VIBRIO VULNIFICUS

THE ORGANISM/TOXIN

An infrequent cause of disease in New Zealand, but has a high associated case fatality rate. It is a marine organism (grows in 6% NaCl) that can grow both in the presence and absence of air.

GROWTH AND ITS CONTROL

Growth:

Temperature: Optimum 37^{o}C, range 8-43^{o}C. In live oysters growth does not occur below 13^{o}C. Grows in oysters at 30^{o}C. The organism can grow in shellstock after harvest and so oysters need to be chilled as rapidly as possible to prevent this.

pH: Optimum 7.8, range 5-10.

Atmosphere: Grows in the presence or absence of air.

Water Activity: Optimum 0.98, range 0.96-0.997 (optimum 2.5% NaCl, range 0.5-5.0% NaCl).

Survival:

Temperature: May survive well under refrigeration by entering the VNC state in water. Survives quite well in oysters at 0-4^{o}C.

pH: Survives at pH 5 in artificial media of low salinity at 5 and 20^{o}C for 72h.

Viable but non-culturable (VNC) cells: There is now compelling evidence that vibrios can enter the VNC state. Resuscitation is achieved simply by raising the temperature of the VNC forms in suspension.

Inactivation (CCPs and Hurdles):

Temperature: Decimal reduction times are approximately 50 min at 45^{o}C and 10 sec at 51^{o}C.

A low temperature pasteurisation of 10 min at 50^{o}C has been suggested for shellstock oysters.

Freezing reduces the population in oyster tissue by 95-99%, but the surviving population remains fairly stable during frozen storage.

pH: D values at 21^{o}C are reported to be 30-50 min at pH 4.0, 1.5-4.5 min at pH 3.5 and 0.4-0.5 min at pH 2.0 (HCl was the acidulant used). Inactivation is likely to be slower at lower temperatures.

In oyster homogenates the D time at pH 6.2 and 40^{o}C is 12 min, and at 50^{o}C it is 2.7 min. When the pH is reduced to 4.6 the D time at 50^{o}C is 1.7 min.

Water activity: Is inactivated more readily in seawater at salinity levels higher or lower than seawater.

Preservatives: (NB: Some of the preservatives discussed here may not be permitted in New Zealand). Is inhibited by some, but not all, commercial liquid and solid smoke preparations. Numbers in shellfish exposed to seawater with 0.05% diacetyl reduced 10-100 fold after 2 days at 5^{o}C. The same effect was not shown for 0.05% lactic acid or butylated hydroxyanisole.

Hot sauces (e.g. Tobasco®) can reduce numbers on the surface, but not within the meat and so are not effective.

Radiation: A 1.0-1.5 kGy treatment for oysters has been proposed. This would inactivate the vibrios but leave the oysters alive. A dose of 2 kGy produced an approximate 10^{7}-fold reduction of *V. vulnificus* in frozen shrimps.

Raising the temperature can enhance the effect of radiation. For example raising the temperature from 25 to 40^{o}C had the effect of approximately halving the dose required to give the same kill.

Depuration: Ineffective. Relaying to higher salinity environments can result in a reduction in pathogen numbers.

THE ILLNESS

Incubation: Gastroenteritis may result 16 hours after consuming contaminated food. For the more serious forms of the disease the mean time for onset of symptoms is 38 hours after consumption, with a range of 12 hours to several days, and septicaemia may follow within 36 hours of the initial symptoms.

In wound infections the appearance of symptoms may be extremely rapid, e.g. 4 hours.

Symptoms: *Wound infections* causes swelling and tenderness of the affected limb. These account for about 45% of cases. Invasion of the blood stream (septicaemia) may follow wound infections.

Primary septicaemia follows the consumption of contaminated food. Death can occur rapidly in 50% of septicaemia cases, and in 25% of all wound infection cases. Initial symptoms include fever, malaise and chills. In 2/3 of cases skin lesions develop. Diarrhoea is rare in foodborne cases where these serious symptoms are manifest. These account for around 45% of cases.

Gastroenteritis alone may occur (accounts for only around 5-10% of cases). This is characterised by vomiting, diarrhoea or abdominal pain.

Hospitalisation occurs in around 91% of total cases.

Condition: Wound infections, gastroenteritis, primary septicaemia.

At Risk Groups: People with impaired liver function (e.g. alcoholics) or who are immunosuppressed are at risk groups for primary septicaemia. Of cases progressing to septicaemia 95% will have a pre-disposing condition. Wound infections may be acquired in people with normal immune systems. In the USA cases are mostly confined to the Gulf States where oysters are

harvested from warm waters. It is the leading cause of foodborne illnesses that result in death in Florida.

Long Term Effects: Surgery to save life may require limb amputation.

Dose: The dose for healthy people is unknown, but in at risk groups it may be less than 100 cells.

NZ Incidence: Not a notifiable disease. However two wound infection cases have been reported in New Zealand; one resulted in an amputation, the other case died. Four cases were reported in New South Wales between 1988 and 1995, two of which were fatal, and two of which involved oyster consumption. A non-fatal wound infection has been reported in Victoria, Australia.

Of 996 faecal samples from 715 cases of gastrointestinal illness in the Bay of Plenty only two samples contained *Vibrio*, and these were species other than *V. vulnificus*.

Treatment: Antibiotics (tetracycline alone or in combination with others) are used, treatment of symptoms is given and surgical removal of infected tissue or amputation may be necessary.

SOURCES

Human: No record of human carriage found.

Animal: Concentrated by filter-feeding marine life (e.g. mussels and oysters) growing in waters containing the organism. Has been isolated from shellfish in New Zealand.

Food: Contaminated seafood, e.g. shellfish and crustacea. Shellfish, primarily oysters, are considered to be the most significant food involved in foodborne infections as they filter feed and concentrate the organism. In the USA 95% of all seafood-related deaths are due to this organism. Oysters have been reported to contain $>10^5$ /g in the summer months.

Fish feeding on plankton and other fish may also contain high counts in their guts. This is possibly more important in Eastern countries where fish are frequently eaten raw.

Has not been reported in processed foods.

Environment: *V. vulnificus* is a normal inhabitant of the marine environment, but is only detected in large numbers when the seawater temperature rises above approximately 17^{o}C. At temperatures lower than this it enters the VNC state.

Transmission Routes: Infection can occur by three routes 1) ingestion of contaminated food 2) contact of an existing wound with seawater and 3) wound occurring in the marine environment.

OUTBREAKS AND INCIDENTS

Outbreaks: No major outbreaks have been reported. Most cases are sporadic.

Epidemiology: For foodborne disease; consumption of raw oysters harvested from warm waters and (usually) liver disease or impaired immune function.

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 to:	**Internal temperature reached**	**Time**
Fish, seafood	63^{o}C	15 sec
″	50^{o}C	10 min
Hold foods at	≤ 5^{o}C or ≥ 60^{o}C	
Reduce pH of seafood to ≤ 4.0 for 30-50 mins at 21^{o}C		
Ensure shellfish are harvested from approved shellfish gathering waters		
Avoid cross contamination from raw to cooked foods		

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