Norovirus (and bivalve molluscs)

What is norovirus?

Noroviruses are a group of viruses that are the most common cause of gastroenteritis or stomach bugs, and are often referred to as the ‘winter vomiting virus’. It is estimated that norovirus affects between 600,000 and one million people in the UK each year.

Noroviruses are highly contagious - as few as 10 viral particles may be sufficient to infect an individual. When a person becomes infected with norovirus, the virus begins to multiply within the small intestine. After approximately 12h to 2 days, norovirus symptoms can appear. These include diarrhea, nausea and vomiting. If dehydration is not treated, the very young and those people whose immunity to infection has been compromised are most affected.

Norovirus is easily transmitted from one person to another. In the UK, the spread of norovirus is by:

- person-to-person transmission
- food borne transmission via salads, fruit and vegetables (raw, ready-to-eat food group involving commercial food handlers)
- food borne transmission via ‘ready to eat’ bivalve shellfish (mainly contaminated raw oysters)

What is the risk of norovirus from eating live bivalve molluscs?

The number of people in the UK who contract norovirus from eating live bivalve molluscs is relatively very small.

New figures for England and Wales released by the UK Health Protection Agency (HPA) show that over the last nine years they have received notification of 679 outbreaks of Infectious Intestinal Disease (IID). Of these, 68 were norovirus outbreaks with 25 attributed to live bivalve molluscs. The table also shows increased incidence in 2009.

<table>
<thead>
<tr>
<th>Year</th>
<th>All Foodborne Outbreaks (IID)</th>
<th>Foodborne Norovirus Outbreaks</th>
<th>Norovirus Outbreaks from Bivalves</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>98</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>2001</td>
<td>91</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>2002</td>
<td>71</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>2003</td>
<td>71</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>2004</td>
<td>56</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2005</td>
<td>81</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>2006</td>
<td>59</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2007</td>
<td>42</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2008</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2009*</td>
<td>95</td>
<td>14</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>679</td>
<td>68</td>
<td>25</td>
</tr>
</tbody>
</table>

Source: eFOSS database April 2010  See: www.hpa.org.uk

Food borne transmission via bivalve shellfish (mainly contaminated raw oysters) is one (but the least likely) way of contracting norovirus. Although the risk may be considered to be low, bivalve molluscs should only be commercially harvested from approved production areas.

This fact sheet looks specifically at the harvesting of live bivalve molluscs, routes of norovirus contamination and treatment options available to reduce contamination levels.
ASSESSING THE RISK

Viruses undergo genetic change by several mechanisms and there are many different ‘types’ or ‘strains’ of norovirus. The different ‘strains’ of norovirus are grouped as Genotype I and Genotype II. Whilst the Genotype I norovirus is thought to be as common as Genotype II, it is Genotype II which is thought to cause 90% of outbreaks.

Until very recently, it was not possible to quantify the actual number of viral particles in a sample of mollusc flesh. This is now changing and modern techniques, including polymerase chain reaction (PCR), can give precise numbers of viral particles in a sample. Unfortunately, science cannot tell us yet whether the virus particles detected are viable and able to infect a human or not.

Complex equipment and skilled personnel are required to estimate the total number of virus particles in a sample. It can be expensive, at about £190 a sample. It is also difficult to quantify how representative the sample is – it could represent 25 oysters, 2,500 animals or 3 days harvesting.

End Product Testing

Seafish has been advised that any laboratory used for enumeration of norovirus should follow the methodology outlined in the following three documents, ensuring appropriate quality control is in place.


A CEN standard method for the detection of viruses in food is under development.

Norovirus and live bivalve molluscs

Bivalve molluscs which include oysters, mussels, clams, cockles and scallops are filter feeders so they are susceptible to picking up and accumulating toxins or microbiological contaminants, including noroviruses from their environment. Live bivalve molluscs have a unique ability to consolidate and retain substances from the water in which they grow.

For live bivalves the theoretical route of infection is when faeces contaminated with norovirus from infected individuals enter the sea. Bivalves then filter the contaminated seawater and accumulate norovirus particles and retain them in their intestinal tract. When infected bivalves are consumed, without first being heat treated, the route of infection is complete.

Classifying harvesting waters

Currently an E. coli assessment is used to estimate the risk of faecal contamination in a shellfish harvesting area. However there is not a clear relationship between E.coli and norovirus. This means that the E.coli value may be low but the level of norovirus can be low or very high. It is very difficult to predict
the expected viral load in live bivalve molluscs.

Whilst there are no current plans to use norovirus to determine the classification of shellfish harvesting waters, from an industry perspective it will soon be possible for the regulator to carry out a survey to determine the level of norovirus contamination in oyster harvesting grounds.

Factors that affect levels of contaminants in mollusc flesh

Environmental conditions, the time of year and the quantity of faecal contamination discharged into a coastal area all affect the ability of the molluscs to filter seawater and retain virus particles:

Seasonal effects

Different species of bivalve mollusc have different rates of filtering for a given temperature. Generally the warmer the water the greater the amount of water filtered by the animal and the higher the risk of potential contamination. Other environmental factors will influence the respiration rate or filtering activity of the mollusc including salinity and dissolved oxygen. Even different individuals of the same species in the same small area can behave differently. This makes it even more difficult to predict the effect of the seasons or weather conditions on the accumulation rate of viruses by molluscs. There is an increased incidence of norovirus found in mollusc flesh in the winter months. This could be due to a number of factors:

1. The amount of norovirus in the human population has been reported as greater in the winter months.

2. Bivalve molluscs have a remarkable ability of being able to accumulate, and in some cases retain contaminants for long periods of time. In winter months they may filter and retain virus particles at a slower rate than during the summer, but will take a great deal longer in winter to clear their intestinal tract of a contaminated meal, than in summer.

3. Sunlight kills viruses so less sunlight in the winter may aid the survival of the norovirus particles in the coastal zone.

4. Generally there can be increased rainfall and stormwater overflows during the winter. This coincides with the time of increased levels of gastroenteritis in the community.

Sewage treatment

The quantity of faecal contamination discharged into a coastal area and whether it is treated or not may be important considerations in evaluating the potential risk to human health. There are generally three levels of sewage treatment:

1. **Primary** – crude sewage passes into tanks where the majority of solids settle and the liquid moves on. At some stage solids may be removed for further treatment or disposal.

2. **Secondary or biological treatment** - where settled sewage flows into an oxygen rich environment that allows beneficial microorganisms to remove and oxidize many pollutants.

3. **Tertiary** - where specific pollutants are removed using methods such as filters, reed beds or U.V. lamps. The better the sewage treatment prior to any discharge to sea the better. However, even with the best (tertiary) treatment plant available, the effluent can still be discharged in a raw or highly contaminated state when
when high rainfall occurs. It is not always possible to fund and build sufficient holding tanks for storm conditions. Therefore, adequate sewage treatment can only be expected to reduce the level of norovirus discharged to sea in reasonable weather conditions.

Although the quality of coastal water (and water classification) is outside the control of the bivalve shellfish gatherers or producers, they can help to control the risk of norovirus getting into the food supply chain.

**Treatment options to reduce contamination levels**

Consumption of live or raw oysters that are not heat treated is a higher risk food product than any cooked mollusc dish. There are methods that can be used to kill the virus.

**Heat Treatment**
Norovirus heated to 60°C for 30 minutes remained infectious for volunteers. EU legislation gives guidance on this by specifying that shellfish should be heated to an internal temperature of 90°C for 90 seconds to produce a safer seafood product. Freezing is unlikely to inactivate norovirus.

**Purification Technology**
Holding live bivalve molluscs in good quality water in controlled conditions (tanks) may help to reduce the total viral load, but there are no indications that the current minimum time of purification at 42 hours is sufficient to clear all viral contamination. Should there be any suspicion that norovirus is present in harvesting waters, the duration of the purification period should be extended and the temperature of the seawater in the tanks elevated to as high as 18°C for oysters.

Using bacteriophage as an indicator of viral contamination suggested that holding the animals for 4 or 5 days at elevated temperatures may eliminate a viral threat to consumers from ready-to-eat oysters. One of the reasons for the relatively low levels of contaminated oysters originating in the UK may be partially because of the insistence of purification for all oysters harvested from category ‘B’ waters.

**Summary**

- You can get norovirus from eating contaminated food including shellfish. Bivalve molluscs filter norovirus from the water in which they grow.
- Bivalve molluscs should only be commercially harvested from approved production areas, which are monitored to ensure they meet strict toxin and microbiological criteria.
- Depuration may reduce some norovirus load, although the current minimum 42 hour purification time will not completely remove norovirus.
- It is now possible to quantify the number of norovirus in mollusc flesh.
- The quality of coastal water is outside the control of the bivalve shellfish gatherers or producers. However, heating molluscs to 90°C for 90 seconds may inactivate the virus.

If you have any doubts do not harvest and seek advice.