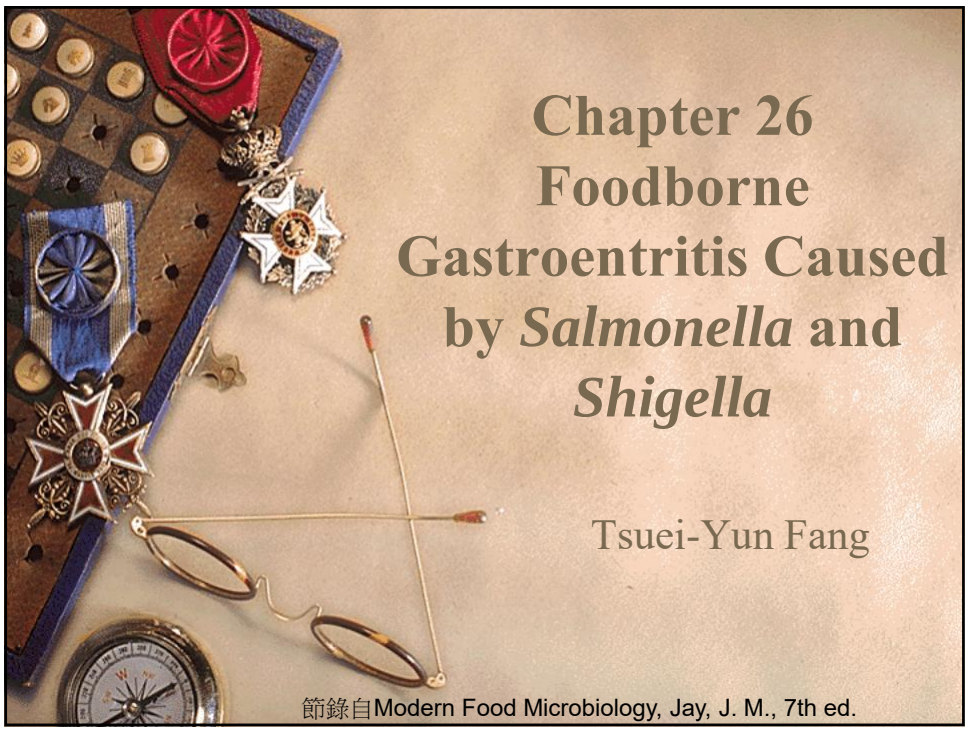
Chapter 26
Foodborne
Gastroentritis Caused
by *Salmonella* and
Shigella
Tsuei-Yun Fang
節錄自Modern Food Microbiology, Jay, J. M., 7th ed.


Salmonellosis (沙門氏菌感染症)
Salmonellae: **small, G(-), nonsporing rods**
Widely distributed in nature; Primary reservoir: **humans & animals**
Salmonella food poisoning ← **ingestion of significant numbers of pathogenic Salmonellae** → **Food infection**

Salmonellosis

- *Salmonella* Typhimurium ➔ *S. enterica* serovar Typhimurium
- three groups of Salmonellae:
- **infect humans only**
- **host-adapted** (宿主適應型) **serovars** ➔ specific host preference
- **unadapted serovars** ➔ no host preference ➔ include most foodborne serovars
- **Serotyping of *Salmonella***
  - A, B, C1, C2, D, E1 (Table 26-1)

Distribution

- primary habitat: **intestinal tract** of humans and other animals
- **Animal Feeds**
- **Food Products**: **Eggs**, **milk, poultry, meat, and meat products**➔ most common food vehicles of salmonellosis to humans

Growth and Destruction of Salmonellae

- typical of G(-) ➔ able to grow on many culture media and produce visible colonies well within 24 hours at 37°C
- optimum pH for growth is around neutrality ➔**best growth: pH 6.6 – 8.2**
- **pH > 9.0 or pH < 4.0➔ bactericidal**
- lowest temperature for growth ➔ **6.2°C** for *S.* Typhimurium
- upper temperature limit for growth
  - **around 45 °C**

Growth and Destruction of Salmonellae

- moisture: **a_w 0.94** at neutral pH ➔ observed growth inhibition
- **unable to tolerate high salt concentration** ➔ above 9 % ➔ bactericidal
- **Nitrite** is effective ➔ greatest effect at the lower pH values
- All salmonellae are readily **destroyed at milk pasteurization temperature.**
- Quite **sensitive to ionizing radiation** ➔ 5 – 7.5 kGy ➔ sufficient to kill salmonellae from most foods and feed

The Salmonella Food-Poisoning Syndrome

- Caused by **ingestion of significant numbers** of pathogenic Salmonellae
- Symptoms **develop in 12 – 14 hours** after the time of ingestion of food
- Symptoms: nausea, vomiting, abdominal pain (not as severe as with staphylococcal poisoning), headache, chills, and diarrhea ➔ companied by prostration (疲劳), muscular weakness, faintness (暈眩), moderate fever, restlessness, and drowsiness (睡意). ➔ persist for 2 –3 days

The Salmonella Food-Poisoning Syndrome

- Average mortality rate is 4.1% ➔ 5.8% for the first year of life; 2% between the first and 50th year; 15% in person over 50
- ***S. Choleraesuis*** produce the highest mortality rate ➔ 21%
- Up to 5% of **patients may become carrier** of the organisms upon recovery from this disease
- **10^7 – 10^9/g** are generally necessary for salmonellosis (may occur at even lower numbers)
- The **acid tolerance response** may lower the number of cells needed to initiate Salmonellosis to **as few as 10 cells**.

Salmonella Virulence Properties

- Enterotoxin and cytotoxin seem to play only a minimal (if any) role in the gastroenteritis syndrome
- Virulence mechanism is still unknown

Incidence and Vehicle Foods

- Figure 26-2 (*Salmonella* serotypes Typhimurium and Entertidis)
- Table 26-3 (*S.* Enteritidis)
- **Eggs, milk, poultry, meat, and meat products**
- *S.* Enteritidis ➔ outbreaks have occurred following the **consumption of raw and undercooked eggs**

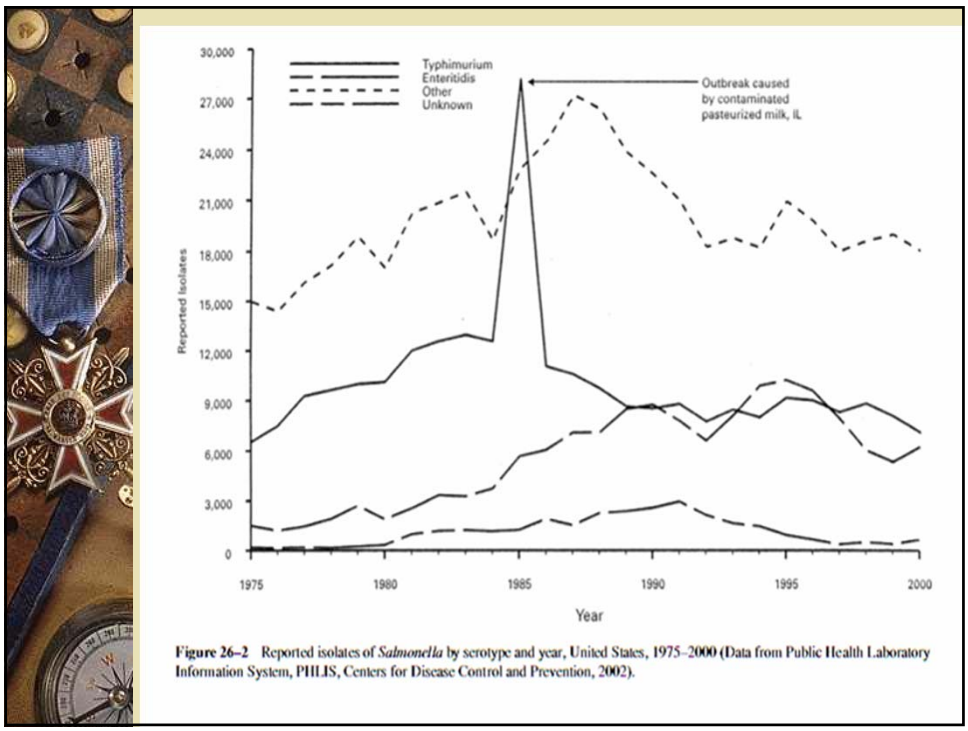

Figure 26–2 Reported isolates of *Salmonella* by serotype and year, United States, 1975–2000 (Data from Public Health Laboratory Information System, PHLIS, Centers for Disease Control and Prevention, 2002).

Table 26–3 Some Characteristics of All Outbreaks of *Salmonella* serotype Enteritidis Infection and Outbreaks in Health-Care Facilities, by Year—United States, 1985–1998 (Summarized from Reference 11)

		All outbreaks			*Outbreaks in health-care facilities*		
Year		*Number of Outbreaks*	*Number ill*	*Deaths*	*Number of Outbreaks*	*Number ill*	*Deaths*
1985		26	1,159	1	3	55	1
1986	47	1,444	6	6	96	5	
1987	58	2,616	15	8	489	14	
1988	48	1,201	11	8	227	9	
1989	81	2,518	15	19	505	13	
1990	85	2,656	3	12	265	3	
1991	74	2,461	5	8	118	4	
1992	63	2,348	4	2	42	2	
1993	66	2,215	6	6	66	4	
1994	51	5,492	0	2	32	0	
1995	56[a]	1,312	8	6	147	6	
1996	50	1,460	2	3	64	0	
1997	44	1,098	0	1	13	0	
1998	47	709	3	3	32	3	
Total		796	28,689	79(0.28%)	87	2,151	64(3%)

[a]Includes one outbreak associated with a Komodo dragon exhibit at a zoological park.

Prevention and Control of Salmonellosis

- primary habitat: **intestinal tract** of humans and other animals ➔ **animal fecal matter** is of greater importance than humans
- Salmonellae's presence in meats, eggs, and even air makes their presence in certain foods inevitable through the agency (媒介) of **handlers** and **direct contact** of noncontaminated foods with contaminated foods.

Competitive Exclusion to reduce Salmonellae Carriage in Paultry

- **Feces from salmonellae-free birds**, or **a mixed fecal culture of bacteria**, are given to young chicks so that they will **colonize the same intestinal sites** that salmonella employ ➔ **exclude the attachment of salmonellae or other enteropathogens**

Competitive Exclusion to reduce Salmonellae Carriage in Paultry

- The **enteropathogen-free biota (生物群)** may be **administered orally** to newly hatched chicks **through drinking water** or by **spray inoculation** in the hatchery (孵化場).

SHIGELLOSIS

(Toxin-mediated infection)

- The genus ***Shigella*** (Gram-negative, nonsporing rods) belongs to the family Enterobacteriaceae, as do the salmonellae and escherichiae.
- Only four species are recognized: *S. dysenteriae, S. flexneri, S. boydii*, and *S. sonnei*.痢疾志賀氏菌. 福式志賀氏菌. 鮑氏志賀菌. 宋內志賀氏菌
- Mode of invasion: **Penetrate the epithelial cells** of the intestines and **release a powerful enterotoxin**.

SHIGELLOSIS

- ***S. dysenteriae*** is a primary pathogen that causes **bacilliary dysentery (**杆菌性痢疾**)**; as few as **10 cfu** are known to initiate infection in susceptible individuals.
- *S. dysenteriae* produces a potent toxin called **Shiga toxin** (may **inhibit mammalian protein synthesis**).

SHIGELLOSIS

- Shigellae are **all human reservoirs**.
- Growth occurs at as low as **10°C** and as high as **48°C**.
- Best growth pH: **pH 6 – 8**
- Growth is inhibited by **nitrite** as **temperature** and **pH** were decreased or as **NaCl** was increased.

Foodborne Cases

- 1973 – 1987 reported food poisoning cases: **Salmonellosis** (45%) > Staphylococcal food poisoning (14%) > Shigellosis (12%)
- ***Shigella sonnei*** and ***S. flexneri*** are the main cause of Shigellosis for the years 1975-2000.
- **Poor personal hygiene** is a common factor in foodborne shigellosis, with **shellfish**（貝), **fruits** and **vegetables**, **chicken**, and **salads** being prominent among vehicle foods.