Food and Agriculture Organization of the United Nations

World Health Organization

Joint FAO/WHO Expert Meeting on microbiological risk assessment of viruses in foods Part 2: prevention and intervention measures

WHO HQ, Geneva, Switzerland: 12-16 February 2024

SUMMARY AND CONCLUSIONS

Issued in March 2024

The Joint FAO/WHO Expert Meeting on Microbiological Risk Assessment (JEMRA) on microbiological risk assessment of viruses in foods, Part 2 prevention and intervention measures was convened in Geneva, Switzerland from 12-16 February 2024 in response to the request by the Codex Committee on Food Hygiene (CCFH) at its 53rd session in 2022. The Expert Committee reviewed recent scientific developments, data, and evidence associated with foodborne viruses to provide recommendations for updating the guidance CXG-079-2012. The CCFH requested JEMRA to provide scientific advice, specifically for a review of the scientific evidence on prevention and intervention measures and the efficacy of interventions in the food systems continuum.

This document summarizes the conclusions of the meeting, which focused on prevention and intervention measures, and was made available to facilitate the deliberations of the CCFH. The full report will be published as part of the Food and Agriculture Organization of the United Nations (FAO) and World Health Organization (WHO) Microbiological Risk Assessment (MRA) Series.

The meeting participants are listed in Annex 1 of this summary report. Nigel Cook served as Chairperson and Lee-Ann Jaykus as Rapporteur.

More information on this work is available at:

http://www.fao.org/food-safety/en/

and

https://www.who.int/foodsafety/en/

Meeting objectives

The Expert Committee reviewed the scientific literature published since the 2008 JEMRA report on foodborne viruses, relative to control measures to protect the food supply chain from contamination with foodborne viruses. The virus-commodity pairs chosen were those identified in Part 1 (Food Attribution, Analytical Methods and Indicators) of this series of expert meetings. Specifically, during this Part 2 meeting, the Expert Committee: 1) reviewed the relevant scientific literature; 2) deliberated on the developments that have occurred in control of foodborne viruses in the relevant food supply chains since the 2008 JEMRA report; and 3) identified the most promising approaches to further protect the food supply chain from virus contamination.

The Expert Committee decided that water intended for drinking was not within the scope of this committee. Water relevant to virus transmission was considered only for water used in food production, processing, and preparation; used as an ingredient; and as a vehicle for food contamination; where water is not the final product that is consumed.

Conclusions

In the Part 1 Expert meeting, the virus-commodity combinations ranked of highest priority were human norovirus and hepatitis A virus in shellfish, fresh and frozen produce, prepared and ready-to-eat (RTE) foods, and hepatitis E virus in pork and wild game. The Part 2 Expert meeting focused on these virus-commodity combinations and their associated contamination routes. Human faecal matter and vomit from infected individuals are the primary sources of contamination for norovirus and hepatitis A virus. Across the food supply chain, the primary contamination routes are faecally-impacted waters, food handlers carrying foodborne viruses, and surfaces. Zoonotic hepatitis E virus is present in the meat, organ tissues, and excretions of infected swine and some game animals. Since that initial expert meeting report from 2008, awareness of the public health importance of these foodborne virus-commodity combinations has increased, resulting in additions or changes to some food supply chain management strategies and research initiatives. Prevention remains the cornerstone of control of foodborne viruses. This is because these viruses are environmentally persistent and resistant to many treatments commonly used to inactivate foodborne pathogens. Effective inactivation methods continue to be necessary and are currently being evaluated.

Shellfish

Shellfish (bivalve molluscs) are contaminated with viruses primarily by faecally-impacted growing waters arising from community wastewater, septic tank failures, non-point source pollution, and discharge from boats and other recreational or commercial uses. Sanitary surveys are increasingly used to evaluate human faecal pollution status in shellfish growing areas and can be used to determine the conditions in which harvesting can occur safely. The use of male-specific coliphages to assist in evaluating the efficacy of depuration and relaying processes appears promising. The use of more effective tertiary wastewater treatment can reduce viral load in effluent but requires infrastructure investment. Climate change is anticipated to result in heavier rainfall in some locations, which may increase the likelihood of sewage overflows or runoff. Contaminated products are either discarded or diverted to processing (depuration, relaying, heat, or high pressure).

Fresh and frozen produce

Fresh and frozen produce are usually contaminated pre-harvest by sewage sludge, human faecally-impacted source waters (e.g., used for irrigation, washing, pesticides, frost protection), and infected food handlers (pickers/packers). Frozen produce (particularly berries) predominates in foodborne virus outbreaks associated with produce, aided by the fact that freezing preserves virus infectivity and results in globally distributed products with extended shelf-life. In the last 16 years, prevention of virus introduction during production and processing has been included in textual refinements to Good Agricultural Practices, Good Manufacturing Practices and Good Hygiene Practices. Specific production-related intervention strategies should focus on water source, location, method and timing of application. Emerging treatments of water (e.g., ozone, photocatalysis, ultraviolet and ultrafiltration) demonstrate potential, but require infrastructure investment. Biochar filtration is a relatively inexpensive method that shows promise for treating reused water.

Prepared and RTE foods

In the case of norovirus and hepatitis A virus, prepared and RTE foods are usually contaminated through handling by infected food handlers. Prevention focuses on exclusion of infected food handlers from work, gloving, surface disinfection, and attention to personal hygiene, including handwashing. Facilities (handwashing and toilets) should be available and of appropriately designed to encourage good personal hygiene. In many countries, national or regional policies guiding appropriate employee behaviours have been implemented in food service. This includes policies about the length of time infected food handlers should be excluded from work, and mandates for glove use while preparing foods. Most countries actively promote handwashing; some specify when and how to wash. Nonetheless, compliance with such behaviours is often poor. In response to findings that noroviruses are shed and aerosolized in vomiting events, formalized guidelines for clean-up and disinfection after vomiting or defecation incidents in food service have been implemented.

Pork and wild game meat

Zoonotically transmitted hepatitis E virus enters the food chain by infection of pigs and wild game animals. Human exposure occurs by: consumption of raw or inadequately cooked meats and tissues derived from these animals (e.g., liver, intestine, and muscle), direct contact with infected animals on farms and in slaughterhouses (surface cross-contamination), or use of untreated pig manures or runoff from farms. Recent studies have proposed that control measures should focus on prevention of animal infection at the pre-harvest phase (i.e., biosecurity measures and disinfection) and post-harvest interventions (i.e., preventing cross-contamination, virus inactivation by heat and avoiding the use of high-risk tissues in product formulations).

Intervention methods focused on virus inactivation

While most of the control measures discussed above are designed to prevent virus contamination, inactivation methods are also being investigated. It is important to note that several intrinsic (e.g., water activity, pH) and extrinsic (e.g., vacuum packaging, and storage temperature) parameters have minimal effect on virus inactivation. Novel food processes remain experimental. Accurate assessment of their efficacy is complicated by myriad factors, e.g., the inability to culture the many wild-type strains of these viruses *in vitro* from foods; the need to use cultivable surrogates, that often behave differently from wild-

type viruses, in laboratory-based studies; variability in matrix, virus, strain and location in food; lack of consistency between studies; and the absence of scale-up studies. Nonetheless, some of these methods are promising.

Shellfish: Depuration (<48 hours) does not adequately remove and/or inactivate viruses from contaminated products but relaying into clean seawater for ≥21 days is effective. For diverted product, thermal processing provides virus inactivation at very high internal temperatures (>90°C) held for 90 seconds, but this may result in an unacceptable product. Emerging data suggest that other time-temperature combinations can lead to the same outcome. High Pressure Processing is effective for virus inactivation, although organoleptic properties may be impacted.

Fresh and frozen produce: Most fresh berries are not washed post-harvest. Washing other produce items (e.g., lettuce and green onions) with water alone removes ≤1 $\log_{10}$ foodborne viral pathogens; addition of low concentrations of chlorine-based disinfectants (e.g., hypochlorite and chlorine dioxide) can boost efficacy but with regulatory and organoleptic concerns. For produce diverted to thermal processing, commercial sterilization (jams and jellies) should result in inactivation of virus. Standard juice pasteurization conditions should provide some inactivation, but longer times and/or higher temperatures may be needed to eliminate heat-resistant strains. Novel and emerging food processing techniques have been investigated, but none yet have a strong body of evidence to justify their routine use.

Prepared and RTE foods: Chemically-based virus inactivation and removal in this commodity group focuses on surface disinfection and hand sanitation. For maximum efficacy, surfaces should be cleaned before disinfection. Surface disinfection guidelines for norovirus disinfection using free chlorine differ by country. Most commercial disinfectants and hand sanitizers, used under manufacturer recommended conditions, provide only partial inactivation of norovirus. There is significant variability in product performance based on active substance(s) and formulation.

Pork and wild game meat: In meat, hepatitis E virus is highly resistant to heat. For example, it was reported that it took 20 minutes in a pâté-like product to obtain the similar inactivation as was observed for a relatively pure virus suspension treated at the same temperature (70-72°C) for 2 minutes. Omitting the use of high-risk contaminated tissues (liver or blood) in raw or undercooked pork products can also reduce transmission risk from foods.

Data gaps and future directions

Many data gaps and needs were identified, often commodity group specific. An overarching issue throughout is the limited ability to routinely cultivate wild-type foodborne viruses in the laboratory, which complicates the ability to validate interventions, compare studies and/or interpret monitoring data. Specific directions for future research and/or development include:

- Early identification of contamination hotspots (e.g., wastewater surveillance) may be a useful control tool.
- Technologies such as remote sensing (satellite imagery) and hydrographic dye studies could help to predict virus dispersion (i.e., how far viruses travel in waterways).

- The usefulness of indicator organisms to predict virus occurrence and infectivity could be better understood through appropriately designed studies with global representation, from which large, coordinated datasets are collected and analyzed using robust statistical methods.
- Emerging scientific data should be used to develop surface disinfectant and hand sanitizer formulations with greater efficacy against environmentally stable viruses.
- Capacity building is critical, especially in low to middle income countries, particularly in education and training, sharing epidemiological and genomic sequencing data, and technology transfer.
- Vaccinations are an effective control measure but are not yet developed and/or not routinely implemented in policy globally.
- Risk assessments would be useful, particularly with consideration of region-specific practices, in terms of better understanding the relative value of alternative or combined intervention methods.
- Novel interventions are in development, but these should be validated using the relevant viruses before wide application in real-world prevention and control situations.

Annex 1: List of participants

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