Sanitary Testing of Molluscan Shellfish

Background
Commercially marketed molluscan shellfish in Canada are monitored for the presence of pathogenic microorganisms and other agents which could potentially affect the health of consumers. Prince Edward Island shellfish which include blue mussels, oysters, quahaug, soft-shell clams, and bar clams have a reputation of being safe and of consistently high quality. It is very important to the shellfish industry that this reputation is maintained.

Molluscan shellfish feed by filtering suspended food particles from the waters in which they grow. The filtered material may include bacteria and viruses that have potential to cause disease in humans. These bacteria and viruses may occur naturally in the environment or their presence may be a result of sewage contamination.

There are documented cases of diseases in humans resulting from the consumption of contaminated molluscan shellfish. Some of the more well known pathogens that have caused disease in humans include: *Salmonella* (including *S. typhi* and *S. paratyphi* agents of typhoid fever), *Shigella*, *Campylobacter*, enteropathogenic *Escherichia coli*, *Vibrio* and viruses such as, *Hepatitis A*, and the Norwalk-like viruses. *Vibrio* species, with the exception of sewage associated *Vibrio cholera*, occur naturally in sea water environments and can live as normal flora in molluscs. Only a few of these *Vibrio* species are pathogenic to humans.

Rationale for Testing
Molluscan shellfish are often eaten raw or under-cooked, therefore it is important to ensure that the product purchased by the consumer is free of pathogenic organisms. Unfortunately, it is difficult to test for a specific pathogenic organism which may be present in a water sample or molluscan tissue sample. Some pathogenic organisms are very difficult to grow on culture media. Consequently, responsible authorities (e.g., Environment Canada, Canadian Food Inspection Agency (CFIA) test for the presence of indicator organisms, rather than the actual pathogens. The indicator organisms currently used to determine the sanitary quality of water and molluscan shellfish belong to the coliform group of bacteria. Historically, the coliform group has been considered a good indicator of sewage pollution, since it contains bacteria primarily found in the intestinal tracts of warm-blooded animals. The coliform group, however, includes bacteria belonging to other genera, not all of which are faecal in origin. For example, some organisms like *Klebsiella*, *Citrobacter* and *Enterobacter* may be found in plants and soils and are common in surface run-off as well as faeces. Since the coliform group contains bacteria from both faecal and non-faecal origins, tests were developed to isolate a more specific sub-group of coliform bacteria, known as faecal coliforms.

Bacteriological Tests and Procedures
The multiple tube fermentation technique is most commonly used to estimate bacterial numbers in seawater and shellfish. This technique uses the principle of dilution to extinction to estimate the number of bacteria in a sample. Decimal dilutions of the sample are introduced into replicate tubes of a medium designed to select for growth of a particular organism being enumerated. Thus it reasonably can be assumed that the maximum dilution at which growth occurs represents a volume containing a single organism. The results of such analysis are expressed in terms of the Most Probable Number (MPN). This represents an estimate based...
on probability formulae. Bacterial water quality standards, based on faecal coliform levels, as determined by the MPN method, are presently used for the classification of shellfish growing waters, depuration effectiveness, and verification of shellstock in conditionally approved areas. Bacteriological shellstock count standards based on \textit{E. coli} levels are presently in use for the evaluation of a processing plant’s Quality Management Program (QMP). The classifications presently used to describe water quality conditions in shellfish growing waters are \textbf{approved, conditionally approved and closed} areas.

\textbf{Maximum Levels}

Domestic shellfish, whether fresh or frozen, are considered satisfactory when they are harvested from an approved or conditionally approved area and the \textit{E. coli} (for end-of-line product) or faecal coliform (product prior to processing) counts conform to the Canadian Food Inspection Agency’s, \textit{Bacteriological Guidelines for Fish and Fish Products}. The current bacteriological guidelines for fish and fish products and guidelines for depuration, relaying, overlay waters and a processing plant’s QMP appear in the following web sites:

\url{www.inspection.gc.ca/english/anima/fispoi/guide/bace.shtml}
\url{www.inspection.gc.ca/english/anima/fispoi/manman/cssppccsm/append3e.shtml}
\url{www.inspection.gc.ca/english/anima/fispoi/manman/cssppccsm/chap2e.shtml}

\textbf{Administration}

In 1948, Canada signed a bilateral agreement with the United States to guarantee the quality of shellfish products prior to export. The standards and protocols developed from this agreement form the basis of the Canadian Shellfish Sanitation Program (CSSP). Under the terms of a Memorandum of Understanding (MOU), Environment Canada is the lead agency responsible with regards to water quality and classification of shellfish growing areas. This is accomplished through comprehensive sanitary and bacteriological surveys of molluscan shellfish growing areas. In PEI, the Department of Environment, Energy and Forestry collects and analyzes water samples under an MOU with Environment Canada. Water quality and classification of shellfish growing areas are discussed by the PEI Shellfish Working Group which includes industry, provincial and federal government departments and stakeholders. Following these discussions, Environment Canada recommends to the Atlantic Shellfish Area Classification Committee the specific classification of shellfish growing areas and their boundaries. A shellfish classification map index for Prince Edward Island is found in the following website: \url{www.ns.ec.gc.ca/epb/sfish/maps/pei/pei.html}

DFO may have additional temporary closures in place periodically due to elevated biotoxin levels, CFIA shellfish stock monitoring results, unscheduled sewage discharges or conservation purposes. These periodic closures are not shown on the Environment Canada maps. It is recommended that people contact their local Department of Fisheries and Oceans (DFO) office before harvesting shellfish for human consumption. DFO is the lead agency with regards to enforcement of regulations for shellfish relays, depuration of contaminated shellstock and harvesting of shellfish from classified areas. The handling, processing, marketing and export of shellfish is the responsibility of the Canadian Food Inspection Agency.

\textbf{For further information contact:}

Neil MacNair, Aquaculture Biologist
PEI Department of Agriculture, Fisheries and Aquaculture
Fisheries and Aquaculture Division
PO Box 2000
Charlottetown, PEI C1A 7N8
Tel: (902) 368-5615
ngmacnair@gov.pe.ca
\url{www.peifarm.ca}