The Sea Fish Industry Authority

Seafish Technology

A Summary of the Illness Associated Organisms Which Can Affect Molluscan Shellfish Safety

Seafish Report No. IR1436

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Summary

This report outlines the illness associated organisms associated with bivalve molluscs. These agents are acquired from three sources:

1. Faecal pollution of the aquatic environment

2. The natural aquatic environment

3. Post harvest contamination

The report describes the main causative agents and the testing and control measures routinely adopted to protect the public. This report was originally written as an appendix to a report on the First International Conference on Molluscan Shellfish Safety, to provide background information on the illnesses discussed during the conference. This conference, at which Seafish presented a paper on some of their recent work on Mollusc Depuration, was held on the 14th-17th November 1994 at the University of New South Wales, Sydney, New South Wales, Australia.

1. Introduction

Bivalve mollusc's have the potential to transmit disease from viral and bacterial microorganisms and from toxin producing algae . These agents are acquired from three sources:

1. Faecal pollution of the aquatic environment
2. The natural aquatic environment
3. Post harvest contamination

A brief description of the main causative agents of molluscan associated illness and the testing and control measures routinely adopted to protect the public are outlined in the following summary.

2. Sewage Pollution Related Organisms

2.1 Bacterial Pathogens

Human illness caused by the consumption of molluscs contaminated by seawater polluted with bacterial pathogens has largely been stopped by a general decrease in the incidence of bacterial illness within the human population, the adoption of depuration technology to cleanse shellfish grown in mildly polluted waters and the closing of heavily polluted harvesting areas.

The coliform indicator used to define water and product quality is an indicator of bacterial and possibly viral human enteric pathogens. A problem with the coliform indicator is that it does not indicate the presence of non-sewage related naturally occurring bacterial pathogens such as *Vibrio*'s, also it does not correlate well with the presence of human enteric viruses, which are the pathogens now most commonly associated with sewage contamination of molluscs.

Another potential problem is that the microbial quality of harvest waters does not appear to be a good indicator of some bacterial pathogens such as nontyphoidal *Salmonella* contamination. In the US oysters removed from closed and open beds show the same level of contamination (4%), and no correlation was observed between the presence of *E.coli* and *Salmonella* in shellfish. However, *Salmonella* do not grow well in oysters during storage and are not retained during depuration or relaying so contaminated oysters can be purified.

The EU currently use the US end product standard to define our clean water category rather than the US water standard. The US standards are:

A mean level of 14 *F.Coli* MPN/100ML with <10% of samples exceeding 43 *F.Coli* MPN/100ML and an end product standard of 230 *E.Coli* MPN/100g of meat.

2.2 Viral Pathogens

The largest number of illnesses are reported from unknown etiologies clinically suggestive of Norwalk and Norwalk-like agents of human enteric viral gastroenteritis. The vast majority of these cases are associated with the consumption of raw mollusc's taken from harvest waters contaminated with raw or poorly treated human sewage.

Classification of molluscan growing waters based on valid human enteric virus indicators, as well as proper treatment and disposal of sewage are required to deter raw shellfish associated viral infections. Currently there is no accepted indicator for human viruses in shellfish or growing waters.

Depuration and relaying remove enteric bacterial pathogens and indicators from mollusc's. However, the depuration of some enteric viruses may be slow. *Hepatitis A* virus (HAV) persists far longer in oysters and clams than *E.coli*. Depurated mollusc's have been responsible for outbreaks due to enteric viruses.

Vital research is needed to develop an adequate viral indicator and (if possible) to develop enhanced depuration technology to reduce viral pathogens.

3. Naturally Occurring Marine Microorganisms

3.1 Bacterial Pathogens

The main pathogenic, free living, natural bacteria are of the *Vibrio* species. These are not generally associated with faecal contamination and their numbers tend to be higher in the warmer summer months. *Vibrio*'s are responsible for fewer cases of illness than viruses. However, as well as causing gastroenteritis some species are associated with high mortalities in people who are immunocompromised or have liver disease. *Vibrio vulnificus*, which is common in waters warmer than 20°C, has, in the US, killed 39 people between 1978 - 1987. Currently all shellfish harvesting in the southern US states is prohibited due to the severity of the problem with the death toll standing at 6.4 people per year in Florida state alone.

Testing for *Vibrio*'s is not a problem and research into removal of *V.parahaemolyticus* and *V.vulnificus* by depuration and relaying is ongoing. Depuration maybe possible but not within the 42 hour period currently used for bacterial removal.

3.2 Toxin Producing Algae

A number of species of algae produce toxins of one form or another. These algae are bioaccummulated by molluscs when algal blooms occur and the shellfish become toxic and remain toxic for several weeks after the bloom subsides. A number of different forms of poisoning have now been recognised :

PSP	Paralytic shellfish poisoning
DSP	Diarrhetic shellfish poisoning
NSP	Neurotoxic shellfish poisoning
ASP	Amnesic shellfish poisoning

There are currently no depuration methods for combating toxic algal bioaccummulation. However, there is scope for research in this field. The standard control measure is to not harvest/catch the shellfish until levels of the toxin have subsided naturally. This requires regular routine monitoring to ensure that the algal toxins are not present.

3.2.1 PSP

Paralytic shellfish poisoning results from the consumption of mollusc's that have bioaccummulated toxigenic dinoflagellates. The species of concern are *Gonyaulax catenella*, *G.tamarenses*, *Alexandrium minutum* and *Gymnodinium cateratum*. The cause of PSP is a complex of toxins known as saxitoxins which are neurotoxins. These are potentially life threatening however more usually cause tingling and numbness.

PSP can be tested for by Mouse bioassay, HPLC (high performance liquid chromatography), and ELISA (Enzyme linked immuno absorbent assays) tests. The latter method is not yet fully developed.

3.2.2 NSP

Neurotoxic shellfish poisoning or brevetoxic poisoning is caused by the red tide organism *Gymnodinium breve*. This causes respiratory irritation/gastroenteritis and is not usually fatal.

There is a mouse bioassay for NSP.

3.2.3 DSP

Diarrhetic shellfish poisoning is caused by *Dinophysis fortii, D.acuminata* and *Procentrum lima*. A number of toxins have been identified most commonly okadaic acid. Symptoms include diarrhoea, nausea and vomiting. This is not life threatening.

There is a mouse bioassay for DSP, HPLC can be used for okadaic acid determination.

3.2.4 ASP

Amnesic shellfish poisoning is the name given to the illness caused by consumption of domoic acid which is present in the diatom *Nitzschia pungens* and *N.pseudodelicatissima*. The symptoms of domoic acid poisoning are vomiting, diarrhoea, disorientation and memory loss. There have been reports of death in older people.

This can be tested for by HPLC.

4. Post Harvest Contamination

With live in-shell molluscan shellfish there is little risk of post harvest contamination as the shellfish are surrounded by their shell. They should, however, be kept away from possible sources of contamination such as dirty water, vessel bilges, seagulls, etc. The product should be kept in chill conditions at temperatures of <5°C. The main area of risk with in-shell product is if the shellfish are immersed in unsuitable conditions. Immersion should only take place in controlled conditions such as a purification plant.

Shucked molluscs should be handled in a hygenic manner and kept chilled to <5°C after processing to reduce the potential for bacterial growth.

Any cooking process which is used for molluscs should have control mechanisms to ensure that a 90°C core temperature is achieved for a minimum of 90 seconds to kill any viral organisms. Post cooking handling of the product should be kept to a minimum and temperatures should be held at below 5°C.

5. Conclusions

Faecal pollution can contribute viral and bacterial contaminants and is the primary source of infection. The natural aquatic environment is associated mainly with bacterial pathogens such as Vibrio's and toxin producing algae.

If growing, harvesting or catching molluscs the potential for mollusc associated illness needs consideration. Several factors need to be taken into consideration, including host risk factors, sources and types of microorganism, reduction potential by depuration or heat treatment procedures, processing and handling methods which can allow microorganisms to survive and grow prior to consumption.

The industry and also possibly the public must be made aware of all these factors . All products have different levels of risk which must be surveyed to monitor these risks adequately. The largest number of illnesses are clinically suggestive of Norwalk virus. Although these are the most common molluscan associated illnesses, they tend to be relatively mild with no associated mortalities. Other naturally occuring marine species are responsible for fewer reported cases of infections but can have more serious consequences so should not be overlooked.