

# YERSINIA ENTEROCOLITICA

## THE ORGANISM/TOXIN

There is a pronounced geographical variation in pathogenic serotypes worldwide. For example serotype O:8 is associated with North America, while types O:3, O:9 and O:5,27 are distributed worldwide. In New Zealand serotype O:3 accounts for 90% of cases.

Can grow in the presence or absence of oxygen. Able to grow at refrigeration temperatures. Only a proportion of isolates are pathogenic. It is not regarded as a good competitor with other bacteria.

## GROWTH AND ITS CONTROL

### Growth:

Temperature: Range 0-44°C, optimum 28-29°C.

pH: The minimum pH for growth is in the range 4.2-4.8 depending on the temperature and the acidulant. Maximum pH around 10.0, optimum 7.2-7.4.

Atmosphere: Growth is retarded under vacuum packaging, 100% N<sub>2</sub>, and CO<sub>2</sub>/N<sub>2</sub> gas mixes, but the effect is more pronounced at refrigeration temperatures. For example growth on beef mince under 20% CO<sub>2</sub>:80% N<sub>2</sub> was much the same as under air at 15°C, but was completely inhibited at 1°C.

Water activity: Maximum a<sub>w</sub> = 0.945 (5% NaCl).

### Survival:

Temperature: Survived (numbers increased and then declined) for 64 weeks in spring water stored at 4°C. Readily withstand freezing.

pH: At pH values below those allowing growth, survival is greater at lower temperatures.

Water Activity: Survived well in soil maintained at its original water content, but reduced in number significantly when soil was allowed to air dry.

### Inactivation (CCPs and Hurdles):

Temperature: D<sub>55</sub> = approx. 2 min, D<sub>60</sub> = approx. 0.5 min, D<sub>65</sub> = approx. 2 sec. Pasteurisation is an effective heat treatment.

pH: At any given pH lower than that allowing growth the bactericidal activity of different acidulants was in the order acetic acid > lactic acid > citric acid > sulphuric acid. However, at 4°C D values are generally measured in days.

Water activity: 5-7% NaCl inhibits growth.

Preservatives: (NB: Some of the preservatives discussed here may not be permitted in New Zealand). Growth is retarded by potassium sorbate up to 5000 ppm at pH 6.5 in a dose-dependent manner. At pH 5.5 concentrations above 1000 ppm virtually eliminate growth or cause inactivation depending on dose.

Sodium nitrite at a concentration of 150 ppm

retarded growth on bologna. Sodium nitrate was less inhibitory than sodium nitrite and potassium nitrate when tested in pork mince.

Inhibited by some herb and spice extracts including cloves, allspice, sage, cinnamon, rosemary and oregano when present at 4.1-4.7%.

Lactate and ALTA 2341 (shelf life extender) lengthened lag times in poultry but effectiveness decreased as temperature increased.

Sanitisers/Disinfectants: Thought to be somewhat resistant to chlorine.

Radiation: D values (kGy) approx. 0.1-0.2 at 25°C, 0.4 at -30°C.

More sensitive to ultraviolet radiation than *E. coli* and commercial UV water treatment units producing 30 mWs/cm<sup>2</sup> are considered adequate.

## THE ILLNESS

**Incubation:** Approximately 7 days, range 1-11 days.

**Symptoms:** In adults: abdominal pain (which can be confused with appendicitis), headache, fever, diarrhoea, nausea, vomiting. In children: produces a watery/mucoid diarrhoea.

Self limiting, with symptoms abating after 2-3 days.

Extraintestinal infections occur rarely producing septicaemia and a number of other disease. These patients usually have pre-disposing conditions. Approximately 2/3 of cases report being ill for >1 week.

**Condition:** Yersiniosis. Hospitalisation rate estimates vary from 0.5-24%, case fatality rate estimates 0-0.5%.

**Toxins:** Toxins are not produced in foods by this organism.

**At Risk Groups:** There is a bimodal distribution by age with peaks in those aged 4 or less, and those in the 20-34 year age group. Males are affected more frequently than females.

**Long Term Effects:** Enterocolitis may persist for several months. Acute inflammatory, arthritic syndromes may develop 7-21 days after acute infection. Other symptoms such as urethritis and painful red skin lesions can occur, especially in adults.

**Dose:** Not known.

**NZ Incidence:** 13.9 cases/100,000 in 1999, 15.1 in 1998.

**Treatment:** Antibiotics do not reduce the severity or duration of the gastrointestinal illness, but are of use in more serious manifestations of the disease.

## SOURCES

**Human:** Person-to-person transmission can occur.

Transmission within hospitals has been documented.

**Animal:** Most associated with pigs, especially the tongue and tonsil area. Serotype O:3 is common in pigs in NZ. May also be carried by companion animals. Has been isolated from rats and insects. A NZ study failed to detect the organism in 100 ovine and 100 bovine carcass swabs. Transmission from animals to humans is suspected.

**Food:** The organism is associated with pork and pork products. Has been isolated from dairy products, fruit, vegetables, tofu, pastries and sandwiches. A New Zealand study detected *Y. enterocolitica* in 3.4% of 203 foods tested, but these included non-pathogenic types. The proportion of cases that are foodborne have been estimated at between 65 and 90%.

**Environment:** Waterborne transmission has resulted in disease, sometimes via contaminated food. Can be isolated from drinking and surface waters, as well as sewage sludge.

**Transmission Routes:** Ingestion of contaminated food is the primary route.

## OUTBREAKS AND INCIDENTS

Overseas Outbreaks: Dairy products are the food group most often associated with outbreaks.

**Chocolate milk:** 218 cases, 36 hospitalised, 16 appendectomies. Control measure failure: post pasteurisation contamination during addition of chocolate syrup.

**Pasteurised Milk:** 10 cases, 3 hospitalised, 1 appendectomy. Control measure failure: post pasteurisation contamination.

**Tofu:** 50 cases. Control measure failure: contamination of water used in production.

**Various foods (chow mein, reconstituted powdered milk):** 239 cases, 7 hospitalised, 5 appendectomies. Control measure failure: contamination of foods by food handler.

Epidemiological studies: An Auckland case control study identified more than two people living in a household as being associated with disease, while having a town water supply and reticulated sewage, as well as looking after a young child were protective factors. Pork was eaten more frequently by cases than controls, and cases ate more frequently at sandwich bars. Controls were higher consumers of smallgoods and bacon (i.e. these were protective factors).

In overseas studies disease has been associated with consumption of pork products, sausages, eating raw food or food cooked rare and the consumption of untreated water.

## 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, ham), fish, seafood	63°C	"
Poultry, breast	77°C	"
Poultry, whole	82°C	"
Hold foods at	≤ 5°C	up to 7 days
Hold foods at	≤ 7.2°C	up to 4 days
Reheat cooked foods to	74°C	Instantaneous
Avoid direct handling of food by infected food handlers		
Avoid post-processing contamination of ready-to-eat foods with long shelf lives		

## REFERENCES

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