Joint FAO/WHO Expert Meeting on microbiological risk assessment of viruses in foods
Part 1: food attribution, analytical methods, and indicators

FAO HQ, Rome, Italy: 18-22 September 2023

SUMMARY AND CONCLUSIONS

Issued in October 2023

The Joint FAO/WHO Expert Meeting on Microbiological Risk Assessment (JEMRA) on microbiological risk assessment of viruses in foods was convened in Rome, Italy from 18-22 September 2023 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 update the guidance CXG-079-2012. The CCFH requested JEMRA to provide scientific advice, specifically including: an up-to-date review of foodborne viruses and relevant food commodities of highest public health concern; a review of the analytical methods for relevant enteric viruses in food commodities; and a review of scientific evidence on the potential utility of viral indicators or other indicators of contamination.

This document summarizes the conclusions of the meeting, which focused on food attribution, analytical methods, and indicators, 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. Kalmia Kniel served as Chairperson and Miranda de Graaf 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 on foodborne viruses published since the 2008 JEMRA report on foodborne viruses, and the information submitted in response to a call for data for this meeting. The Expert Committee: 1) reviewed the literature and available surveillance databases, and participated in an expert knowledge elicitation, which ranked foodborne viruses according to frequency and severity; 2) ranked the relevant food commodities of highest public health concern; 3) discussed methods for virus testing performed for outbreak investigation and product testing as part of surveillance and monitoring strategies; and 4) reviewed current and potential indicators for viral 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

Foodborne viruses and foods of highest public health concern

The committee conducted a review of viruses associated with human foodborne illness. The frequency of illness, and the clinical severity of disease, as well as virus-food commodity pairs, were ranked in the context of foodborne illness. A semi-quantitative approach for an expert knowledge elicitation guided the ranking.

Human norovirus was identified as the leading cause of viral foodborne illness, followed by hepatitis A and hepatitis E viruses. Hepatitis A virus and hepatitis E virus were ranked equally but higher compared to norovirus in terms of clinical severity. When considering both frequency and severity, the ranking for these viruses fell into three groups as follows:

1. norovirus
2. hepatitis A virus and hepatitis E virus ranked in order
3. rotavirus, sapovirus, enterovirus, astrovirus, and enteric adenovirus ranked in order.

The Expert Committee considered commodities from a global perspective, and identified the virus-commodity pairs of highest global public health burden associated with specific viruses:

Norovirus	Hepatitis A virus	Hepatitis E virus
1. Prepared food	1. Shellfish*	1. Pork
2. Frozen berries*	1. Frozen berries*	2. Wild game
2. Shellfish*	1. Prepared foods*	

*Substantial regional differences were noted.

The committee acknowledged the lack of sufficient data to conduct a ranking of foods that may be contaminated by astrovirus, sapovirus, enterovirus, enteric adenovirus, and rotavirus. To address the collective need for more data, countries should enhance investigation of foodborne illness and/or relevant foods for these viruses. Ranking of virus commodity pairs on a global level is challenging; this is partially due to regional differences in foods attributed to human foodborne illness. These differences are in part linked to virus circulation among persons, to regional variations in food consumption and preparation patterns, and to immune and nutritional status.

Viral foodborne disease has a substantial impact in terms of morbidity and mortality. Globally, the lack of surveillance data, the potential for asymptomatic shedding, and sparse reporting of foodborne cases pose a major challenge to prevention and control strategies.

Each year, norovirus is estimated to cause 125 million cases of foodborne illness and 35 000 deaths globally. Norovirus is highly infectious, and outbreaks have been linked to foods with low levels of contamination. Viral contamination can occur over the whole food chain. Severe outcomes including hospitalization and death mainly affect children less than 5 years of age, the elderly, and immunosuppressed individuals who may shed the virus for extended periods of time.

Hepatitis A virus is estimated to cause 14 million cases of foodborne illness and 28 000 deaths globally, each year, and is a reportable disease in some countries. There are significant regional differences in the proportion of hepatitis A cases that are attributed to food due to endemic prevalence and vaccine utilization. International trade of foods plays an important role in transmission to susceptible populations. Wider compliance with international standards, e.g., good agricultural and hygiene practices, is likely to reduce global transmission.

Hepatitis E virus is unique among the foodborne viruses in that it is a zoonotic pathogen with many asymptomatic animal reservoirs, notably swine. While there is no global estimation of cases attributed to food, countries that have investigated further have found that their prior estimates are too low by one order of magnitude or more. Genotypes 3 and 4 originating from infected animals are major sources for foodborne cases of hepatitis E, a trend that has been increasing in recent years in some countries. These genotypes cause acute hepatitis which can be severe in individuals with underlying health conditions. They cause chronic hepatitis leading to cirrhosis and liver damage in people with immunocompromised conditions and are associated with a wide range of neurological sequalae. Undercooked pig products including liver or raw sausage containing liver or blood, as well as liver pâté, are the main foods contaminated by hepatitis E virus.

Analytical methods and indicators for foodborne viruses

Since the 2008 JEMRA report on viruses in foods, international and national standard methods have been developed and validated for detection and quantification of human norovirus and hepatitis A virus in foods. The methods have been implemented in various countries. The ISO (International Organization for Standardization) methods ISO-15216-1:2017 and ISO-15216-2:2019 are widely used for the detection of norovirus and hepatitis A virus in various commodities and as a benchmark for validation of new methods. Matrices included in these ISO methods are e.g., leafy greens, soft fruits, and shellfish. ISO methods for hepatitis E virus detection in meats and meat products are in development. National methods, aside from ISO methods, have been validated and are being used by some laboratories. Current standardized methods are based on detection of viral nucleic acid, which does not necessarily indicate infectivity. The methods can be limited by several factors (e.g., the complexity of the food composition, low levels of contamination). Despite the methodological advancements, there remain challenges in their use, most notably ensuring accurate interpretation; application to other viruses and/or matrices; integration of sequencing technologies; and implementation in low resource countries. Sharing of laboratory and epidemiological data, nationally, regionally, and internationally can improve the understanding and control of foodborne viruses.

A variety of indicators for viral contamination have been investigated, including bacteria, bacteriophages, and plant and animal viruses. Up to this point, these have been mostly studied in environmental waters and shellfish, with variable utility. Additional research is needed to determine if there is an appropriate viral indicator for use in other commodities associated with foodborne virus contamination.

Needs assessment and data gaps

There is a need for infectivity assays for wild-type viruses, relative to detection. Despite the existence of multiple experimental approaches, there is still no definitive means to differentiate infectious from non-infectious viruses using molecular amplification. Human norovirus and hepatitis E virus *in vitro* propagation models have been developed but are not yet suitable for routine use.

The Expert Committee recommends that member countries consider capacity building to support training and adoption of these methods for detecting viruses in foods and the environment. This approach has the potential to enhance knowledge on food attribution, support risk analysis, and reduce the burden of viral foodborne disease worldwide.

Appropriate global actions will help alleviate the anticipated increase in public health risk from viral foodborne illness arising from population growth, the climate crisis, and globalization of food supply chains.

Annex 1: List of participants

EXPERTS

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