Investigation into the prevalence, distribution and levels of norovirus titre in oyster harvesting areas in the UK

Area of research interest: Foodborne pathogens
Study duration: 2008-09-01
Planned completion: 1 August 2011
Project code: FS235003 (P01009)
Conducted by: Centre for Environment, Fisheries and Aquaculture Science (Cefas)

Background

Contamination of bivalve shellfish with norovirus (causing gastroenteritis) is recognised as a major human health risk associated with the consumption of contaminated shellfish. Risk assessment and management relies on E. coli levels as an indicator of faecal (sewage) contamination in shellfish. However this is considered to be inadequate in determining the risk from human enteric viruses such as norovirus. There is currently a lack of quantitative data on the prevalence, distribution and levels of norovirus in oysters and oyster production/harvesting areas within the UK.

Over recent years considerable progress has been made towards the development of sensitive molecular methods (PCR) to detect norovirus in shellfish. The Centre for Environment, Fisheries and Aquaculture Science (Cefas) has developed a quantitative method for detection of norovirus in bivalve shellfish which targets the shellfish digestive glands (hepatopancreas), based on the CEN draft standard for detection of viruses in food.

The systematic surveillance data generated will be used to develop the Agency's policy on virus contamination of bivalve shellfish and contribute to an EFSA review of data on norovirus in oysters expected to inform further discussions in Europe.

Research Approach

This study applied a standardised, quantitative norovirus detection method to provide monthly surveillance data on up to 50 representative oyster harvesting locations across the UK over a 2 year period. A range of sites was selected based on relative risk of norovirus contamination according to pre-defined criteria. All samples will also be tested for E. coli as a generalised indicator of faecal contamination. In addition, pairs of sewage samples (crude and treated) from a sewage treatment works that potentially impacts on the selected oyster sites were collected fortnightly and tested for norovirus using an adapted CEN/ISO detection method.

Results

Norovirus was detected in 76.2% (643/844) of samples tested, with similar prevalence in the 2 species of oyster tested; 76.1% (468/615) for Pacific oysters (Crassostrea gigas) and 76.4%

(175/229) for native oysters (Ostrea edulis). There was a marked seasonality with a positivity rate of 90% (379/421) for samples taken between October and March compared with 62.4% (264/423) for those taken between April and September.

Quantification of norovirus positive samples revealed that 52.1% (335/643) were below the limit of quantification (<100 copies/g) for both norovirus GI and GII. However 1.4% (9/643) of the positive samples contained norovirus levels >10,000 copies/g. As with prevalence, average quantities varied between seasons, with the highest levels detected between December and March and lowest recorded between May and August. Levels of norovirus GII were on average higher than those for GI.

In all, 39 sites were tested and each site provided at least one norovirus positive result, although prevalence varied from 21% (5/24 samples) to 100% (20/20 samples). Norovirus levels also varied between sites with some sites scoring consistently >1,000 copies/g during the winter while others rarely or never exceeded 100 copies/g.

The study also examined relationships between norovirus contamination and potential risk factors. A statistically significant correlation between norovirus levels and harvesting areas classification was observed. Furthermore a significant correlation was found between E. coli and norovirus levels on a production site basis rather than by sample. This finding supports the use of E. coli as an indicator organism for classification purposes. Correlations between norovirus contamination and environmental temperatures were also found with higher prevalence and levels of norovirus associated with colder temperatures. There was a correlation with both national average air temperatures (as reported by the Met Office) and with local water temperatures in the majority of cases on a site-by-site basis.

The data generated from this study provides a systematic analysis of norovirus contamination in classified oyster production areas in the UK and will help to inform risk management strategies and support development of a future EU standard for norovirus in live bivalve molluscs. The data has also been submitted to EFSA to inform an opinion on ‘norovirus in oysters: methods, limits and control options’ due to be published on 31 December 2011. This UK data is considered by European experts to be among the best available and is of particular value to EFSA.

Published Papers

1. Lowther, J.A., Gustar, N.E., Hartnell, R.E. & Lees, D.N. (2012) Comparison of norovirus RNA levels in outbreak-related oysters with background environmental levels. Journal of Food Protection, 75(2), 389-393 doi: org/10.4315/0362-028X.JFP-11-360

Final reports

England, Northern Ireland and Wales

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