Information Statement

Institute of Food Science & Technology Trust Fund

Foodborne Viral Infections

The Institute of Food Science & Technology has authorised the following Information Statement dated April 2008, which replaces the version issued in March 2002

SUMMARY

Foodborne viral infections are caused mainly by two types of virus, norovirus (formerly named as Norwalk-like viruses (NLV) or small round structures viruses (SRSVs)) which cause gastroenteritis and Hepatitis A virus which causes hepatitis. All foodborne viruses originate from the human intestine and contamination of food occurs either by contamination from an infected food handler during preparation or by contact with sewage, sewage sludge or polluted water. Control measures mainly depend on staff education and good factory and kitchen hygiene; food handlers suffering from symptoms should be excluded from work immediately and all staff made aware of the ease with which viral contamination is transmitted. The use of clean water for irrigation of crops that are likely to be eaten raw and cultivation of molluscan shellfish in sewage-free seawater are also essential to prevent viral contamination of food.

THE PROBLEM

Foodborne viruses are a common and, probably, the most under-recognised cause of outbreaks of gastroenteritis. Human infection can occur following consumption of contaminated food, person-to-person body contact, or release of aerosols. Food may be contaminated by infected food handlers or by contact with water contaminated by treated or untreated sewage. Outbreaks of viral foodborne illness have been associated with the consumption of shellfish that have been harvested from sewage-polluted waters. The greatest risk of foodborne illness occurs with catering operations preparing ready to eat foods, although foodborne spread is difficult to prove.

VIRAL FOODBORNE ILLNESS

The types of foodborne virus fall into two main groups:

(1) Norovirus (formerly named Norwalk-like viruses (NVLs) or small round structured viruses (SRSVs)) which cause gastroenteritis;

(2) Hepatitis A virus, which causes hepatitis.

5 Cambridge Court, 210 Shepherds Bush Road, London W6 7NJ
Telephone: 020 7603 6316 **Fax:** 020 7602 9936 **Email:** info@ifst.org **Web:** www.ifst.org

Norovirus

Illness caused by norovirus is usually sudden in onset and characterised by vomiting, diarrhoea and abdominal pain. Vomiting frequently occurs without warning and may be projectile and uncontrollable, whilst diarrhoea may be explosive. The incubation period is usually 24 - 36 hours after eating an implicated food but may be from 15 - 72 hours, depending on the number of virus particles consumed. The duration of the symptoms varies from 12 - 72 hours but, after the initial uncontrollable onset, the symptoms may be relatively mild. Despite this, sufferers may feel debilitated for 2-3 weeks.

Very few virus particles are needed to cause illness, so the attack rate in an outbreak can be very high, with the majority of people who ate the contaminated food becoming ill. Because the viruses multiply in the gut, a very large number of virus particles are excreted during the illness (often more than 10 million per gram of faeces or vomitus). As a result of the uncontrollable nature of the symptoms, food can easily become contaminated by infected food handlers and secondary person-to-person spread is also common.

Hepatitis A

Viral hepatitis has a long incubation period of 3 - 6 weeks, with symptoms developing gradually. Symptoms include loss of appetite, malaise, fever and vomiting, followed by jaundice. Illness usually lasts a few weeks but may last several months, and is usually more severe in adults than in children. Death may occur, particularly in the elderly, but is very rare. Large numbers of virus particles can be shed in the urine and faeces during the latter part of the incubation period, before jaundice is apparent, but they are usually absent one week after the onset of jaundice.

SOURCE

Viruses require a host in order to multiply, and the original source of all foodborne viruses is the human intestine. They cannot grow in food. Contamination of food may occur either during preparation and serving by infected food handlers or by contact with sewage or sewage-polluted water.

The main food type associated with foodborne viruses is molluscan shellfish such as oysters, cockles and mussels, which are usually found in shallow coastal or estuarine waters, commonly near sewage outlets. These shellfish are filter feeders that can concentrate virus particles from the surrounding water. Molluscs are either eaten raw or after a mild heat process, which if poorly controlled may not inactivate virus particles present. Shellfish harvesting areas are classified according to the level of faecal indicator bacteria present in the shellfish flesh; if the levels exceed the specification for direct consumption, the shellfish must be relayed in cleaner water, receive an approved heat treatment or undergo a purification process (depuration) before sale. However, depuration cannot be guaranteed to remove viruses, and outbreaks of viral gastroenteritis have been attributed to depurated shellfish. Cultivation of molluscan shellfish in water protected from sewage contamination is therefore paramount in the control of viral infection.

Although molluscs are the most clearly implicated source of foodborne viral illness, they do not necessarily cause most illness.

Fruit and vegetables may act as vehicles of infection if fertilized with sewage sludge or irrigated with sewage-contaminated water. Guidelines issued by the World Health Organisation (WHO) state that fruit and vegetables intended to be eaten raw should not be fertilized with sewage or irrigated with contaminated water. Apart from an outbreak of Hepatitis A resulting from contaminated soft fruit, there are no proven outbreaks associated with contamination of these foods at source. Control of sewage sludge application to land is important to prevent viral (and other pathogens) being recycled to affect human and animal health. In the UK, the Sewage (Use in Agriculture) Regulations 1989 are designed to protect the environment and human and animal health where sewage sludge is used on agricultural land. A “Safe Sludge Matrix” (ADAS, 2001) recommends the minimum time periods between the application of sludges to land and its use for food production and includes a table of crop types, together with clear guidance on the minimum acceptable level of treatment for any sewage sludge (often referred to as biosolids).

Contamination of food by infected food handlers is an important cause of viral foodborne illness. Food items such as salads and dessert dishes that receive considerable handling during preparation and are not given any further heat treatment before consumption are often implicated in foodborne viral outbreaks. Consumption of contaminated water and ice, or their use in food preparation, has also caused viral illness.

DETECTION

Detection of viruses in food has not been considered possible in a routine laboratory because of their requirement for a living host or animal tissue for growth. In addition, the level of virus particles in a contaminated food is usually very low. Specialist laboratories may achieve detection using cell culture and complex extraction methods but techniques previously available are not suitable for routine application and recovery rates remain poor. The use of the polymerase chain reaction (PCR) is being developed for detection of norovirus in foodstuffs implicated as the source of outbreaks. A recent method, said to give results in under 4 hours, involves recirculating-IMS linked to PCR (paper on inter-laboratory trials awaiting publication).

Methods currently used for routine detection of NLVs in faeces are based on immunoassays and PCR. Ideally, samples should be collected within 48 hours of the onset of symptoms since these contain the greatest levels of the virus. Use of this PCR test enables the detection of more than 90% of NLV infections and also allows characterization of the strains.

Detection of Hepatitis A virus in faeces is not usually possible because, by the time jaundice occurs, the peak of excretion of virus particles has passed. Diagnosis is based on detection of specific IgM and IgG antibodies in the blood serum or saliva.

SURVIVAL CHARACTERISTICS

Foodborne viruses are hardy and may survive for prolonged periods in foods or the food handling environment as well as persisting in aquatic environments. They are highly resistant to chilling, freezing, preservatives and ionising radiation. Hepatitis A virus and norovirus have both been shown to survive 60°C for 10 minutes. However, inactivation of

these viruses occurs at temperatures above 65°C at a rate proportional to the temperature but also depends on the composition of the medium. Both agents are killed by boiling. They are resistant to acidic conditions (pH 3) and can therefore survive on acid fruits such as strawberries and raspberries and in processes such as pickling in vinegar or yogurt production. They are also resistant to alcohol and high sugar concentrations.

MANAGEMENT OF FOOD HANDLERS

Food handlers suffering from vomiting or diarrhoea should be excluded from work immediately. They should not return to work until at least 48 hours after cessation of symptoms. After the initial onset of symptoms, although infection may appear to be sufficiently mild to enable the food handler to continue working, this must be prevented since even very low numbers of norovirus can result in illness if transferred to the food. Prevention of foodborne viral illness requires good staff supervision and food handlers should be encouraged to report symptoms of illness as soon as they occur. Staff should also be made aware that they could transfer viral contamination to food via hands and clothing following contact with an ill family member. There is no carrier state associated with norovirus although some patients, particularly children, may be asymptomatic. .

Hepatitis A is mainly spread by person-to-person transmission but can be spread by food handlers. Cases of viral hepatitis are most infectious before jaundice is apparent, but exclusion of food handlers from work for one week after the onset of jaundice is recommended. There is no chronic carrier state. If food handlers are exposed to Hepatitis A, those shown not to be immune by antibody testing may be vaccinated or given prophylactic human normal immunoglobulin by injection. Children can show very mild or asymptomatic infection.

CONTROL

Shellfish are an important cause of viral gastroenteritis. Cultivation in clean waters is very important, as depuration procedures may not be effective in eliminating viruses. Heat treatment to an internal temperature of 85°C - 90°C, maintained for 90 seconds, is required to destroy viruses in molluscs but careful control is necessary to achieve this without toughening of the shellfish flesh. Consumption of uncooked molluscs such as oysters remains a risk, as is cross-contamination from contaminated shellfish to other food in the kitchen.

Contamination of foods other than shellfish will normally occur on the surface of the food, where viruses will be more susceptible to heat treatment. Heat processes commonly used in the food industry, such as heating to a core temperature of 70°C for two minutes, will significantly reduce the level of virus contamination but may not destroy all the viruses if the contamination level was very high.

The number of virus particles required to cause infection is very low. Contamination of food with norovirus by infected food handlers and person-to-person spread occurs easily due to the very large numbers of virus particles present in the stools and vomitus at the onset of symptoms, and to the survival characteristics of the viruses. Infection of personnel may take place by aerosol inhalation and subsequent ingestion as well as the hand-to-mouth route.

Thorough hand washing with soap and warm running water and drying with disposable towels or air hand dryers are essential to minimize spread of contamination.

If vomiting has occurred in the kitchen or factory, a rigorous and appropriate disinfection for viral decontamination of the environment must be implemented. This is best achieved by cleaning, using hot water and detergent, followed by disinfection with a chlorine-based disinfectant at a concentration of 500 ppm available chlorine. Food that may have been exposed to aerial contamination or handled by the ill person should be destroyed unless it is to be heated above a core temperature of 85°C following exposure. If contaminated food is not destroyed, cross-contamination and re-infection may occur. Any soiled clothing should be rinsed to remove gross contamination, preferably into the toilet bowl, and then laundered in a domestic or commercial washing machine with a hot cycle (above 85°C).

OTHER FOODBORNE VIRAL INFECTIONS

Norovirus is not the only virus that can cause diarrhoeal illness. Although many of these viruses are transmitted via person to person, especially during childhood, they can also be transmitted via food handlers as well as by sewage contamination of drinking water, shellfish, fruit, vegetables and salad products. These viruses include aichivirus, rotavirus, sapovirus, parvovirus and astrovirus. As with norovirus, there is, to varying degrees, evidence for environmental robustness which allows survival on dry surfaces, in food matrices and in water (including sea water). However, all are killed by boiling.

Hepatitis A virus is not the only cause of foodborne hepatitis, which can also be caused by Hepatitis E virus. The clinical features of infection are similar to Hepatitis A, although the incubation period for infection is often longer (mean 40 days, range 15 - 60 days) and the disease is more severe. The case fatality rate is 0.1-1%. Hepatitis E can cause life-threatening infections in women in the later stages of pregnancy, with case fatality rates approaching 20%. The incidence of Hepatitis E is highest in developing countries in tropical or subtropical areas of the world with inadequate environmental sanitation. Most disease presents as endemic or sporadic cases although major epidemics do occur affecting tens of thousands of patients. The primary source of Hepatitis E infection appears to be faecal contamination of water and epidemic outbreaks are often preceded by periods of heavy rain which lead to contamination of water supplies with untreated sewage. Food-borne transmission occurs uncommonly and person-to-person transmission is rare. Hepatitis E infections do occur in developed countries and, although usually associated with travel to endemic regions, recent studies have identified cases with no history of recent foreign travel (termed **autochthonous),** often with links to either contact with pigs or the consumption of pig meat. Certainly, Hepatitis E is endemic in British pigs and several human cases have been shown to be infected with virus strains similar to those found in pigs.

IMPLICATIONS FOR THE FOOD INDUSTRY

The prevention of foodborne viral illness depends on the quality of raw materials, staff education and a high level of awareness in the manufacturing and catering industries. If payment is withheld during sickness, staff will be reluctant to cease working when symptomatic. However, the cost of sickness benefit is minimal compared with the potential costs incurred as a result of a foodborne outbreak.

FURTHER READING

ADAS (2001). "Safe Sludge Matrix" 3rd Ed.
http://www.adas.co.uk/media_files/Publications/SSM.pdf

Carter MJ. (2005). Enterically infecting viruses: pathogenicity, transmission and significance for food and waterborne infection. J App Microbiol; 2005; 98:1354-80.

Regulation (EC) No 853/2004 laying down specific hygiene rules for food of animal origin, Annex III, Section VII. OJ L226: 25.6.2004, pp22-82 (as amended). http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2004R0853:20070101:en:pdf

Koopmans, M and Duizer, E. "Foodborne viruses: an emerging problem?" ILSI Europe (Sept 2002). http://europe.ilsi.org/publications/Report+Series/FoodborneViruses.htm

Mara, D. and Cairncross, S. (1991). Guidelines for the safe use of wastewater and excreta in agriculture and aquaculture. WHO: Geneva.
www.who.int/water_sanitation_health/medicalwaste/130to134.pdf

Viral Gastroenteritis Sub-Committee of PHLS Virology Committee (1993). Outbreaks of gastroenteritis associated with SRSVs. PHLS Microbiology Digest **10:** 2-8.

Working Party of the PHLS Salmonella Committee (1995). The prevention of human transmission of gastrointestinal infections, infestations, and bacterial intoxications. Communicable Disease Report **5**: Review No.11, R158 - R172.
www.hpa.org.uk/CDR/archives/CDRreview/1995/cdrr1195.pdf

UK Statutory Instrument 1989 No. 1263. The Sludge (Use in Agriculture) Regulations 1989. HMSO, London. http://www.opsi.gov.uk/si/si1989/Uksi_19891263_en_1.htm

---

The Institute of Food Science & Technology (IFST) is the independent professional qualifying body for food scientists and technologists. It is totally independent of government, of industry, and of any lobbying groups or special interest groups. Its professional members are elected by virtue of their academic qualifications and their relevant experience, and their signed undertaking to comply with the Institute's ethical Code of Professional Conduct. They are elected solely in their personal capacities and in no way representing organisations where they may be employed. They work in a variety of areas, including universities and other centres of higher education, research institutions, food and related industries, consultancy, food law enforcement authorities, and in government departments and agencies. The nature of the Institute and the mixture of these backgrounds on the working groups drafting IFST Information Statements, and on the two Committees responsible for finalising and approving them, ensure that the contents are entirely objective. IFST recognises that research is constantly bringing new knowledge. However, collectively the profession is the repository of existing knowledge in its field. It includes researchers expanding the boundaries of knowledge and experts seeking to apply it for the public benefit.

Competence, integrity, and serving the public benefit lie at the heart of IFST philosophy. At all times IFST aims to:

- Benefit the public supply of safe, wholesome, nutritious, tasty and attractive food through the application of sound science and technology;
- Improve public knowledge and awareness of important issues relating to the supply, production, safety and quality of food;
- Develop and communicate the knowledge underlying food science and technology, and further the education of food scientists and technologists;
- Safeguard the public by defining, promoting, and upholding professional standards of competence, integrity and ethical behaviour; and
- Maintain these standards by encouraging members to continue their professional education and development throughout their careers.

In serving the public benefit IFST takes into account the many elements that are important for the efficient and responsible supply, manufacture and distribution of safe, wholesome, nutritious, and affordable foods with due regard for the environment, animal welfare and the rights of consumers.