A critical review on the survival and elimination of norovirus in food and on food contact surfaces

Area of research interest: Foodborne pathogens
Study duration: 2014-12-01
Planned completion: 1 March 2015
Project code: FS101120
Conducted by: Food and Environment Research Agency (FERA)
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Background

Norovirus is a major foodborne pathogen but little is definitively known about its environmental robustness or its response to elimination and disinfection procedures. This critical review provided an in-depth examination of published studies and other relevant information to determine the survival characteristics of norovirus in foods and on food contact surfaces, whether the food matrix or surface structure affects norovirus survival or inactivation, and whether chemical or physical treatments (heat, freezing, pH, disinfectants, etc.) are effective in reducing or eliminating norovirus in the food chain. The critical review also discussed what may be inferred regarding the effectiveness of current disinfection procedures and whether these are appropriate for control of norovirus contamination of foods, and in food production and preparation environments.

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Research Approach

The review scrutinised the relevant publications, and produced a critical narrative summary of the studies they described, bringing out their strengths and weaknesses where they are apparent, and linking salient common features of the information to highlight key aspects of norovirus survival characteristics and the structural features which underlie them. The review also identified the key knowledge gaps and made recommendations on how to fill them where the abilities of current technology indicate that it is feasible to do so.

The approach was based on review of scientific literature, information from grey literature such as industry-related publications, conference proceedings, and other sources. Any relevant sources of information since the first identification of norovirus in 1968 were reviewed. The review made use of the evidence review database containing relevant data extracted from published norovirus survival studies in FSA project FS241043 and included more recent publications.

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Results

Norovirus (NoV) is resistant to freezing and thawing and may persist in water for extended periods, possibly for several weeks in some circumstances. The persistence of norovirus in fresh produce may exceed 7 days at refrigeration or room temperatures. The norovirus genome can

persist for several days in other food products such as cooked turkey, processed foods and apples, and on food preparation surface materials and fingers.

Heating of norovirus at 63oC and above in suspensions can reduce norovirus. Autoclaving is effective in reducing norovirus by >5 log. Chlorine at concentrations of 200-500 ppm appears to be a suitable disinfectant against norovirus. Hypochlorous acid and some commercial disinfectants containing alcohols formulated with other compounds may be effective against norovirus. Hydrogen peroxide, quaternary ammonium compounds, ethoxylated alcohol-based disinfectants, antiseptics and ethanol-based hand sanitizers are generally ineffective. Studies indicate that washing hands with soap may not be effective at removing norovirus contamination levels above 2 logs.

Heat and high hydrostatic pressure can reduce norovirus in foods. Ozone and high pH (> 8.0) solutions could be useful for surface disinfection. Studies suggest that depuration does not totally eliminate norovirus from shellfish. Freeze drying of some foodstuffs can reduce NoV levels by up to 3.5 log. Gamma irradiation appears to alter norovirus structure but its effect on norovirus RNA or infectivity is unknown. It is likely that ultraviolet (UV) irradiation can inactivate norovirus but it is not known to what extent. Washing of fresh produce with water could be effective in reducing norovirus depending on the produce type.

Research into norovirus survival and elimination is hampered by the lack of an effective infectivity assay and funding to support development of in vitro culture of NoV should be considered. Development of alternative methods to determine norovirus infectivity should be closely monitored and support for validation studies of promising methods should be explored.

Meanwhile, volunteer studies are the only conclusive means currently available to identify norovirus infectivity. They offer the opportunity to determine the effect of environmental conditions and processing scenarios on norovirus infectivity. In the absence of other infectivity assays, volunteer studies can provide definitive information and should be considered for funding.

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Research report

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