

Study on the Genus *Salmonella* Cultures Isolated in Korea 1982*

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= 국문 초록 =

한국에서 분리된 *Salmonella* 균속에 관한 연구

국립보건원 미생물부

정태화 · 윤승기 · 이복권 · 최재두 · 이명원

1982년도 1월 부터 12월 1년간 서울을 비롯한 전국 보건연구소, 검역소, 서울 시내 종합병원 임상병리실험실에서 수거한 가검물 및 분리한 세균 등 총 1,518건을 시험한 결과 이중 살모넬라균속이 687건이 동정되었다. 이중 441건이 장티푸스였으며 그의 살모넬라균이 246건이었다. 이에 대한 생화학적 특성, 혈청학적 특성, 지리적, 계절적, 성별에 대한 발생특성, 앰피실린 등 12가지 항생제에 대한 감수성 시험을 하였다.

INTRODUCTION

A lot of papers concerned with members of the Genus *Salmonella* have been reported^{3,4,9,10,11,12,16,17,18} since the isolation of *Salmonella typhi* made by Gaffky in 1884, and later other *Salmonella*(*Salmonella choleraesuis*) was isolated by Salmon and Smith in 1885.

The Genus *Salmonella* now comprises about 2000 serotypes, which can infect a wide range of warm, cold-blooded animals and men¹⁹. Salmonellosis most commonly results from the ingestion of contaminated food. In industrialized countries, water-borne outbreaks have occurred as a result of sewage contamination of water supplies which are not purified or protected.

There have been a number of *Salmonella* organisms detected in Korea until now^{3,4,10,11,12,16,17,18}. The authors identified 687 cultures of *Salmonella* among 1,518 suspectable enteric

pathogens and *Vibrios* collected from the twelve provincial & city health laboratories and general hospital laboratories so as to confirm bacteriologically in the Korean National Salmonella Center (NIH) in 1982.

The results of the tests for biochemical, serological properties and drugs sensitivity patterns performed with whose cultures are presented in this paper.

MATERIALS AND METHODS

As a result of laboratory examination performed by the National Salmonella Center, 1,528 suspected cultures of enteric pathogens and *Vibrios* were collected in 1982 from the twelve hygiene laboratories of cities and provincial level and general hospital laboratories. Those cultures were primarily screened and transported in either KIA or nutrient slant media to the Salmonella Center, NIH.

* 본 論文의 要旨은 第51次 大韓微生物學會 席上에서 發表하였음.

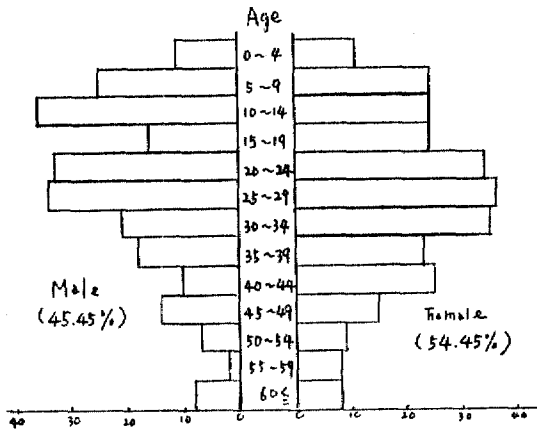


Fig. 1. Sex & Age distribution of *Salmonella* in 1982

(1) Biochemical test were performed as follows ^{1,2,4,6,8,14,15};

1. H₂S producing test: Kligler's Iron Agar, Kligler, 1917
2. Indole producing test: Kovac, 1928
3. Methyl Red Test: Methyl Red indicator
4. VP reaction = Acetylmethylcarbinol (acetoin) producing test; Barritt, 1936
5. Citrate utilization test: Simmon's citrate agar, Simmon, 1926
6. Motility test: Semisolid medium, Edwards & Bruner, 1942
7. Urease Test: Christense, 1946
8. Arginine dihydrolase test: Moeller, 1955
9. Lysine decarboxylase test: Moeller, 1955
10. Ornithine decarboxylase test: Moeller, 1955
11. Malonate test: Ewing, 1957
12. Phenylalanine deaminase test: Ewing, 1957
13. Carbohydrate fermentation test: Stainer & Doudoroff, 1953
Glucose, Lactose, Sucrose, Mannitol, Dulcitol, Salicine, Adonitol, Inositol, Sorbitol, Arabinose, Raffinose, Rhamnose
14. Oxidase test: 1% Dimethyl-P-Phenylenediamine oxalate aq. soln., Steel 1962
15. Growth in the presence of potassium cya-

nide: KCN medium, Moeller 1954

16. Oxidation or Fermentation of glucose: Hugh & Leifson, 1953

17. Tartrate utilization test: Jordan and Harmon, 1928

(2) For the determination of antigenic structures, the group specific diagnostic antisera prepared in the National Institute of Health, Korea were used and the flagella antigens were confirmed by comparing the results with the *Salmonella*-O, single type-specific antisera prepared by Difco Laboratory.

The nomenclatural system for the Genus *Salmonella* employed was suggested by Ewing ^{1,6}, which was based upon the three species concept proposed by Kauffman and Edward; according to this conception, the species *Salmonella enteritidis* included all other serotypes except *Salmonella choleraesuis* and *Salmonella typhi*.

(3) The sensitivity of *Salmonella* cultures tested to Ampicillin, Carbenicillin, Cephalosporin, Chloramphenicol, Kanamycin, Colistin, Gentamicin, Tetracycline, Streptomycin, Nalidixic acid, Neomycin, Polymyxin-B was performed by means of disc diffusion method recommended by Kirby-Bauer ¹⁴, using the discs prepared in BBL Laboratory.

RESULTS & DISCUSSION

1. Six hundred eighty-seven cultures of *Salmonella* were identified from 1,518 suspected specimens or cultures of enteric pathogens collected from various health laboratories of Korea in 1982.

Seventy nine cultures belonging to A-group were all *Salmonella enteritidis* bioser *Paratyphi* A.

Six cultures out of seventy seven belonging to the B-group were *Salmonella enteritidis* ser. *Paratyphi* B and the rest were *Salmonella*

Table 1. Number of Cultures and Antigenic formulas of Human Salmonellosis

1981~1982

Species or Serotypes	Somatic (o) antigen	Flagellar (H) antigen		Serogroup	Number of culture
		phase 1	phase 2		
<i>Salmonella enteritidis</i> bioser <i>Paratyphi A</i>	1. 2. 12	a	—	A	79 (61)
<i>S. enteritidis</i> ser <i>Paratyphi B</i>	1. 4. 5. 12	b	1. 2	B	6 (58)
<i>S. enteritidis</i> ser <i>Typhimurium</i>	1. 4. 5. 12	i	1. 2	B	65 (15)
<i>S. enteritidis</i> ser <i>Thompson</i>	6. 7. [14]	k	1. 5	C ₁	2 (4)
<i>S. enteritidis</i> ser <i>Infantis</i>	6. 7. [14]	r	1. 5	C ₁	1 (1)
<i>S. enteritidis</i> ser <i>Newport</i>	6. 8	e.h	1. 2	C ₂	2 (0)
<i>S. enteritidis</i> ser <i>Blockley</i>	6. 8	k	1. 5	C ₂	3 (10)
<i>Salmonella typhi</i>	9. 12[vi]	d	—	D ₁	441(343)
<i>S. enteritidis</i> ser <i>Enteritidis</i>	1. 9. 12	g.m	—	D ₁	67 (52)
<i>S. enteritidis</i> ser <i>Berta</i>	9. 12	f.g.t	—	D ₁	1 (0)
<i>S. enteritidis</i> bioser <i>Pullorum</i>	9. 12	—	—	D ₁	3 (0)
<i>S. enteritidis</i> bioser <i>Gallinarum</i>	1. 9. 12	—	—	D ₁	9 (4)
<i>S. enteritidis</i> ser <i>London</i>	3. 10	l.v	1. 6	E ₁	1 (0)
<i>S. enteritidis</i> ser <i>Anatum</i>	3. 10	e.h	1. 6	E ₁	0 (15)
<i>S. enteritidis</i> ser <i>Newington</i>	3. 15	e.h	1. 6	E ₂	0 (2)
<i>S. enteritidis</i> ser <i>Senftenberg</i>	1. 3. 19	g.s.t	—	E ₄	7 (0)
Total					687(565)

() : Figures in parentheses indicate those of 1981

[] : Antigen present or absent

enteritidis ser. *Typhimurium*. Eight cultures belonging to C-group were *Salmonella enteritidis* ser. *Thompson*, *Salmonella enteritidis* ser. *Infantis*, *Salmonella enteritidis* ser. *Newport*.

Four hundred forty-one cultures belonging to D-group were *Salmonella typhi*.

Among the five hundred twenty one cultures of *Salmonella* D-group and the rest were *Salmonella enteritidis* ser. *Enteritidis*, *Salmonella enteritidis* ser. *Berta*, *Salmonella enteritidis* bioser. *Pullorum* and *Salmonella enteritidis* bioser *Gallinarum*.

Salmonella enteritidis bioser. *Gallinarum* and *Salmonella enteritidis* bioser. *Pullorum* were very seldom isolated in this country before.

There were eight cultures of *Salmonella* belonging to the E-group, one of which was *Salmonella enteritidis* ser. *London* and the other

were *Salmonella enteritidis* ser. *Senftenberg* *Salmonella* serotypes tested were summarized in Table 1.

2. The physical and biochemical tests on the *Salmonella* cultures identified demonstrated the typical results when compared with the characteristic properties obtained in other reference ^{2,5,6,15}.

The results were shown in Table 2.

3. The geographical distribution of *Salmonella* cultures were summarized in Table 3. Forty seven percent of six hundred eighty seven of *Salmonella* cultures was isolated in Seoul metropolitan hospital while Kyung Buk was the next predominant area.

4. Seasonal distributions of *Salmonella* cultures were summarized in Table 4. June is the month with the highest incidences but those

Table 2. Biochemical properties of *Salmonella* culture tested in 1982

Test or Substrate	Types	<i>Salmonella typhi</i>		<i>Salmonella</i> other than <i>S. typhi</i>	
		Sign	%+	Sign	%+
Hydrogen Sulfide		+	100	+	78
Indole		-	0	-	0
Methyl Red		+	100	+	100
Voges-Proskauer		-	0	-	0
Simmons citrate		-	0	d	36
Urease		-	0	-	0
KCN		-	0	-	0
Motility		+	100	+	98
Lysine decarboxylase		+	100	+	68
Arginine dihydrolase	(+) or -	41		+	88
Ornithine decarboxylase		-	0	+	93
Malonate		-	0	-	0
Phenylalanine deaminase		-	0	-	0
Gae from Glucose		-	0	+	86
Acid from Glucose		+	100	+	100
Lactose		-	0	-	0
Sucrose		-	0	-	0
Mannitol		+	100	+	100
Dulcitol		-	0	+	82
Salicin		-	0	-	0
Adonitol		-	0	-	0
Inositol		-	0	-cr +	10
Sorbitol		+	100	+	100
Arabinose		-	0	+	86
Raffinose		-	0	-	
Rhamnose		-	0	+	87

d : different reaction

(+) : delayed positive reaction

figures were not necessarily related to the date of outbreak disease.

Some laboratories would send us *Salmonella* cultures which were stored for sometime. Sex and age group distribution of *Salmonella* were summarized in the Table 5. and Fig. 1 concerning to *Salmonella* occurrence according to sex which shows relatively higher for the female than in case of male, and 25~29 age were shown the highest group.

Table 3. Geographical distribution of *Salmonella* serogroups isolated in 1982

Area	Serogroup	<i>Sal. typhi</i>	<i>Salmonella</i>					Total
			Agr.	Bgr.	Cgr.	Dgr.	Egr.	
Seoul		256	50	4	5	7	1	323
In chun		—	—	1	1	1	—	3
Pu san		21	4	—	—	—	—	25
Kyung-gi Do		8	—	2	—	31	1	42
Kwang won Do		3	2	—	—	—	—	5
Chung-buk		21	2	9	—	18	—	50
Chung-nam		37	8	18	—	—	—	63
Kyung-buk		57	10	—	—	1	—	68
Kyung-nam		7	1	—	1	10	—	19
Jeon-buk		8	—	1	—	1	5	15
Jeon-nam		23	2	36	1	11	1	74
Total		441	79	71	8	80	8	687

Table 4. Seasonal distribution of *Salmonella* isolated in 1982

Month	Serogroup	<i>Sal. typhi</i>	<i>Salmonella</i>					Total
			Agr.	Bgr.	Cgr.	Dgr.	Egr.	
Jan.		5	2			1		8
Feb.		18	8	3	1			30
Mar.		9	8			8		25
Apr.		15	4			1		20
May.		38	4		2	25	2	71
June.		84	16	35		1	1	137
July.		42	8	27	2	2	5	86
Aug.		30	9	1		4		44
Sep.		30	2	2	1	10		45
Oct.		23	7					30
Nov.		32	2	3	1	18		56
Dec.		115	9		1	10		135
Total		441	79	71	8	80	8	687

5. In the sensitivity patterns of *Salmonella* cultures tested in 1981, forty cultures out of three hundred forty-three *Sal. typhi* appeared to be resistant to streptomycin, twenty eight cultures to tetracycline and thirteen cultures to chloramphenicol⁴⁾.

Nineteen cultures of *Salmonella* A group

Table 5. Sex & Age distribution of *Salmonella* isolated in 1982

Age group	Male	Female	Total
0-4	11	11	22
5-9	25	24	49
10-14	36	24	60
15-19	16	24	40
20-24	28	34	62
25-29	34	36	70
30-34	21	35	56
35-39	18	23	41
40-44	10	25	35
45-49	14	15	29
50-54	7	9	16
55-59	2	8	10
60 ≥	8	8	16
Unkown			181
	230	276	687

other than *Sal. typhi* were resistant to streptomycin and seven cultures to carbenicillin, tetracycline, eighteen cultures of *Salmonella* B-group other than *Sal. typhi* were resistant to tetracycline, but all of the seventy-three cultures were found to be sensitive to ampicillin, carbenicillin⁷.

All seventeen cultures of *Salmonella* E-group other than *Sal. typhi* were found not to be resistant to all twelve antibiotic tests as shown in Table 6.

For the sensitivity tests of *Salmonella* cultures isolated in 1982, thirty six cultures of *Sal. typhi* were appeared to be resistant to streptomycin, twenty nine cultures to carbenicillin, twelve cultures to tetracycline, ten cultures were found to be resistant to chloramphenicol as shown in Table 7.

Table 6. The Sensitivity of *Salmonella* cultures to the antibiotic tested in 1981.

Antibiotics	Cultures unit	<i>S. typhi</i>						A gr.						Bgr.					
		S		I		R		S		I		R		S		I		R	
		No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Amp.	10	323	94	10	3	10	3	56	92	0	0	5	8	73	100	0	0	0	0
Carb.	50	277	81	56	16	10	3	24	39	30	49	7	12	45	62	28	38	0	0
Ceph.	30	321	94	5	2	17	5	55	90	1	2	5	8	69	95	2	3	2	3
Chlor.	30	323	94	7	2	13	4	58	95	2	3	1	2	72	99	0	0	1	1
Colistin	10	333	97	7	2	3	1	61	100	0	0	0	0	70	96	1	1	2	3
Gent.	10	336	98	0	0	7	2	60	98	0	0	1	2	69	95	0	0	4	5
Kana.	30	324	94	3	1	16	5	56	92	0	0	5	8	69	95	3	4	1	1
Nalidix	30	300	87	40	12	3	1	52	85	7	12	2	3	61	84	12	16	0	0
Neo.	30	318	93	10	3	15	4	55	90	1	2	5	8	68	93	0	0	5	7
Poly.	300	333	97	9	3	1	0.3	58	95	3	5	0	0	66	90	3	4	4	5
Str.	10	181	53	121	35	41	12	28	46	14	23	19	31	37	51	35	48	1	1
Tetr.	30	297	87	26	8	20	6	38	62	16	26	7	12	42	58	13	18	18	25

S : Sensitive I : Intermediate R : Resistant antibiotic unit : —mcg
Ampicillin. Carbenicillin. Cephalothin, Chloramphenicol, Colistin. Gentamycin. Kanamycin. Nalidixic acid

It was found that the antibiotics for treating *Salmonella* infections including *Sal. typhi* could be cephalosporin, chloramphenicol, colistin, gentamicin, Kanamycin, etc.^{7,13)}

SUMMARY

The authors identified 687 cultures of the

Table 7. The Sensitivity of *Salmonella* cultures to the antibiotic tested in 1982

Antibiotics unit	Cultures						<i>S. typhi</i>						A gr.						Bgr.						
	S		I		R		S		I		R		S		I		R		S		I		R		
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	
Amp.	10	325	97.01	1	0.3	9	2.69	61	91.0	1	1.5	5	7.5	52	98.4	0	0	1	1.9						
Carb.	50	218	65.07	88	26.27	29	8.66	21	31.4	42	62.7	4	6.0	27	50.9	25	47.2	1	1.9						
Ceph.	30	323	96.41	5	1.49	7	2.09	64	95.5	1	1.5	2	3.0	53	100	0	0	0	0						
Chlor.	30	324	96.72	1	0.3	10	2.99	64	95.5	1	1.5	2	3.0	51	96.2	0	0	2	3.8						
Colistin.	10	331	98.81	4	1.19	0	0	66	98.5	1	1.5	0	0	53	100	0	0	0	0						
Gent.	10	334	99.7	0	0	1	0.3	67	100	0	0	0	0	53	100	0	0	0	0						
Kana.	30	323	96.42	6	1.79	6	1.79	65	97.0	0	0	2	3.0	52	98.1	0	0	1	1.9						
Nalidix.	30	297	88.65	37	11.04	1	0.3	45	67.2	21	31.3	1	1.5	37	69.8	16	30.2	0	0						
Neo.	30	312	93.13	14	4.18	9	2.69	65	97.0	0	0	2	3.0	52	98.1	0	0	1	1.9						
Poly.	300	301	89.85	34	10.15	0	0	48	71.6	19	28.4	0	0	5	9.4	48	90.6	0	0						
Str.	10	67	20	232	69.25	36	10.74	28	41.8	28	41.8	11	16.4	6	11.3	21	39.6	26	49.1						
Tetr.	30	276	82.38	47	14.03	12	4.58	21	31.3	41	61.2	5	7.5	27	50.9	25	43.2	1	1.9						

No	Cgr.						Dgr.						Egr.					
	S		I		R		S		I		R		S		I		R	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
15	100	0	0	0	0	54	96	0	0	2	4	17	100	0	0	0	0	
15	100	0	0	0	0	53	95	0	0	3	5	17	100	0	0	0	0	
15	100	0	0	0	0	51	96	2	4	0	0	17	100	0	0	0	0	
15	100	0	0	0	0	54	96	0	0	2	4	17	100	0	0	0	0	
15	100	0	0	0	0	54	96	2	4	0	0	17	100	0	0	0	0	
15	100	0	0	0	0	56	100	0	0	0	0	17	100	0	0	0	0	
15	100	0	0	0	0	53	95	0	0	3	5	17	100	0	0	0	0	
15	100	0	0	0	0	56	100	0	0	0	0	15	88	2	12	0	0	
15	100	0	0	0	0	53	95	0	0	3	5	17	100	0	0	0	0	
15	100	0	0	0	0	53	95	3	5	0	0	17	100	0	0	0	0	
9	60	5	33	1	7	52	93	2	3	2	3	14	82	3	18	0	0	
12	80	3	20	0	0	50	90	5	9	1	2	15	88	2	12	0	0	

Acid. Polymyxine-B. Streptomycin. Tetracyclin.

Genus *Salmonella* among 1516 suspected cultures or specimens of enteric pathogens submitted by the twelve hygiene laboratories of cities and provincial level and general hospital laboratories in 1982.

In accordance with the results obtained from the biochemical tests and the antigenic

structural analysis, four hundred forty one cultures of *Salmonella typhi*, seventy nine of *Salmonella enteritidis* bioser, *Paratyphi A*, sixty five of *Salmonella enteritidis* ser. *Typhimurium*, sixty seven cultures of *Salmonella enteritidis* ser. *Enteritidis*, nine cultures of *Salmonella enteritidis* bioser *Gallinarum*, and other *Salmo-*

Cgr.						Dgr.						Egr.					
S		I		R		S		I		R		S		I		R	
No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
5	100	0	0	0	0	65	95.6	1	1.5	2	2.9	7	100	0	0	0	0
5	100	0	0	0	0	65	95.6	1	1.5	2	2.9	7	100	0	0	0	0
5	100	0	0	0	0	67	98.5	1	1.5	0	0	7	100	0	0	0	0
5	100	0	0	0	0	67	98.5	0	0	1	1.5	7	100	0	0	0	0
5	100	0	0	0	0	66	97.1	2	2.9	0	0	7	100	0	0	0	0
5	100	0	0	0	0	68	100	0	0	0	0	7	100	0	0	0	0
5	100	0	0	0	0	67	98.5	0	0	1	1.5	7	100	0	0	0	0
3	60	2	40	0	0	67	98.5	0	0	1	1.5	7	100	0	0	0	0
4	80	0	0	1	20	67	98.5	0	0	1	1.5	7	100	0	0	0	0
5	100	0	0	0	0	59	85.8	9	13.2	0	0	7	100	0	0	0	0
1	20	3	60	1	20	50	23.5	12	17.6	6	8.8	4	57.1	3	42.9	0	0
3	60	2	40	0	0	53	77.9	13	19.1	2	2.9	3	42.9	4	57.1	0	0

nella enteritidis ser. Paratyphi-B, Salmonella enteritidis ser. Thompson, Salmonella enteritidis ser. Infantis, Salmonella enteritidis ser. Newport, Salmonella enteritidis ser. Blockley, Salmonella enteritidis ser. Berta, Salmonella enteritidis bioser Pullorum, Salmonella enteritidis ser. London, Salmonella enteritidis ser. Senftenberg were confirmed.

As a result of disc diffusion test modified by kirby-Bauer, it was found to be effective In Vitro tests that the drugs for treating Salmonella infections could be chloramphenicol, kanamycin, gentamicin.

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