

SHIGELLA

THE ORGANISM/TOXIN

This genus includes four species; *S. dysenteriae*, *S. flexneri*, *S. boydii* and *S. sonnei*, which are able to cause bacillary dysentery. They are very similar to *Escherichia coli* and are serologically cross reactive, but have remained separate species for clinical reasons.

GROWTH AND ITS CONTROL

Growth: Very little is known about the growth and survival of the organism in food. *S. sonnei* is more robust than *S. flexneri* (data for *S. sonnei* given). It has been shown to be able to grow on foods (e.g. parsley).

Temperature: Minimum 6-7°C, maximum 45-47°C. Will grow on sliced fruits at room temperature.

Water activity: Maximum 5.2% NaCl.

pH: Minimum 4.8-5.0 in 3.8-5.2% NaCl, 5.5 in the presence of 300-700 mg/litre NaNO₂. Maximum 9.3 in the presence of 5.2% NaCl.

Atmosphere: Able to grow in the absence of oxygen.

Survival:

Temperature: In general they survive best at low temperatures (subzero and refrigeration). Can survive storage in butter for more than 100 days at -20°C and 4°C. Can survive storage on soil, cheese and herbs for 50 days, in orange juice for 1-6 days and in white cheese, cheese curd and salad with mayonnaise from 19-32 days. Persisted for 11-20 days on salads, depending on salad type.

Survives heating to 63°C for 2-3 min.

Water Activity: In general they survive better in low moisture foods.

Some strains can survive 15% NaCl for 1 day.

pH: Despite its relatively high minimum pH for growth, *Shigella* is among the most acid resistant of foodborne pathogens. Some strains can survive exposure to pH 2.5 or 3.0 for 2 hours, and for a few hours to a day in fruit juices of various pH values.

Organic acids are more inhibitory than mineral acids.

Inactivation (CCPs and Hurdles):

Temperature: Rapidly inactivated at temperatures above 65°C.

pH: Are inactivated at pH values <4.0 (but can persist for some time, see above).

Water activity: Numbers decline slowly (over days/weeks) at 6% NaCl. Two of 21 isolates survived for 4 days in 10% NaCl.

Preservatives: (NB: Some of the preservatives discussed here may not be permitted in New Zealand). *S. flexneri* is inhibited by plastic containing 1,500 ppm of triclosan. At pH 5.5 450

ppm nitrite was required to inhibit *S. flexneri* but 700 ppm was required to inhibit *S. sonnei*.

Sanitisers/Disinfectants: (These products must be used as advised by the manufacturer).

90% inactivation was produced by sodium hypochlorite at a concentration 0.5-1.5 mg/litre free chlorine and at 4°C. A 6D reduction was achieved on inoculated parsley with 5.2% acetic acid or 200 ppm free chlorine after 5 minutes exposure at 21°C. Treatment with 7.6% acetic acid or 250 ppm chlorine increased the kill to >7D.

(N.B. The absence of a sanitiser/disinfectant from this section does not necessarily imply that it is ineffective).

Radiation: Sensitive to γ radiation, a dose of 3 kGy results in a 7D kill. D values are of the order of 0.2-0.4 kGy.

THE ILLNESS

Incubation: 12 hours to 4 days. In outbreaks incubation times of up to 36 hours are observed.

Symptoms: Abdominal pain, diarrhoea, fatigue, malaise and fever. Mucus and occasionally blood appear in the faeces. The illness may progress to the "colonic phase" within 1-3 days where the symptoms are intense cramps as well as frequent and painful bowel movements.

Lasts for 3 to 14 days.

Estimated 13.9% hospitalisation rate, 0.16% case fatality rate.

Condition: Bacillary dysentery or shigellosis.

Toxins: Toxins are not produced in foods.

At Risk Groups: Some groups are more predisposed to infection: children under 6 in day care centres, people in nursing homes or prisons, male homosexuals (sexual transmission).

Long Term Effects: Septicaemia sometimes occurs in the immunocompromised host with an associated high fatality rate. May rarely cause haemolytic uraemic syndrome.

Dose: The dose required to cause disease is small at 10-100 cells.

NZ Incidence: 3.3/100,000 to October 2000, 4.0/100,000 in the previous year. A focused study did not isolate *Shigella* from the faeces of cases with diarrhoea (implied rate <4/100,000).

Treatment: Antibiotic treatment is possible, but is not required in milder cases. Oral replacement of fluids may be required. Antibiotic resistance is common. No effective vaccine exists.

SOURCES

Human: Humans and the higher primates are the

reservoir for this organism. The organism can be found in the faeces for weeks after symptoms have ceased. It can survive in human faeces for days if the samples remain moist.

Animal: Not carried by animals other than primates.

Food: Foods can become contaminated by water or soiled hands.

Environment: Water that is contaminated by sewage may act as a vehicle for this organism.

Transmission Routes: Person-to-person spread (during convalescence) is important, but in many countries food and waterborne transmission are more significant. Most meals implicated in causing shigellosis comprise cooked food that is served cold and that has been contaminated by a food handler.

Food can become contaminated by flies carrying sewage or faeces.

OUTBREAKS AND INCIDENTS

Overseas Outbreaks:

Dip: >30 cases. Control point failure: not described.

Lettuces: 110 confirmed cases. Control measure failure: Likely faecal contamination of ready-to-eat food.

Salad: 46 cases. Control point failure: Possible contamination by sick food handler.

Parsley: 478 cases in 8 incidents. Control point failure: contaminated water and ice used in processing and transport.

ADEQUATE PROCESSING GUIDELINES

N.B. These guidelines have been derived from published information. Industry is advised to ensure that processing steps they are using are adequate to meet their particular food safety objectives.

Cook meats to:	Internal temperature reached	Time
Minced meats (beef, veal, lamb, pork) + pork cuts	71°C	15 sec
Minced poultry	74°C	"
Meat cuts (beef, veal, lamb), fish, seafood	63°C	>3 min
Poultry, breast	77°C	15 sec
Poultry, whole	82°C	"
Hold foods at	≤ 5°C or ≥ 60°C	
Reheat cooked foods to	74°C	Instantaneous
Thoroughly wash all fruit and vegetables with potable water		
Avoid contamination of ready-to-eat foods from flies		
Avoid direct handling of food by infected food handlers		

REFERENCES

Smith, J.L. (1987) *Shigella* as a foodborne pathogen. *Journal of Food Protection* 50, 788-801.

The International Commission on Microbiological Specifications for Foods (1996) *Shigella*. In *Microorganisms in Foods 5 Microbiological Specifications of Food Pathogens*, pp 280-298. Blackie Academic and Professional, London.

