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Recent Trend of Salmonella Food Poisoning and Serovars

Abstract

During 1993-1997, there had been in the Taiwan Area 19 incidents of *Salmonella* food poisoning. By places of infection, six incidents occurred in schools, six in restaurants and cafeterias, five at homes, one at a dinner party, and one imported. By geographic area, the northern and the southern areas had the most incidents, followed by the central area. The eastern area had only one incident. *Salmonella* of these incidents came in ten serovars. Six incidents were caused by *Salmonella enteritides*, involving 174 victims and accounting for 55.1% of all incidents. Three incidents were caused by *S. montevideo,* involving 32 victims and accounting for 10.1%. Four incidents were caused by *S. weltevreden* or *S. virchow*, involving 28 and 9 victims. The rest six incidents was caused by *S. java, S. emek, S.. regent, S. blockley, S. stanley* and *S. typhimurium* respectively, involving a total of 73 victims. The isolation rates of the causative pathogenic agents were 12.5-100%.

From 1991 to 1997, *Salmonella enteritidis* had been isolated from patients in 141 cases of all sporadic diarrhea and outbreaks of *Salmonella* food poisoning. Before 1994, no *Salmonella enteritidis* food poisoning outbreaks had been reported, and the number of *S. enteritidis* isolated each year was less than ten. The first *S. enteritidis* food poisoning outbreak occurred in 1995. Between 1996 and 1997, five more outbreaks had been reported, and the number of *S. enteritidis* isolated had increased sharply. With the exception of February, *S. enteritidis* was isolated in every month, particularly between July and October.

Introduction

All *Salmonella* bacilli, except *Salmonella typhi* and *S. paratyphi* of the notifiable typhoid and paratyphoid infectious diseases, are capable of inducing gastroenteritis in man and induce either sporadic diarrhea or outbreaks of *Salmonella* food poisoning. In the past, *Salmonella* isolated from sporadic cases in the Taiwan Area was primarily *S. typhimurium*[1]. In the last ten years, the number of *S. enteritidis* food poisoning outbreaks has increased sharply in Europe, the US, and Japan, and has become a major concern of all. Various preventive measures have thus been taken. In Japan for instance, the number of *S. enteritidis* food poisoning outbreaks has increased drastically since 1989, replacing *S. typhimurium* to become the first responsible cause for the *Salmonella* food poisoning[2]. With a few sporadic cases, no indigenous *S. enteritidis* food poisoning outbreaks had been reported in Taiwan before 1994.

In July 1992, members of a tour group developed food poisoning while in the Philippines. From specimens collected upon their return to Taiwan, the incident was confirmed by the National Institute of Preventive Medicine as the first imported *S. enteritidis* food poisoning outbreak. Between 1981 and 1992, the National Institute of Preventive Medicine conducted regular serotype analysis of *Salmonella* bacilli isolated from sporadic gastroenteritis patients. The results showed there had been only one sporadic case in the southern and the eastern parts of Taiwan individually.

Materials and Methods

1. Isolation of Strains

   In 1991-1997, the laboratory procedure for the isolation of strains was either to place the rectal swabs collected from sporadic gastroenteritis patients and cases of food poisoning outbreaks in selenite broth, or to place blood specimens in the brain heart infusion (BHI) broth under 37℃. Rectal swabs were then isolated within 18 hours with *Salmonella-Shigella* (SS) and DHL (Desoxycholate-Hydrogen-Sulfide Lactose). Blood specimens were placed under 37℃ for 6-10 days for daily observation of the growth of bacilli. Bacilli were then cultured with SS and DHL. Colonies were removed for observation the next day.
2. Identification of Strains

   Suspected *Salmonella* colonies were then picked up and placed on TSI (Triple Sugar Iron agar) and SIM (Sulfide-Indole-Motility agar) under 37℃ for 18-24 hours for the assessment of various bio-chemical reactions[3]. The colony could be considered *Salmonella* if the reactions were: glucose-Fermentation, sucrose and lactose non-Fermentation, H2S (+), Lysine decarboxylase (+), motility (+), and gas formation (+). Confirmation was made by further intestinal tract bacteria test[3].
3. Serological Identification

Once it was confirmed *Salmonella*, it was then processed with poly *Salmonella* anti-serum for an agglutination reaction. If it was positive, it was further processed with O-group serum for the agglutination reaction to decide the O-antigen type. After these bio-chemical assessments and serological testing, it was further analyzed for the H-antigen structure. The procedure was, the colony was inoculated on H broth for flagella antigen (H) to grow. The known serum factors phase I or phase II were then used for test tube agglutination reaction. If phase I was used, its serum was used to induce antigen of phase II; and vice versa. Sera were then used for test tube agglutination reaction. Serum reactions of O serum and H serum were used to confirmed the serotype[1].

4. Data Analysis

Data were analyzed by geographic areas, places of infection, number of persons infected, and isolation rate in outbreaks, and distribution by year and month of *Salmonella* isolated from sporadic infections, to understand the recent trend of *S. enteritidis* for the reference of health care, food sanitation, and disease control professionals in the formation of policies.

Results

1. Serotypes of *Salmonella* Isolated in Recent Food Poisoning Incidents

In the years between 1993 and 1997, except 1993, *Salmonella* food poisoning was reported each year. Thus, a total of 19 incidents (one imported) was counted. By places of infection, six incidents occurred in schools, six in restaurants and cafeterias, five at homes, one at a dinner party, and one imported.

By geographic area, cases of the imported incident came from different areas of the island. Of the other indigenous 18 incidents, 7 occurred in the southern area, 6 in the northern area, 4 in the central area, and only one in the eastern area of the island. The pathogenic agents of these incidents involved 10 serovars of *Salmonella*: six incidents by *S. enteritidis*, involving 174 victims and accounting for 55.1% of all incidents. This kind of infection never occurred before. Three incidents were caused by *S. montevideo*, involving 32 victims and accounting for 10.1% of all incidents. Two incidents were caused by *S. weltevreden*, involving 28 victims; another two incidents were caused by *S. virchow*, involving 9 victims. The rest incidents was caused by *S. java, S. emek, S. regent, S. blockley, S. stanley,* and *S. typhimurium* respectively, involving a total of 73 victims. The isolation rates of the causative pathogenic agents from specimens of patients were 12.5-100% (Table 1).

2. Distribution of *Salmonella* Isolated from Sporadic Cases and Outbreaks

Since the first isolation of *S. enteritidis* from sporadic patients of acute gastroenteritis in 1991, a total of 141 cases of *S. enteritidis* had been isolated from specimens of patients of sporadic infections and food poisoning outbreaks by the

end of 1997. In particular, since the imported food poisoning incident from the Philippines in July 1992, more *S. enteritidis* infections have been reported. Though the number of cases during 1993-1994 was still less than ten, after the first *S. enteritidis* food poisoning outbreak in the northern part of Taiwan in August 1995, the number of *S. enteritidis* isolated in that year increased sharply. In 1996-1997, five *S. enteritidis* outbreaks occurred, bringing the number isolated to a high level. Particularly in 1997, the number of *S. enteritidis* isolated was the second highest in the Taiwan Area, next to *S. typhimurium*. This increase deserves special attention. In the last ten some years, though *S. typhimurium* was the major pathogenic agent of sporadic infections in Taiwan, it rarely caused outbreaks. *S. enteritidis* though was less isolated in sporadic cases, as it caused six outbreaks in only three years (1995-1997), its threat should not be overlooked. The distribution shows that except February, *S. enteritidis* is isolated in every month, and particularly in the months between July and October (when most food poisoning occur, Table 2).

Discussion

In 1983-1992, there had been nine incidents of *Salmonella* food poisoning in the Taiwan Area. From them, 10 strains of different serotypes had been isolated. In 1993-1997, there had been 19 incidents caused by strains of 10 serotypes. During these years, *S. enteritidis*, *S. virchow*, *S. typhimurium*, and *S. weltevreden* each had, in addition to the imported *S. enteritidis* incident from the Philippines, caused more than two incidents. *S. montevideo*, *S. blockley*, *S. java*, *S. regent*, and *S. emek* appeared only recently. They have been isolated in sporadic cases, but not necessarily induce outbreaks. In 1995-1996, *S. montevideo* induced three food poisoning incidents and became the second leading cause of *Salmonella* food poisoning in Taiwan. The rest serotypes have caused occasional non-repeated sporadic infections. Their trend, however, should be observed closely. Food environment in the Taiwan Area before 1990, perhaps, had not yet been contaminated by *S. enteritidis*, cases were very few. On the other hand, *Salmonella* became prevalent in other parts of the world, and was the leading cause of food poisoning[2].

In 1992, the imported *S. enteritidis* became the source of contamination. Because it was not a reportable disease, no control measures were taken. It was suspected that contamination spread out since then. The number of cases though had not increased significantly in the next few years, *S. enteritidis* has, in the last three years (1995-1997), induced six food poisoning incidents. More *S. enteritidis* has also been isolated, which is an indication that the agent has spread out, its threat should not been overlooked. Precautions, particularly in food sanitation, should be taken to avoid any serious large-scale outbreaks in the future. More westernized food habit, more eating-out, more fast food, and more overseas visits may bring about.

like in western countries and Japan, more opportunity for *S. enteritidis* food poisoning to become a major health issue.

In 1991-1995 in Japan, of *Salmonella* of all serotypes isolated from food poisoning incidents, *S. enteritidis* accounted for 25% of all *Salmonella* in 1991. This proportion had increased to 36.7% in 1992, 47.6% in 1993, 55.7% in 1994, and decreased to 46.8% in 1995. In the five years, *S. enteritidis* had remained the leading cause of food poisoning. The important food item responsible for food poisoning, as shown by surveys, was eggs, particularly eggs laid by chickens brought in from abroad which had probably been contaminated earlier by *Salmonella*[4-6].

In 1996 in Japan, *Salmonella* food poisoning accounted for 36% of all bacterial food poisoning, exceeding the 27.9% of *V. parahaemolyticus*. This was due to the sharp increase in *S. enteritidis.* food poisoning[4]. No outbreaks of *S. enteritidis* were reported in Taiwan before this time. The reasons could have been that food habit of Taiwan population was different from that of the western countries and Japan. People of other countries often eat food raw or half-cooked. Food not well-cooked could be contaminated. People in Taiwan though eat raw fish occasionally, eat food well-cooked. Heating kills pathogenic agents and is less likely to induce food poisoning. However, if food is cross-contaminated, poisoning is likely to occur. To prevent contamination of food, heating is recommended. In particular, tourists or people visiting abroad on business should never eat raw food or drink cold drink to avoid infection.

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Table 1. Serotypes Isolated in *Salmonella* Food Poisoning Outbreaks, 1993-1997

Year	Area	Places of infection	Serovars	No. of cases	Positive/No. of Specimens	Isolation Rate
1993	-	-	-	-	-	-
1994	N&S	traveler*	*S. emek*	15	2/15	13.3%
	N	feast	*S. blockley*	10	3/5	60.0%
	S	school	*S. java*	19	12/19	63.2%
	Central	school	*S. weltevreden*	16	2/16	12.5%
1995	C	home	*S. virchow*	3	1/3	33.3%
	S	home	*S. typhimurium*	16	9/9	100.0%
	S	restaurant	*S. virchow*	6	2/5	40.0%
	N	restaurant**	*S. enteritidis*	9	7/7	100.0%
	S	restaurant	*S. montevideo*	11	7/11	63.6%
	S	school	*S. montevideo*	13	4/13	30.8%
1996	S	cafeteria	*S. montevideo*	8	3/8	37.5%
	C	cafeteria	*S. weltevreden*	12	9/12	75.0%
	N	home	*S. stanley*	4	4/4	100.0%
	N	home	*S. regent*	9	4/6	66.6%
	N	school	*S. enteritidis*	43	19/21	90.5%
1997	E	cafeteria	*S. enteritidis*	17	9/14	64.3%
	C	home	*S. enteritidis*	9	5/6	83.3%
	S	school	*S. enteritidis*	36	2/4	50.0%
	N	school	*S. enteritidis*	60	14/41	34.1%

*imported case

**first *S. enteritidis* food poisoning in Taiwan

-:no outbreaks

Table 2. Monthly Distribution of *S. enteritidis* Isolated in Sporadic Cases and Outbreaks, 1991-1997

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1991									1				1
1992							14*				1		15
1993	1			1	1						1		4
1994					1						1		2
1995				1	1	1	2	9#	6		1		21
1996			1	1	4	1	4	3	19#	3	1	2	39
1997	1		1	1	6		18#	3	7#	16#	5	1	59
Total	2		2	4	13	2	38	15	33	19	10	3	141

*imported case

#including outbreak cases