevalent type from 1973 to 1990. This biovar could be detected when all *S.* Typhimurium strains were submitted to lactose fermentation test for 15 days or to ONPG test[9]. Interestingly, all rapid/late lactose fermenting strains were devoided of somatic antigen 05. Nosocomial outbreak by lysine decarboxylase negative *S.*Typhimurium strains has also been reported[5].

The following periods, 1977-82 (Figure 1C) and 1983-90 (Figure 1D) are characterized by a declining trend of *S.* Typhimurium, a significant rise of the isolation of other serovars, and *S.* Agona ranking as second serovar in the 80's. *S.* Agona, spread worldwide, has also been introduced in São Paulo State in 70's. The first isolates of *S.* Agona were from non-human sources, however, the increase on its isolation from human clinical sources began on late 70's. This serotype represented the second most frequent one among the strains identified in our laboratory[3,6,7,17].

Taking into account that diarrhea is the most common infection caused by non-host-adapted serovars, similar features shown in the Figure 1 (A,B,C,D) are

seen when we analyze the data on serovars isolated from stool (Figure 2).

Among extraintestinal infections caused by *Salmonella*, bacteremias and meningitis are the most serious, particularly in infants, and according to Montevideo Doutrine[8], extraintestinal infections without enteric manifestation are common features in those susceptible hosts.

During the studied period more than 40 different serovars were isolated from blood culture which emphasizes the concept that the invasiveness of this microorganism is not an intrinsic characteristic of a given serovar.

Changing patterns of serovars isolated from blood culture can be seen in figure 3 (A,B,C,D) and we can evaluate the problem of typhoid fever in our State in the 50 and 60's. Typhoid fever is still a public health concern, due to poor sanitary conditions and unsatisfactory personal hygiene of people having a low standard of living. As presented in the Figure 3 (A,B,C,D), *S.*Typhi showed a striking declining trend after late 70's. On the other hand non-typhoid *Salmonella* serovars, and among them *S.* Typhimurium was the prevalent one from blood cultures.

Children with gastrointestinal infection could represent sources of serious nosocomial infections. Increase in the isolation of *S.*Agona, *S.*Dublin, *S.* Infantis, *S.*I 4,12: i: -, and *S.*I 6,7: - : 1,5 from blood cultures were associated with the rise in the isolation of these serovars from stool cultures.

Meningitis by *Salmonella*, reported in São Paulo State since the 50's and caused mainly by *S.*Typhimurium[1] presented a dramatic increase in the

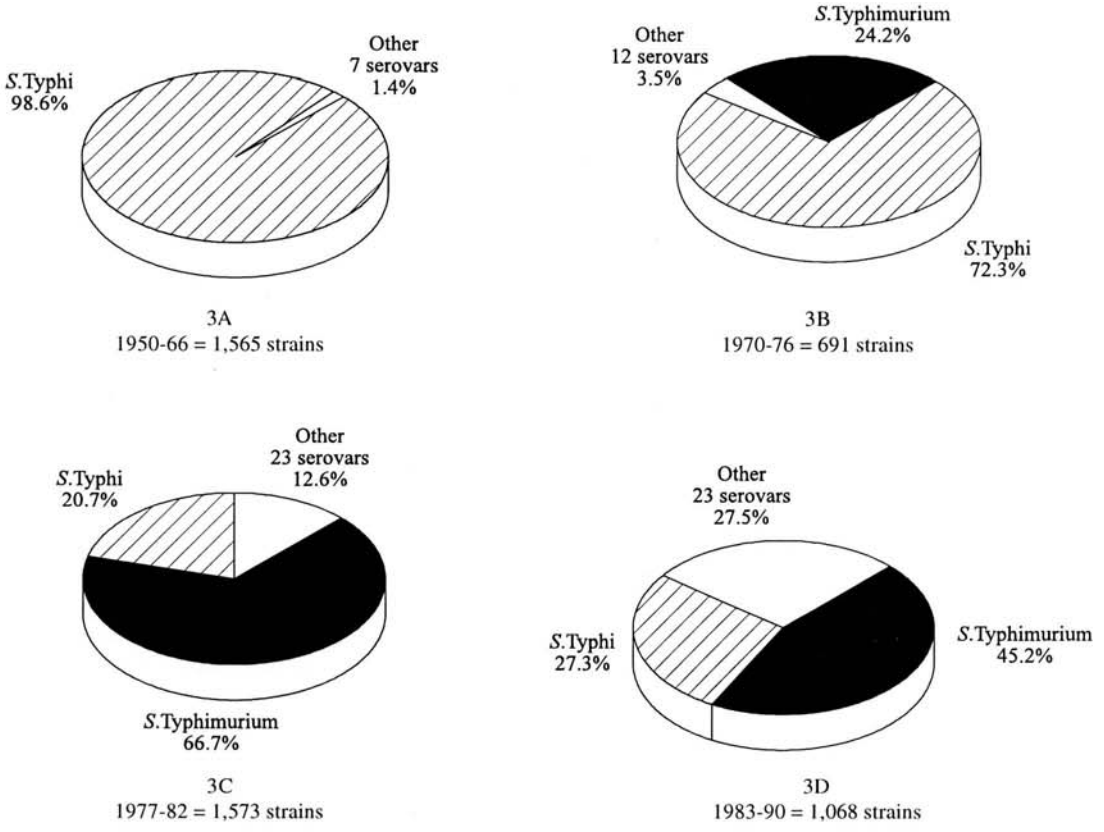

Fig. 3 – Most common serovars isolated during the period 1950-90 from blood

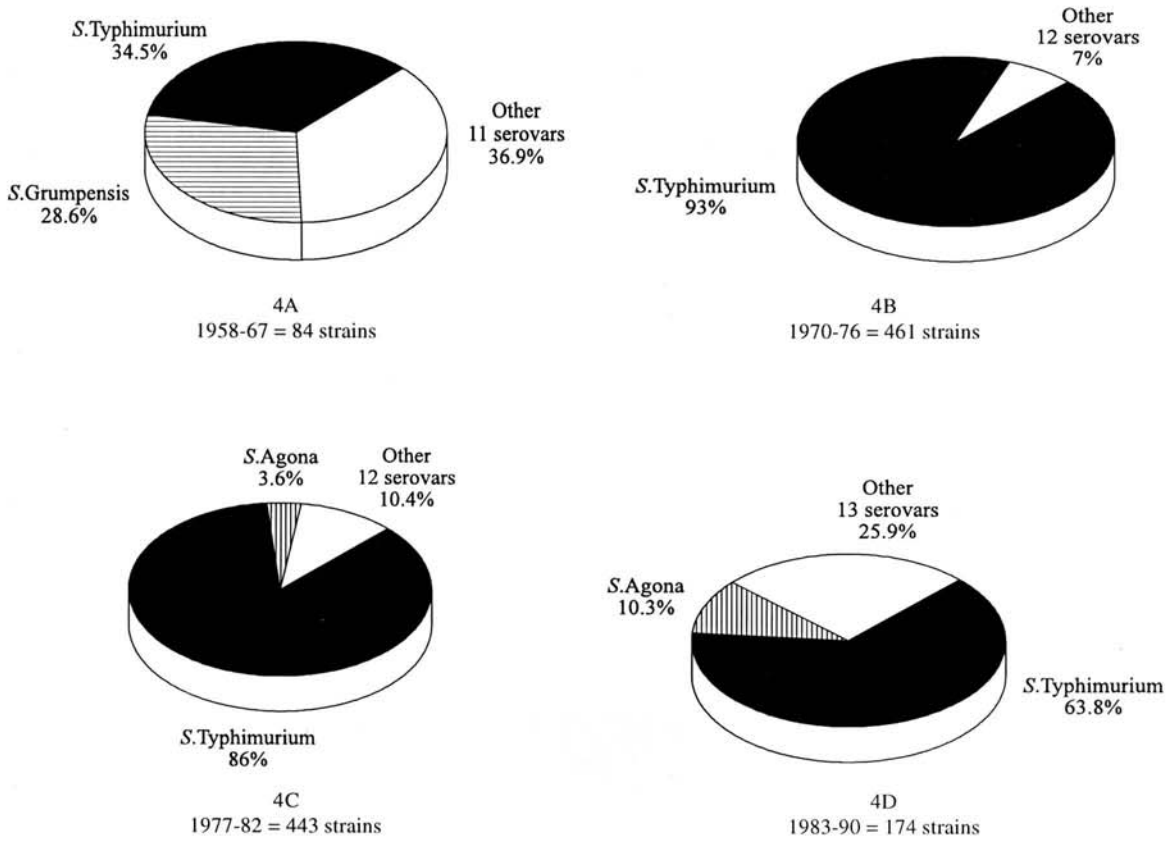

Fig. 4 – Most common serovars isolated during the period 1958-90 from cerebrospinal fluid

70's associated with meningococcal meningitis epidemics when the drop of the quality of hospital medical care due to meningococcal epidemics represented a favorable condition to the dissemination of *S.*Typhimurium.

Over four decades, *S.*Typhimurium was the most frequent serovar isolated from cerebrospinal fluid culture (Figure 4) (A,B,C,D). *S.*Grumpensis meningitis outbreak detected in a São Paulo Maternity Hospital, reported by TAUNAY et al.[23], in 1962, is an example of how an unusual serovar can be a cause of serious infection, particularly of nosocomial origin. This fact stresses the important role of the laboratory to identify any *Salmonella* serovar.

With regard to *Salmonella* serovars of non-human sources, the data are presented in figure 5 (A,B,C,D). More than a hundred different serovars were identified among food, food stuffs, water, environment, etc, showing their potential hazard to public health.

Contamination of products of animal origin and the food-borne diseases associated to these products have a high social and economic cost in developed and developing countries[21]. According to EDWARDS[4], salmonellosis is the only enterobacterial infection which trends to increase even in developed countries.

In São Paulo State, salmonellosis of nosocomial origin, particularity in pediatric hospital[14,22], is an important public health problem. During the period 1983-90, more than 70% of gastrointestinal infections, bacteremias, and meningitis caused by *S.*Typhimurirum and *S.*Agona, were children aged less than 5 years.

This report presented a view of the problem of salmonellosis in São Paulo State. This evaluation, covering a long period of 40 years, based only on laboratory records, emphasizes the important role of a Public Health Laboratory in the surveillance of one of the most important zoonosis in the world.

RESUMO

O Laboratório de Saúde Pública no problema da salmonelose no Estado de São Paulo

No período de 1950-90 foram identificadas 45.862 cepas de *Salmonella*, sendo 31.517 provenientes de infecções humanas e 14.345 de materiais de origem não humana. O objetivo deste trabalho foi analisar as alterações ocorridas quanto à freqüência dos sorotipos isolados neste período. No período 1950-66, não houve predomínio evidente de nenhum sorotipo; entretanto, no período 1970-76, com início em 1968, a *S.*Typhimurium passou a ser o sorotipo predominante, representando 77,7% dos sorotipos isolados. Observou-se um aumento significativo da *S.* Agona, bem como de uma grande variedade de sorotipos. Quanto às salmonelas de origem não humana, chama a atenção o grande número (mais de 100) de sorotipos. Quanto aos sorotipos isolados de materiais de origem humana, 74,9% foram isolados de fezes, 15,5% de sangue e 3,7% de LCR. Ressalta-se a coincidência da ocorrência do surto de meningite por *S.*Typhimurium com a epidemia de meningite meningocócica (1972-1975). Registra-se também, na década de 60, a ocorrência de um surto de meningite por *S.*Grumpensis, sorotipo não detectado na região até aquela época, o que enfatiza nossas observações de que qualquer sorotipo poderá provocar epidemias graves e prolongadas. Este trabalho mostra o importante papel do Laboratório de Saúde Pública no estudo de uma das principais zoonoses em todo o mundo.

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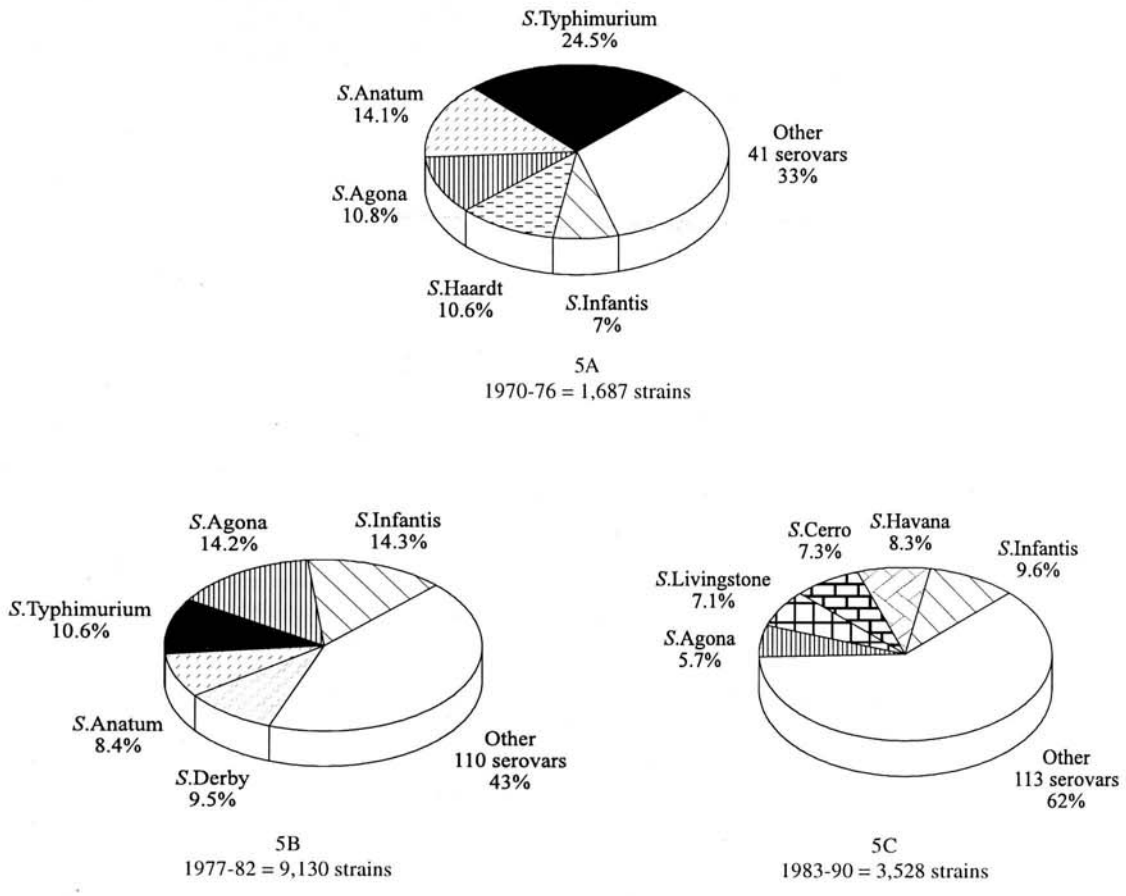

Fig. 5 – Most common serovars of non-human sources isolated during the period 1970-90

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TABLE 1A

Salmonella serovars from human source, isolated in São Paulo during the period of 1950-90.

Serovars	Nº	Serovars	Nº	Serovars	Nº	Serovars	Nº
1. *S.* Typhimurim	18877	41. *S.* Bovismorbificans	18	81. *S.* Worthington	4	120. *S.* IV Volksdorf	1
2. *S.* Agona	3950	42. *S.* London	18	82. *S.* Salinatis	4	121. *S.* Java	1
3. *S.* Typhi	3150	43. *S.* Tennessee	15	83. *S.* Thompson	4	122. *S.* IV 6,7: g, z_{51}: -	1
4. *S.* Infantis	686	44. *S.*I 6,7 : - : -	14	84. *S.* Stanleyville	3	123. *S.* Bornun	1
5. *S.* I 4, {5}, 12: i : -	617	45. *S.* I 4, [5], 12: - : 1,2	14	85. *S.*I 3,10: - : 1,6	3	124. *S.* III 50: i : z	1
6. *S.* Newport	459	46. *S.* Mbandaka	13	86. *S.*I 6,8,: e,n,x : -	3	125. *S.* Makiso	1
7. *S.* Oranienburg	403	47. *S.*I 6,8 : e, h : -	12	87. *S.* Lexington	3	126. *S.* Blockley	1
8. S. Anatum	364	48. *S.* Ohio	12	88. *S.* Brazil	3	127. *S.* Wagenia	1
9. *S.* Derby	294	49. *S.* Madelia	11	89. *S.* Abaetetuba	3	128. *S.* Zwikau	1
10. *S.* Bredeney	170	50. *S.* Havana	11	90. *S.*I 6,7 : c: -	3	129. *S.* Rawach	1
11. *S.* Panama	166	51. *S.* Cerro	11	91. *S.* Livingstone	3	130. *S.*I 3,15: c:	1
12. *S.* Dublin	163	52. *S.* Paratyphi C	11	92. *S.* IV Marina	3	131. *S.*I 6,8: - : -	1
13. *Salmonella* "R"	158	53. *S.* I 4,12: b: -	10	93. *S.* IV Wassenar	3	132. *S.*I 17: - : -	1
14. *S.* Saintpaul	151	54. *S.* Rubislaw	9	94. *S.*I 4,12: d: -	2	133. *S.* III 53: z_4, z_{23}: -	1
15. *S.* I 4, {5}, 12: - : -	143	55. *S.* II Sophia	9	95. *S.* Muenster	2	134. *S.*III 59: - : -	1
16. *S.* Enteriditis	115	56. *S.* Meleagridis	9	96. *S.* Denver	2	135. *S.* IV 40: z_4, z_{32}: -	1
17. *S.* Paratyphi A	95	57. *S.* Coeln	9	97. *S.*I 3,10: e,h: -	2	136. *S.* Irumu	1
18. *S.* Give	75	58. *S.* Litchfield	7	98. *S.* Essen	2	137. *S.* Elisabethville	1
19. *S.* Hadar	63	59. *S.* Adelaide	7	99. *S.* Rostok	2	138. *S.*I 4,12: z_{10}: -	1
20. *S.* Montevideo	61	60. *S.*I 6,8 : z_{10}:-	7	100. *S.* California	2	139. *S.*I 3,10: r : -	1
21. *S.* Choleraesuis	56	61. *S.* Berta	6	101. *S.* Pullorum	2	140. *S.* I 6,7: 1, v: -	1
22. *S.* Muenchen	55	62. *S.* Lille	6	102. *S.* Carrau	2	141. *S.* III 61: i: z	1
23. *S.* Heidelberg	55	63. *S.* I 9,12:-:-	6	103. *S.* Arechavaleta	2	142. *S.*I 4,12: 1,v: -	1
24. *S.* Haardt	51	64. *S.* Belem	6	104. *S.*IV 43: z_4, z_{24}: -	2	143. *S.* Campinense	1
25. S. Inganda	45	65. *S.* IV Bockenhein	6	105. *S.*I 4,12: - : - 1,6	2	144. *S.* Manila	1
26. *S.* Minnesota	43	66. *S.* Emek	6	106. *S.*III 61:1, v: -	2	145. *S.*III 61: i : z_{53}	1
27. *S.* Sandiego	40	67. *S.*I 9, 12 : - : 1,5	6	107. *S.* Isangi	2	146. *S.*I 8,20: b: -	1
28. *S.* Paratyphi B	37	68. *S.*I 4,12 : y: -	6	108. *S.* Matadi	2	147. *S.* Natal	1
29. *S.* Brandenburg	35	69. *S.*I 4, {5}, 12: e, h: -	5	109. *S.* Kingston	1	148. *S.*I 4,12: - : 1,7	1
30. *S.* Miami	34	70. *S.* Nienstedten	5	110. *S.* Pomoma	1	149. *S.*I 16: a : -	1
31. *S.*I 6,7 : - : 1,5	33	71. *S.*I 6,7: r: -	5	111. *S.* Norwich	1	150. *S.* I 3,10: - : 1,7	1
32. *S.* Reading	32	72. *S.*I 4,12: r : -	5	112. *S.*I 3,10: 1, v: -	1	151. *S.* Braenderup	1
33. *S.* Oslo	32	73. *S.* Newington	5	113. *S.*I 30: i : -	1	152. *S.*IV 17: z_{29}: -	1
34. *S.* Senftenberg	31	74. *S.* Saphra	5	114. *S.* Schwarzengrund	1	153. *S.* Istambul	1
35. *S.* Butantan	30	75. *S.* Rissen	5	115. *S.* Decatur	1	154. *S.* Amager	1
36. *S.* Glostrup	30	76. *S.* Bonariensis	4	116. *S.* Sendai	1	155. *S.* Orlando	1
37. *S.* Grumpensis	26	78. *S.*I 6,7 : z_{10}: -	4	117. *S.* Newbrunswick	1	156. *S.* IV Flint	1
38. *S.* Javiana	24	79. *S.* Morehead	4	116. *S.* Takoradi	1	157. *S.* Kentuck	1
39. *S.* Poona	23	80. *S.*I 4,12 : -: 1,6	4	118. *S.*III 47: b : -	1	158. *Salmonella sp*	175
40. *S.* Albany	22			119. *S.* Parera	1		

TABLE 1B

Salmonella serovars from non-human sources, isolated in São Paulo, during the period 1970-90.

Serovars	Nº	Serovars	Nº	Serovars	Nº	Serovars	Nº
1. *S.* Infantis	1759	46. *S.* Ohio	37	91. *S.* I 3,15: y: -	6	136. *S.* III16: z_{10}: e,n,x,z_{15}	2
2. *S.* Agona	1678	47. *S.* Saphra	35	92. *S.* IV 11: z_4,z_{32}: -	6	137. *S.* IV 43: g, z_{51}: -	2
3. *S.* Typhimurium	1549	48. *S.* Coeln	32	93. *S.* Schwarzengrund	5	138. *S.* Mbulani	2
4. *S.* Anatum	1200	49. *S.* Miami	30	94. *S.*I 4,5,12: e,h: -	5	139. *S.* IV Parera	2
5. *S.* Derby	946	50. *S.* Hadar	28	95. *S.* Manila	5	140. *S.* Bonariensis	2
6. *S.* Minnesota	469	51. *S.* Oslo	27	96. *S.*I 21: b: -	5	141. *S.* Virchow	2
7. *S.* Havana	407	52. *S.* III 65: 1, v: z_{35}	26	97. *S.* Choleraesuis	5	142. *S.* Kalamu	2
8. *S.* Newport	375	53. *S.* Nchanga	25	98. *S.* Bergen	5	143. *S.* Carrau	2
9. *S.* Livingstone	345	54. *S.*I 4,12: - : -	24	99. *S.*I 9,12: i: -	5	144. *S.* I 4,12: r: -	2
10. *S.* Oranienburg	306	55. *S.* Poona	24	100. *S.*IV Ochsenzoll	5	145. *S.* I 4,12: b: -	2
11. *S.* Cerro	300	56. *S.* Abaetetuba	24	101. *S.* III 50: r: z	4	146. *S.* IV 45: g, z_{51}: -	2
12. *S.* Seftenberg	290	57. *S.* Clairbornei	23	102. *S.* Sendai	4	147. *S.* I 16: k: -	2
13. *S.* Tennessee	288	58. *S.* Belem	23	103. *S.*I 6,8: e,h: -	4	148. *S.* III 61: z_{52}: 1,5,7	1
14. *S.* Panama	275	59. *S.*I 9,12: - : -	22	104. *S.* California	4	149. *S.* Cambridge	1
15. *S.* Haardt	254	60. *S.* Morehead	21	105. *S.* Litchfield	4	150. *S.* IV 44: z_{36}, z_{38}: -	1
16. *S.* Bredeney	244	61. *S.* Thompson	20	106. *S.* Bornum	4	151. *S.* Paratyphi A	1
17. *S.* Montevideo	164	62. *S.*I 6,7: z_{10}: -	20	107. *S.* Worthington	4	152. *S.* III 61: c: z_{35}	1
18. *S.* Inganda	154	63. *S.* Madelia	20	108. *S.* Serenbam	4	153. *S.* II 16: - : z	1
19. *S.* Muenchen	149	64. *S.* Bovismorbificans	20	109. *S.* IV Soesterberg	4	154. *S.*I 38: - : 1.6	1
20. *S.* Newington	138	65. *S.* Paratyphi B	18	110. *S.* Orion	3	155. *S.* Jerico	1
21. *S.* Mbandaka	130	66. *S.* Java	18	111. *S.* IV Houten	3	156. *S.* III 61: i : z	1
22. *S.* Enteritidis	122	67. *S.* Kaapstad	17	112. *S.* IV Wassenar	3	157. *S.* Muenster	1
23. *S.* Quiniella	121	68. *S.*I 6,7: - : -	17	113. *S.*I 14,25: y: -	3	158. *S.* Braenderup	1
24. *S.* Heidelberg	110	69. *S.* Stanleyville	16	114. *S.* Reading	3	159. *S.* Albany	1
25. *S.* Lexington	109	70. *Salmonella* sp	16	115. *S.* Thomasville	3	160. *S.* Berta	1
26. *S.* Dubllin	109	71. *S.*I 6,7: r: -	15	116. *S.* Indiana	3	161. *S.* IV 44: z_{29}: -	1
27. *S.* Lille	105	72. *S.* Decatur	14	117. *S* . Gloucester	3	162. *S.* I 9,12 : a : -	1
28. *Salmonella* R	103	73. *S.* Alachua	13	118. *S.* Marseille	3	163. *S.*I 3,10: e,h: -	1
29. *S.* Kentucky	98	74. *S.* Rissen	12	119. *S.* III 17: z_4,z_{23},z_{32}: -	3	164. *S.*I 6,8: e,n,x: -	1
30. *S.* Gallinarum	95	75. *S.*II Sophia	11	120. *S.* Falkensee	2	165. *S.*I 11: y: -	1
31. *S.* Sandiego	93	76. *S.*I 9,12: - : 1,5	11	121. *S.* Molade	2	166. *S.*I 28: y: -	1
32. *S.* Javiana	91	77. *S.*I 3,10: - : 1,6	11	122. *S.* Halmstad	2	167. *S.*I 6,8 : a : -	1
33. *S.* Grumpensis	84	78. *S.* Adelaide	10	123. *S.* II Uphill	2	168. *S.*III 38: k : z_{55}	1
34. *S.* Give	81	79. *S.*I 6,8: z_{10}: -	9	124. *S.* III 35:1, v: z_{35}	2	169. *S.* I 4,12: 1,v: -	1
35. *S.*I 4,{5}, 12: i : -	78	80. *S.*I 4,5,12: - : -	9	125. *S.* IV 44: g, z_{51}: -	2	170. *S.* Vleuten	1
36. *S.* Glostrup	68	81. *S.* Urbana	9	126. *S.* I 4,12: d: -	2	171. *S.* Jos	1
37. *S.* Binza	67	82. *S.* I 4,12: d : -	9	127. *S.* I 9,12: k: -	2	172. *S.* III 50: c: z	1
38. *S.* Meleagridis	64	83. *S.* I 4,12: b : -	9	128. *S.* I 8 : - : -	2	173. *S.* Portland	1
39. *S.* Brandenburg	63	84. *S.*I 4,5,12: y : -	8	129. *S.* Isangi	2	174. *S.* Thielallee	1
40. *S.* Cubana	63	85. *S.* Rubislaw	7	130. *S.* Typhi	2	175. *S.* Agama	1
41. *S.* Pomona	60	86. *S.*I 3,19: - : -	7	131. *S.* Newbrunswick	2	176. *S.* Birkenhead	1
42. *S.* London	46	87. *S.* Emek	6	132. *S.* Pensacola	2	177. *S.* Chester	1
43. *S.* III 18: z_4, z_{32} : -	42	88. *S.* Butantan	6	133. *S.* Guarapiranga	2	178. *S.* IV Bockenhein	1
44. *S.* Takoradi	38	89. *S.* Taksony	6	134. *S.* Manhattan	2	179. *S.* I 9,12: - : 1,5	1
45. *S.* Saintpaul	37	90. *S.* I 16: 1, v: -	6	135. *S.* Cotia	2	180. *S.*I 3,10: 1, v: -	1

TABLE 2

Number and percentage of human *Salmonella* isolates of the period 1950-90, according to the sources.

	Period					Total	
source	1950-66	1967-79	1970-76	1977-82	1983-90	Nº	%
stool	720	490 (1)	5,369	12,526	4,503	23,608	74.9
blood	1,565		691	1,573	1,068	4,897	15.5
c.s.f (2)	84 (3)		461	443	174	1,162	3.7
other			30	1,350	470	1,850	5.9
Total	2,369	490	6,551	15,892	6,215	31,517	

(1) corresponding to *S.*Typhimurium (not evaluated other strains identified as serogroup)
(2) cerebrospinal fluid
(3) data corresponding to the period 1958-67

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