

VIBRIO CHOLERAЕ

THE ORGANISM/TOXIN

The species is divided into serotypes on the basis of the O antigen. Cholera is typically associated with O1, but serotype O139 has also been the cause of many cases of cholera in Asia. There are subgroups of O1; classical and El Tor. The classical biovar is responsible for a more severe form of cholera.

GROWTH AND ITS CONTROL

Growth:

Temperature: Optimum 37°C. Range 10-43°C.

pH: Optimum 7.6. Range 5.0-9.6. The organism can grow relatively quickly under optimum conditions.

Atmosphere: Grows with or without oxygen, but growth is optimal under aerobic conditions.

Water activity: Optimum a_w 0.984 (0.5% NaCl). Range a_w 0.940-0.988 (0.1-4.0% NaCl). Does not require the presence of salt for growth.

Survival:

Temperature: Survives better under refrigeration than at ambient temperatures. Also survives freezing.

Viable but Non-Culturable (VNC) Cells: These organisms have been shown to undergo a transition to a VNC state.

Inactivation (CCPs and Hurdles):

Temperature: $D_{60} = 2.7$ min. $D_{71} = 0.30$ min.

pH: Rapidly inactivated at pH values <4.5 at room temperature.

Water Activity: Sensitive to drying.

Sanitisers/Disinfectants: Peracetic acid and hypochlorite are effective disinfectants in the absence of protein. A quaternary ammonium compound was quite effective at 50 ppm.

Isopropanol used to disinfect hands was effective.

Radiation: A dose of 0.5 kGy is optimal for inactivating this organism. D value of 0.11 kGy in frozen prawns.

Preservatives: Freshly squeezed lemon juice has been found to inactivate the organism after 5 minutes exposure. Lime juice has also been shown to inhibit growth.

Depuration: Is not effective for the removal of vibrios from shellfish.

THE ILLNESS

Incubation: 12 to 72 hours.

Symptoms: *Cholera:* Initially mild diarrhoea progressing to diarrhoea characterised by the production of copious pale grey ("rice water") stools. Other symptoms include low blood pressure, nausea, abdominal cramps and occasionally fever. The loss of fluids requires rehydration and if this does not occur death by fluid loss may occur.

Recovery within 1-6 days in healthy people is normal.

Non-O1/O139: The diarrhoea is milder but may be bloody, and is accompanied by abdominal cramps and fever. Can last 6-7 days. Extraintestinal infections may also occur, e.g. in wounds exposed to contaminated water.

Condition: *Cholera.* Six worldwide pandemics of cholera originating in India are known to have occurred. In the seventh pandemic type O1 El Tor originated from Indonesia. The emergence of type O139 from southern India can be regarded as the eighth pandemic.

The hospitalisation rate from cholera has been estimated at 34% and the case fatality rate at 0.6% in the USA.

Non-O1/O139: In the developed world most cases are due to non-O1/non-O139 serotypes. Such incidents are normally associated with the consumption of contaminated seafood.

Toxins: Cholera toxin and a related adherence factor produced in the intestine are essential components for cholera to occur. A number of other factors are also important.

Non-O1/O139 serotypes do not produce these toxins.

At Risk Groups: *Cholera:* Usually between the ages of 2 and 9 years in endemic areas. When people become exposed to new serotypes adults are also susceptible to infection.

Non-O1/O139: Diarrhoea may occur in anyone eating contaminated shellfish. Septicaemia can occur in people with liver cirrhosis or who are immunocompromised.

Long Term Effects: Prevented by rehydration.

Dose: Approximately 10^6 cells when ingested with food in healthy adults, less in those taking antacids.

NZ Incidence: 1 case of cholera in 1998 and 1999, 0 cases in 1997.

In a targeted examination of faecal samples in the Eastern Bay of Plenty an incidence of 4/100,000 p.a. non-O1/O139 has been estimated.

Treatment: *Cholera:* Rehydration and electrolyte replacement. Antibiotics shorten the duration of the illness.

Non-O1/O139: Usually self-limiting. Antibiotics shorten the duration of the illness.

SOURCES

Human: Believed to be the primary reservoir of the organism. Asymptomatic carriers are known to occur.

Animal: Aquatic microscopic animals living in contaminated marine waters become contaminated

themselves. O1 strains have been shown to colonise zooplankton at $>10^4$ cells per animal.

Cholera organisms can be carried by domestic animals, but not for long periods.

Non O1/O139 strains are normal inhabitants of the marine environment.

Food: Food becomes contaminated from food handlers or contaminated water. The most commonly implicated foods are seafood, including shellfish, fish and crustaceans.

Grains, legumes, meat, fruits and vegetables have also acted as vehicles. Fruits and vegetables may be irrigated with contaminated water and consumed raw. Other foods may be contaminated by infected food handlers.

Environment: Whether there is a natural aquatic reservoir for O1 and O139 is still under debate, although the weight of evidence suggests that there is. Cholera serotypes have been isolated from Asian, American and Australian waters.

Other serotypes are associated with marine, brackish and freshwater aquatic environments.

Transmission Routes: By food that has been in contact with contaminated water.

Non O1/O139 cases are associated with the consumption of raw oysters.

OUTBREAKS AND INCIDENTS

Outbreaks in non endemic countries (mainly USA):

Frozen Coconut Milk (Imported from Thailand): (O1) 3 cases, 1 hospitalisation. Control point failure: not identified, although insufficient final cooking occurred.

Canned Palm Fruit (Imported from El Salvador): (O1 El Tor) 4 infected, 2 symptomatic, both hospitalised. Control point failure: probably incorrect processing of the home canned fruit.

Seafood Salad (Airline meal): 75 infected out of 336 exposed, 10 hospitalised, 1 died. Control point failure: not identified.

Crab Meat (Illegally imported from Ecuador): (O1 El Tor) 8 cases. Control point failure: not identified, but presumably temperature abuse was involved.

Raw Oysters: (non-O1) 4 cases. Control point failure: not identified but presumably harvesting contaminated shellfish and/or temperature abuse.

Rice: (O1 El Tor) 15 cases. Control point failure: rice washed in contaminated water after cooking, temperature abuse.

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.

Hold foods at	$\leq 5^{\circ}\text{C}$ or $\geq 60^{\circ}\text{C}$	
Ensure shellfish are harvested from approved shellfish gathering waters		
Avoid direct handling of food by infected food handlers		
Avoid cross contamination from raw to cooked foods		
Thoroughly wash all fruit and vegetables		

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