



JOINT FAO/WHO FOOD STANDARDS PROGRAMME

CODEX COMMITTEE ON FOOD HYGIENE

Fifty-fifth Session

Nashville, Tennessee, United States of America

15–19 December 2025

PROPOSED DRAFT REVISION OF THE GUIDELINES ON THE APPLICATION OF GENERAL PRINCIPLES OF FOOD HYGIENE TO THE CONTROL OF VIRUSES IN FOOD (CXG 79-2012)

(Prepared by the Electronic Working Group chaired Canada, co-chaired by the Netherlands)

Codex Members and Observers wishing to submit comments on the discussion paper should do so as instructed in CL 2025/60/FH available on the Codex webpage/Circular Letters 2025: <https://www.fao.org/fao-who-codexalimentarius/resources/circular-letters/pt/>

BACKGROUND

1. A discussion paper for the revision of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012) (hereafter referred to as “the guidelines”) was presented at the 53rd Session of the Committee on Food Hygiene (CCFH53). CCFH53 responded favorably to the discussion paper and was generally in agreement with the areas presented in which scientific advice would be needed in order to progress any revision.
2. CCFH53 agreed to request Joint FAO/WHO Expert Meetings on Microbial Risk Assessment (JEMRA) to provide scientific advice on the following areas:
 - i. An up-to-date review of the foodborne viruses and relevant food commodities of highest public health concern.
 - ii. A review of the scientific evidence on prevention and intervention measures and the efficacy of interventions in the food continuum.
 - iii. A review of the analytical methods for relevant enteric viruses in food commodities.
 - iv. A review of scientific evidence on the potential utility of viral indicators or other indicators of contamination.
 - v. A review of the various risk assessment models with a view towards constructing more applicable models for wide use among Members, including a simplified risk calculator.
3. A first JEMRA meeting on food attribution, analytical methods and indicators was convened in September 2023 and the report is available in MRA 49¹. A second JEMRA meeting on prevention and intervention measures was convened in February 2024. The conclusion of the second meeting is available in an executive summary report².
4. A project document (CX/FH 24/54/11) taking into consideration the output of the first JEMRA and other available information was presented by Canada and the Netherlands at CCFH54. CCFH54 agreed to start new work on the revisions of the guidelines which was later approved by CAC47. An electronic working group (EWG) was established, chaired by Canada and co-chaired by the Netherlands, working via the Codex Online Forum and open to participation by all Codex Members and Observers.

TERMS OF REFERENCE

5. The EWG was given the following terms of reference:
 - to prepare the proposed draft revisions for circulation for comments at Step 3 and consideration at CCFH55; and

¹ Available on the [FAO](http://www.fao.org) and [WHO](http://www.who.org) websites

² Available on the [FAO](http://www.fao.org) and [WHO](http://www.who.org) websites

- to undertake the full alignment of the text with CXC 1-1969, as necessary.

PARTICIPATION AND METHODOLOGY

6. An invitation was sent to all Codex Members and Observers to participate in the EWG; participants from 34 Codex Members and 4 Observers registered for the EWG. The EWG worked through the Codex Online Forum. The list of participants is attached as Appendix II.
7. The chair and co-chair (hereafter referred to as “the chairs”) prepared a first draft of the revised guidelines based on MRA 49 and made a full alignment of the text with CXC 1-1969. A first draft of the revised guidelines was posted on the Codex Online Platform for comments on November 25, 2024. EWG participants had until January 31st, 2025, to submit written comments. In total, comments were received from 13 Members and 2 Observers.
8. The draft guidelines were well received and there were few points of disagreement. Many suggestions to improve readability and the precision of the text were received. The main points of discussion were as follows:
 - A number of comments were received on the list of other viruses that can also be transmitted by food. After considering all comments from the EWG, the chairs propose to limit the list to the viruses documented in MRA 49.
 - While there were no major objections with the preliminary introduction of saliva as a transmission mode in the draft guidelines, the chairs decided to remove saliva as a transmission mode at this time because its role in the transmission of norovirus remains uncertain.
 - Many Members provided suggestions to modify the definition for human enteric virus. It was renamed enteric virus and modified to include hepatitis E virus (HEV).
 - A majority of Members considered the fresh produce definition from the *Guidelines for the Safe Use and Reuse of Water in Food Production and Processing* (CXG 100-2023) as the most relevant and appropriate for use in this context.
 - A majority of Members agreed that a definition for frozen food would be useful. The chairs prepared a revised definition considering all comments received and the definition of frozen fish in the *Code of Practice for Fish and Fishery Products* (CXC 52-2003).
 - Some comments were received regarding the terminology used to describe water including “clean water”, “water fit for purpose” and “potable water”. The chairs recommended retaining “water fit for purpose” rather than “clean water”. By doing so the risk-based approach to the safe use of water aligns with CXG 100-2023 and promotes consistency across food hygiene texts. Furthermore, using “clean water” instead of “water fit for purpose” would exclude the use of recycled/treated water, which may be safe and appropriate depending on its intended use.
 - Some comments and suggestions were provided on the integration of HEV into sections of the general guidelines or in a separate Annex.
 - Some comments suggested including a consideration for the development of policies where employees are not financially adversely affected by staying home when sick.
 - Some comments suggested specifying the duration of the symptom-free period in the following sentence: “Persons who have had gastroenteritis should only be allowed to return after a period without symptoms for diarrhoea and vomiting”. The chairs proposed using a 48h-period as an example. This provides flexibility and helps to future-proof the guidelines, recognizing that food business operators may implement longer periods, and that different enteric viruses may require different timeframes.
 - Some comments suggested the deletion of some of the guidelines’ content when it overlapped with the *General Principles of Food Hygiene* (CXC 1-1969). Where appropriate, we retained or emphasized certain elements to reflect virus-specific considerations.
 - Some comments were received regarding the exclusion of individuals with symptoms from handling food activities. The chairs proposed emphasizing the exclusion of symptomatic individuals from the premises, rather than solely from the food handling tasks. This approach was applied consistently across the guidelines. This is supported by the JEMRA Part 2 executive summary report.
 - Some comments highlighted the repetitiveness throughout the guidelines of some information important for the control of viruses (e.g. need for handwashing, training etc.). The chairs will address this item when the review is completed and adjust where necessary.

- Several comments were raised regarding whether the JEMRA Part 2 report will provide recommendations on specific prevention and interventions measures. The chairs decided to defer revisions related to surface disinfection, heat treatments, and other specific process steps until the final report is published. This approach ensures that any updates are informed by JEMRA guidance.
- A comment was received suggesting that technical FAO and WHO(2021) *Technical guidance for the development of the growing area aspects of Bivalve Mollusc Sanitation Programmes* (Second edition, Food Safety and Quality Series No.5A, Rome. <https://doi.org/10.4060/cb5072en>) be considered. The chairs reviewed the technical guidance and made some minor additions to the guidelines where appropriate. The technical guidance is also referenced where relevant throughout the guidelines. The chairs were of the opinion that the intent is not to incorporate the full scope of the information related to the implementation of bivalve molluscs sanitation programmes within the Annex on bivalve molluscs, as this is already covered in the *Code of Practice for Fish and Fishery Products* (CXC 52-2003) and the technical guidance.

9. The chairs addressed the EWG's comments to the extent possible and prepared a second draft of the revised guidelines. The chairs also prepared a first draft of the Annex III on the Control of Hepatitis E Virus (HEV) in Pork and Wild Game Meat. The draft guidelines and the Annex III were posted on the Codex Online Platform for comments on May 27, 2025. EWG participants had until June 24th, 2025, to submit written comments. Comments were received from 9 Members and 1 Observers.
10. Once again, the draft guidelines were well received and there were few points of disagreements. Annex III was also generally well received. Many suggestions to improve readability and the precision of the text were received. The main points of discussion were as follows:
11. Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food (CXG 79-2012) and the Annex on the Control of Norovirus and Hepatitis A Virus (HAV) in Bivalve Molluscs (Annex I) and the Annex on the Control of Norovirus and Hepatitis A Virus (HAV) in Fresh and Frozen Produce (Annex II)
 - Comments were received indicating that the sentences on seasonality and norovirus infections in the introduction section remained unclear. The chairs propose incorporating new text from MRA49 to clarify the relationship between seasonal patterns and norovirus infection rates.
 - Comments were received on whether the frozen produce definition should include a temperature of -18°C. The EWG proposed a simplified definition which has been included in the draft guidelines for further consideration by the Committee.
 - A comment was received suggesting the addition of a footnote from CXG 100-2023 to clarify the term "water fit for purpose". The chairs proposed, instead, that to fully understand the concept of "water fit for purpose", the entire CXG 100-2023 should be reviewed in parallel to this document. Therefore, the reference to CXG 100-2023 was considered sufficient rather than adding the footnote.
 - A few comments were received related to the prevention and intervention measures, including suggestions to delete some text. As mentioned in the response to the first EWG consultation (paragraph 8, second last bullet), the chairs decided that revisions related to prevention and intervention measures will be deferred until the publication of the JEMRA Part 2 report. All comments received will be considered in the next draft of the guidelines and its annexes.
 - A comment was received suggesting expansion on the design and use of sanitary surveys as well as the use of Male specific coliphage in *Annex I Control of Norovirus and Hepatitis A Virus (HAV) in Bivalve Molluscs*. New sentences were introduced for review by the Committee to address these points and enhance clarity.
12. Control of Hepatitis E Virus (HEV) in Pork and Wild Game Meat (Annex III)
 - One comment was received questioning the need for a specific Annex on the Control of HEV in Pork and Wild Game Meat, given the perceived lack of specific control measures.
 - In response, the chairs incorporated new information on animal activity at primary production and expanded the section on specific control measures using suggestions from other Members.
 - While some of the measures proposed in Annex III reflect good hygiene practices and general guidance already covered in the main part of the guidelines or in other Codex texts, the chairs believe that a dedicated Annex is necessary. It provides targeted recommendations for this virus-commodity pair, and it emphasizes the general good hygienic practices that are particularly relevant to HEV in pork and wild game meat.

- HEV in pork and wild game meat was identified as having a high global public health burden in MRA49. Given that the general section of the guidelines addressed different viruses and different commodities, the chairs believe that it is important to include specific information and emphasis on HEV in pork and wild game meat in a separate annex for clarity. This approach is consistent with practices used in other Codex documents.
- Some comments were received suggesting the addition of HEV-1, HEV-2 and HEV-7 in the introduction of Annex III. The chairs did not integrate these suggestions given that HEV-1 and HEV-2 are transmitted via contaminated water, whereas Annex III focuses on recommendations specific to HEV in pork and wild game meat. HEV-1 and HEV-2 are already addressed in the introduction of the general section of the guidelines. As for HEV-7, it was not included in the introduction of the general section of the guidelines, given that only a single documented case of a human infection exists.
- A suggestion was made to change the heading of section 8.2 to *Hygienic Production and Processing*. The chairs opted to keep the original heading to maintain consistency with the *General Principles of Food Hygiene* (CXC 1-1969). Relevant information related to processing was moved to section 13, *Control of Operation* to ensure alignment with the Codex structure.
- A comment was received questioning whether the recommendations for product labelling were necessary, or if the information provided by a competent authority in the consumer education section was sufficient. Another comment noted that the product labelling section lacked clarity for Ready-to-Eat products. In response, the chairs made modifications to the product labelling section, which has been included in the draft guidelines for the Committee's consideration.

CONCLUSIONS

13. The EWG completed the tasks identified in its Terms of Reference; specifically, the EWG:
- Reviewed the JEMRA report MRA49 and prepared draft revisions of the guidelines and its annexes, fully aligned with CXC 1-1969.
 - Updated the guidelines and developed an Annex on the Control of Hepatitis E Virus (HEV) in Pork and Wild Game Meat, taking into consideration comments received through two consultations in the EWG.

RECOMMENDATIONS

14. CCFH55 is invited to consider the proposed draft revision of the *Guidelines on the application of general principles of food hygiene to the control of viruses in food* (CXG 79-2012), including the new annex on Control of Hepatitis E Virus (HEV) in pork and wild game meat (Annex III) as presented in Appendix I and provide suggestions and comments for further revision as appropriate.
15. Noting the two options provided for the definition of Frozen produce, CCFH55 is further invited to consider which option is most appropriate for this document.

PROPOSED DRAFT REVISION OF THE GUIDELINES ON THE APPLICATION OF GENERAL PRINCIPLES OF FOOD HYGIENE TO THE CONTROL OF VIRUSES IN FOOD (CXG 79-2012)

1. INTRODUCTION

1. Viruses differ from bacteria in size, structure and biological characteristics. Viruses are strictly host-dependent for their replication and have their own typical host range and cell preference (tropism). They can be transmitted in different ways, e.g. via the respiratory or faecal-oral routes. Human viruses can be transmitted directly from person to person, or indirectly through virus-contaminated water, air, soil, surfaces or food. Some viruses (zoonotic viruses) are transmitted from animals to humans. Despite existing measures to reduce bacterial contamination, foodborne viral infections remain common.

2. The enteric viruses most frequently implicated in foodborne outbreaks are norovirus, followed by hepatitis A virus (HAV) and hepatitis E virus (HEV). Other enteric viruses such as rotavirus, sapovirus, enterovirus astrovirus and enteric adenovirus can also be transmitted by food.

3. Foodborne enteric viruses can be grouped into three categories: those that cause gastroenteritis (e.g. norovirus), those that can cause enterically transmitted hepatitis (e.g. HAV, that replicates in the liver), and a third group that replicates in the human intestine but causes illness only after they migrate to other organs such as the central nervous system (e.g. enterovirus). Enteric viruses that cause gastroenteritis are those that infect mainly via the gastrointestinal tract when ingested through the oral route. They are excreted in faeces and, for some viruses, in vomitus. Asymptomatic infections and viral shedding are common, and can serve as undetected sources of contamination. These factors should be considered as significant risks in food production.

4. The characteristics of foodborne viruses and the associated infections/illnesses, that may be helpful in determining management strategies, are discussed below. In some cases, the management strategies for controlling foodborne enteric viruses may be different than those used for controlling bacterial pathogens:

- Viruses cannot replicate in food. They need to enter the living host cells to be able to multiply (replicate). Consequently, viruses do not cause deterioration of the product, and the organoleptic properties of the food are not affected due to viral contamination.
- Although large numbers of viral particles can be shed in the stools of symptomatic or asymptomatic infected individuals (e.g. exceeding 10^6 particles per gram of stool) or in vomitus, only a few viral/infectious particles (less than 100) are likely needed to cause an infection that may lead to illness.
- Human enteric viruses, such as norovirus and HAV, are highly infectious, with person-to-person contact being the primary transmission route. Secondary spread of these viruses after the primary introduction, such as through contaminated food or water, is common and often results in large and prolonged outbreaks.
- Non-enveloped viruses, such as norovirus, HAV and HEV, consist of nucleic acid and a capsid. Enveloped viruses, such as influenza, are also surrounded by a lipid membrane envelope. Both the capsid and envelope structures influence environmental persistence and the viral resistance to cleaning and disinfection interventions. Non-enveloped viruses tend to be more resistant to inactivation from solvents (e.g. isopropyl alcohol) and desiccation.
- Some viruses transmitted by the faecal-oral route can persist for months in/on foods (e.g. bivalve molluscs, frozen berries) or in the environment (e.g. in soil, water, sediments or on various inanimate surfaces).
- Freezing and refrigeration temperatures preserve viruses and their tolerance to cold temperatures is an important factor increasing the persistence in the environment. Heat and drying can be used to inactivate viruses, but there are virus-to-virus differences in resistance to these processes. The type of matrix (e.g. food or fomite surface) and the presence of organic matter, such as faecal material, can influence relative resistance to heat and drying.
- Adequate hand washing practices (i.e. using soap and water) are more effective than the use of hand sanitizer for reducing the level of infectious virus in food handling settings. Most chemical disinfectants used in food establishments for cleaning and disinfecting surfaces do not effectively inactivate non-enveloped viruses, such as norovirus, HAV or HEV.
- Zoonotic foodborne transmission of norovirus and HAV appears uncommon, but is common for HEV.
- In general, testing of foods for foodborne viruses is challenging due to often complex matrices and low virus

concentration. The available methods consist of a food matrix-dependent extraction followed by detection of viral nucleic acids. The detection of viral nucleic acids in foods (e.g. by using a PCR-based detection method) cannot determine viral infectivity.

- Culture and detection methods for testing inactivation of foodborne viruses in food are lacking. This has led to the use of surrogate viruses (e.g. the use of murine norovirus and Tulane virus in place of norovirus). When evaluating risk management options, the choice of a surrogate should consider the nature of the study and the characteristics of the virus, as the surrogate may not always mimic the resistance of the specific foodborne viruses.

5. During the FAO/WHO Expert meeting on “Microbiological risk assessment of viruses in foods – Part 1” in 2023, norovirus, HAV and HEV were determined to be the viruses of greatest concern from a food safety perspective, based on (i) the incidence of reported foodborne disease, (ii) the severity of disease, including mortality, and (iii) their potential for transmission via foods. Each year globally, norovirus is estimated to cause 125 million cases of foodborne illness and 35 000 deaths while HAV is estimated to cause 14 million cases of foodborne illness and 28 000 deaths. For HEV, there is currently no global estimation of cases attributed to food due to the lack of information. Norovirus was identified as the leading cause of viral foodborne illness, followed by HAV and HEV. HAV and HEV were ranked equally but higher compared to norovirus in terms of clinical severity. While rotavirus was identified as a virus that causes severe illness with significant mortality, foodborne illness attributed to rotavirus is rare. The primary mode of transmission for rotavirus is person-to-person, but in areas with poor hygiene, waterborne and foodborne spread may play a role.

6. Norovirus: Norovirus infections occur year-round, and cause gastroenteritis in people of all ages. Transmission occurs through the faecal-oral route via direct contact with an infectious person or indirectly by consumption of contaminated food or water or contact with contaminated surfaces. Overall, illness is relatively mild and self-limiting but can be more severe and potentially fatal in high-risk groups such as the elderly or those with underlying medical conditions. The greatest public health impact from norovirus outbreaks has been reported in institutions such as hospitals and nursing homes, where norovirus outbreaks commonly occur due to the proximity of patients in an enclosed environment. In the Northern Hemisphere, for which the most data is available, norovirus disease burden peaks in the winter months and is positively associated with rain in the wettest month. Several studies also show that norovirus contamination of bivalve molluscs is correlated to the winter season. However, regional differences in seasonality of documented norovirus outbreaks have been described and foodborne infection, e.g. due to contaminated frozen food, can occur year round. The incubation period is 12-72 hours; however, in most cases symptoms appear between 24-30 hours. Symptoms are often characterised by sudden onset of one or several episodes of projectile vomiting and one to several days of diarrhoea. Norovirus-infected persons shed large amounts of infectious viral particles (10^6 - 10^{10} genome copies/g) in their stools while having symptoms. Shedding of infectious particles may also occur prior to the onset of symptoms, and may continue for 2 or more weeks after resolution of symptoms, even in immuno-competent individuals. The disease and shedding period may be longer in immuno-suppressed individuals. A large portion of individuals with norovirus infections are asymptomatic. A vaccine against norovirus is not currently available. While there are multiple norovirus genogroups, those that infect humans are specific to humans and not zoonotic.

7. HAV: Hepatitis A virus causes acute viral hepatitis and is specifically a human virus. Transmission occurs through the faecal-oral route via direct contact with an infectious person or indirectly by consumption of contaminated food or water or contact with contaminated surfaces. The incidence of HAV infection varies considerably among and within countries. In countries where HAV infection is highly endemic, most people are infected in early childhood, with the infection being asymptomatic, in over 90% of children under 5 years of age. HAV infection provides a lifelong immunity and almost all adults in endemic areas are immune. In HAV endemic areas, children with HAV (asymptomatic or symptomatic) may be an important risk factor in the spread of HAV when they are present in and around primary production or food preparation activities, or are being cared for by a food handler. In countries, where HAV infections are less common as a result of increased standards of public health such as access to safe drinking water, adequate sanitation and hygiene, very few persons are infected in early childhood, and as a result, the majority of adults remain susceptible to infection. The increased susceptibility heighten the potential impact of outbreaks of hepatitis A in these regions. The incubation period for HAV is at least 2 weeks, to a maximum of 6 weeks, with an average of 28 days. The peak infectivity occurs in the 2 weeks preceding the onset of jaundice (i.e. the presence of yellow colouring of the skin and/or mucous membranes). The virus is shed in large numbers (10^6 - 10^8 genome copies/g) in faeces from the final 2 weeks of the incubation period up to 5 weeks into the symptomatic phase noting that up to 20% of infected adults remain asymptomatic. Later in life (persons over 40 years), HAV infection is symptomatic in over 80% of the infected persons and may result in a more severe disease outcome, including death in 1-2% of cases. Some HAV infections occur without symptoms. Effective vaccines against HAV are available.

8. HEV: Hepatitis E virus is another cause of acute viral hepatitis in humans. Symptomatic cases of HEV typically

have an incubation period of 2 to 8 weeks. Hepatitis can be severe in risk groups comprising individuals with underlying health conditions, which include acute hepatitis in persons with pre-existing liver disease or chronic infections leading to cirrhosis and liver damaged in immunocompromised individuals. Furthermore, acute HEV infections have been associated with a wide range of neurological sequelae. HEV genotype 1 (HEV-1) and 2 (HEV-2) only infect humans and are mainly transmitted through contaminated water in countries where it is endemic. HEV-1 is associated with severe disease and increased mortality in pregnant women. HEV genotype 3 (HEV-3) infects humans and a wide range of animal species including domestic pigs, wild boars, deer, mongoose, etc. It is transmitted through the ingestion of contaminated food derived from these animals. HEV genotype 4 (HEV-4) mainly infects domestic pigs and wild boars as well as humans. Both HEV-3 and HEV-4 can be transmitted through zoonosis and foodborne route from many animal reservoirs, notably pigs where infection is predominantly asymptomatic. Transmission can also occur through direct contact with infected animals on farms and in slaughterhouses. HEV-3 and HEV-4 are found in the meat, organ tissues, and excretion of infected animals. Meat and meat products can become contaminated by (i) intrinsic contamination when the animal is infected and the virus has not been fully cleared at the time of slaughter and (ii) cross-contamination with faeces, bile or blood from infected animals at the time of slaughter or (iii) inclusion of contaminated raw liver or blood in ready-to-eat (RTE) or minimally-processed pork and wild game products. Sewage or water contaminated with HEV may potentially be a source for food contamination through irrigation or growing waters for bivalve molluscs, though less documented.

9. During the FAO/WHO Expert meeting on “Viruses in Food”¹ in 2008, three major sources of viral contamination of foods were identified: human sewage/faeces, infected food handlers and animals harbouring zoonotic viruses. The virus-commodity combinations identified as being of greatest public health concern were norovirus and HAV in prepared (RTE) foods, bivalve molluscs, and fresh produce. During the FAO/WHO Expert meeting on “Microbiological risk assessment of viruses in foods – Part 1” in 2023, the virus-commodity combinations of greatest public health concern were identified as norovirus and HAV in prepared (ready-to-eat) foods, bivalve molluscs, and frozen berries, as well as HEV in pork and wild game meat.

10. Preventing contamination remains the cornerstone of controlling foodborne viruses. This is due to their environment persistence and resistance to many treatments commonly used to inactivate foodborne pathogens. Effective control strategies need to focus on prevention of contamination. Such prevention will have to occur primarily at the pre-harvest level for some products, and at the harvest level and at the post-harvest phase for others.

11. Evidence of viral contamination is primarily based on the detection of viral RNA/DNA since many foodborne viruses cannot be reliably cultured *in vitro*. Detection and quantification methods for norovirus and HAV (using reverse transcription quantitative polymerase chain reaction (RT-qPCR)) that require initial matrix-specific extraction have been developed and validated in interlaboratory studies. A number of validated methods are available for the detection of the viral genome in specific food commodities (e.g. leafy greens, soft fruits and bivalve molluscs), including the two-part technical method for the detection (ISO 15216-2:2019) and quantification (ISO 15216-1:2017) of norovirus and HAV RNA in food matrices. ISO methods for the detection of HEV in liver, liver products and meat products are in development. Current standardized methods are based on the detection of viral RNA/DNA which do not discriminate between infectious and non-infectious virus particles. Test results are subject to variability depending on the complexity of the food product, the level and distribution of virus within the food matrix, and the presence of PCR inhibitors. Molecular technologies should be validated by a standard validation procedure and the intended use and interpretation clearly defined. Ideally, the testing laboratory should be accredited.

2. OBJECTIVES

12. The primary purpose of these guidelines is to provide guidance on how to prevent or minimize the presence of foodborne viruses in food and food production environment, specifically norovirus, HAV and HEV. The guidelines provide advice to competent authorities on a framework for the control of enteric viruses in food, to protect the health of consumers and ensure fair practices in food trade. The guidelines also provide information that will be of interest to food business operators (FBOs), food handlers, consumers and other interested parties. Information provided in these guidelines may also assist in minimizing the risks of foodborne illness from new and emerging viruses in foods.

3. SCOPE

13. These guidelines apply to all foods, with a focus on RTE, from primary production through consumption, for the control of enteric viruses, in particular norovirus and HAV. These guidelines also apply to pork and wild game meat from primary production through consumption, for the control of HEV. They should complement controls in place for all other pathogens.

4. USE

14. These guidelines follow the format of the *General Principles of Food Hygiene* (CXC 1-1969) and should be used

in conjunction with it and other relevant Codes of Practice and Guidelines, such as:

- the Code of Hygienic Practice for Precooked and Cooked Foods in Mass Catering (CXC 39-1993),
- the Code of Practice for Fish and Fishery Products (CXC 52-2003),
- the Code of Hygienic Practice for Fresh Fruits and Vegetables (CXC 53-2003),
- the Code of Hygienic Practice for Meat (CXC 58-2005),
- the Guidelines for the Safe Use and Reuse of Water in Food Production and Processing (CXG 100-2023), and
- the Guidelines for the Validation of Food Safety Control Measures (CXG 69-2008).

15. The annex on the *Control of Norovirus and Hepatitis A Virus (HAV) in Bivalve Molluscs* (Annex I), the annex on the *Control of Norovirus and Hepatitis A Virus (HAV) in Fresh and Frozen Produce* (Annex II) and the annex on the *Control of Hepatitis E Virus (HEV) in pork and wild game meat* (Annex III) are supplements to these guidelines and provide additional recommendations for these specific virus-commodity combinations.

4.1 Roles of competent authorities, food business operators, and consumers

16. Refer to the *General Principles of Food Hygiene* (CXC 1-1969).

5. GENERAL PRINCIPLES

17. Refer to the *General Principles of Food Hygiene* (CXC 1-1969).

5.1 Management commitment to food safety

18. Refer to the *General Principles of Food Hygiene* (CXC 1-1969).

6. DEFINITIONS

19. For the purpose of this document, definitions of the *General Principles of Food Hygiene* (CXC 1-1969) and the following definitions apply:

Enteric virus – a virus that replicates in the gastro-intestinal tract or in the liver and is excreted in faeces and for some viruses in vomitus. Enteric viruses originating from humans are transmitted mainly by the faecal-oral route. Zoonotic enteric viruses are transmitted primarily via food derived from infected animals.

Fresh produce – Any fresh fruit, nuts, mushrooms, herbs, and vegetables that are likely to be presented to consumers in a raw form, either unprocessed or physically altered from its original form but remaining in the fresh state (e.g. washed, peeled, cut), and that are generally considered perishable regardless of it being intact or cut from root/stem at harvest.

[Option 1- Frozen produce – fresh produce which has been subjected to a freezing process sufficient to reduce the temperature of the whole product to a level low enough to preserve the inherent quality of the produce, and that has been maintained at -18°C or colder during transportation, storage and distribution up to and including the time of final sale, subject to permitted temperature tolerances.]

Option 2 - Frozen produce – fresh produce that has been frozen to below its freezing point sufficiently to preserve the inherent quality of the food during transportation and storage up to its time of use.]

Ready-to-eat food (RTE-food) – any food that is normally eaten in its raw state or any food handled, processed, mixed, cooked, or otherwise prepared into a form, that is normally eaten without further steps, which could remove viruses or eliminate their infectivity.

Clean water – water that does not meet the criteria for potable water but does not compromise the food safety of the food in the context of its use.

Water fit for purpose – water that is determined to be safe for an intended purpose through the identification, evaluation, and understanding of potential microbiological hazards and other relevant factors (e.g. history of use, the intended use of the food, etc.), including the application of control measures such as treatment options and their efficacy to ensure effective elimination or mitigation of such hazards.

GOOD HYGIENE PRACTICES

7. INTRODUCTION AND CONTROL OF FOOD HAZARDS

20. Refer to the *General Principles of Food Hygiene* (CXC 1-1969).

8. PRIMARY PRODUCTION

21. Refer to the *General Principles of Food Hygiene* (CXC 1-1969). In addition:

OBJECTIVES: To describe the setting in which the primary production occurs and to identify different aspects of production processes that should be controlled to reduce the chance of viral contamination of food.

RATIONALE: Food may become contaminated at the primary production area via water, soil, or through contact with equipment contaminated by faeces, vomitus, blood or bile from infected animals or by food handlers, as well as through cross-contamination from other food products or intrinsic contamination because the animal is infected.

8.1 Environmental control

22. Refer to Section 8.1 of the *General Principles of Food Hygiene* (CXC 1-1969). In addition:

23. Potential environmental sources of viral contamination should be identified prior to production activities. Vehicles of viral contamination of food at primary production include water, soil, manure (not properly treated), sludge or fertilizers contaminated by faeces of human and/or of animal origin or proximity to other production activities which could result in run-off or flooding with virus-contaminated water. Presence of wild animals that are known to be carriers of zoonotic enteric viruses in the primary production environment should be controlled to the extent practicable. Primary food production should not be carried out in areas where the presence of viruses may lead to the viral contamination of food. Assessment of environmental conditions is particularly important for foodborne viruses because subsequent control steps during production may not be adequate to remove contamination.

8.2 Hygienic production

24. Refer to Section 8.2 of the *General Principles of Food Hygiene* (CXC 1-1969). In addition:

25. Food sources should be protected from faecal contamination, vomitus or vomitus-derived aerosols, as well as blood or bile from potentially infected animals.

26. The source of water used for primary production and its delivery method can affect the risk of contamination of food during production. Growers should seek appropriate guidance on water quality and delivery methods to minimize the potential for contamination by viruses. Water used in primary production should be suitable for its intended use [fit-for-purpose] and not compromise food safety and should be applied using an appropriate method. Water fit for purpose should be used during harvesting and post-harvest processing of foods. (Refer to the *Guidelines for the Safe Use and Reuse of Water in Food Production and Processing* (CXG 100-2023), as well as to *WHO Guidelines for the safe use of wastewater, excreta and grey water. Volume 2: Wastewater use in agriculture* (World Health Organization 2006 ISBN 92 4 154683 2, v.2; and *WHO Guidelines for the safe use of wastewater, excreta and grey water. Volume 3 Waste water and excreta use in aquaculture* (<https://iris.who.int/handle/10665/78265>).

27. Natural fertilizers may contain human and/or zoonotic pathogenic viruses that persist for weeks or months. Proper treatment such as application of heat, chemical or biological treatments of biosolids, manures and waste by-products can reduce the risk of virus survival. Growers should seek appropriate guidance on the use and treatment of biosolids, manures and waste by-products.

28. Aquaculture operations should not be established in areas susceptible to sewage contamination, in particular those areas used for production of products intended for consumption without further treatment, i.e. raw consumption.

29. Biosecurity measures can be used to reduce the number of animals infected with zoonotic enteric viruses at the primary production phase. Monitoring the infection status of animals can aid in developing targeted farming strategies to reduce the number of viraemic animals at time of slaughter. Measures should be in place at slaughterhouses to reduce faecal contamination of carcasses and to reduce cross-contamination of animal tissues with enteric viruses via intestine contents, bile and blood.

8.3 Handling, storage and transport

30. Refer to Section 8.3 of the *General Principles of Food Hygiene* (CXC 1-1969). In addition:

31. Harvesting methods vary depending on the characteristics of the product. Specific control measures should be implemented to minimize the risk of contamination from viruses associated with different harvesting methods.

32. Harvesting equipment, utensils and containers should be in a clean condition and in good working order.

8.4 Cleaning, maintenance and personnel hygiene

33. Refer to Section 8.4 of the *General Principles of Food Hygiene* (CXC 1-1969) and the *Guidelines for the Safe Use and Reuse of Water in Food Production and Processing* (CXG 100-2023).

34. Refer to Section 11 (Maintenance, cleaning and disinfection) and 12 (Personal hygiene) of this document for aspects of maintenance, cleaning and disinfection as well as personnel hygiene in primary production given its importance for virus prevention.

9. ESTABLISHMENT - DESIGN OF FACILITIES AND EQUIPMENT

35. Refer to the *General Principles of Food Hygiene* (CXC 1-1969). In addition:

OBJECTIVES: Equipment and facilities should be designed, constructed and laid out to ensure that surfaces can be cleaned and where necessary disinfected.

RATIONALE: Inability to properly clean and disinfect may result in persistence of the virus leading to potential contamination of food, in particular with norovirus and HAV.

9.1 Facilities

9.1.1 Personnel hygiene facilities and toilets

36. Refer to Section 9.2.3 of the *General Principles of Food Hygiene* (CXC 1-1969). In addition:

37. Adequate washing and toilet facilities should be available so that an appropriate degree of personal hygiene can be maintained and to avoid personnel contaminating food.

38. Harvest and production may be subject to seasonal influx of workers to meet the needs of producers and may vary for different products. An inherent risk at the farm and production level is an under-supply of suitable toilet and hand washing facilities to meet this influx. FBOs should ensure that suitable facilities are provided, are readily accessible and meet appropriate hygiene standards.

39. Personnel hygiene facilities and toilets should:

- be located in close proximity to the production area;
- be located in areas adjacent to the processing area, but with adequate separation from the food processing area;
- be in sufficient numbers to accommodate personnel;
- be of appropriate design to ensure hygienic removal of wastes;
- be hygienically designed so that there is no seepage into underground water or entry into the agricultural field;
- have adequate means for washing and drying hands;
- be maintained under sanitary conditions and in good repair;
- be appropriately cleaned and disinfected (see 11.1 Maintenance and cleaning); and
- be separate for both guests and personnel of the establishment, when feasible.

40. Hand washing facilities should be supplied with hand cleanser (soap). Where possible, hand washing facilities should have non-hand operable taps and single-use towels to help prevent the re-contamination of clean hands. If this is not feasible, suitable hand washing and hand drying systems should be available. Hand washing and drying instructions should be visibly present for all users of these facilities.

41. Hand washing and drying facilities should be suitably located in food preparation or production areas to ensure food handlers have ready access to them. There should be hand washing facilities close to the toilets and positioned so that the personnel must pass by them before returning to the food handling area.

10. TRAINING AND COMPETENCE

42. Refer to the *General Principles of Food Hygiene* (CXC 1-1969). In addition:

OBJECTIVES: Food handlers engaged in food growing, harvesting or processing who come directly or indirectly in contact with foods should be trained and/or instructed in the control of enteric viruses to a level appropriate to the operations they are to perform.

RATIONALE: Food handlers may be less familiar with controls specific to enteric viruses.

10.1 Awareness and responsibilities

43. Refer to Section 10.1 of the *General Principles of Food Hygiene* (CXC 1-1969). In addition:

44. FBOs (primary producers, manufacturers, distributors, retailers and food service/ institutional establishments), are responsible for providing specific instructions and training for control of viruses. There is a need to increase awareness of interested parties on the risk of disease outbreaks due to viral contamination of food. Industry and trade associations may be able to assist with this awareness raising.

45. It is the responsibility of the FBO managers to educate and train their personnel, to keep control of the level of awareness of the training content, and to have both cleaning and disinfection programmes operational.

46. It is the responsibility of the FBO managers to ensure that personnel that are ill (refer to section 12.1 Health status), or have family or house-mates that are ill, are aware of their responsibility to stay away from work, and especially if associated with ready-to-eat foods. FBOs should consider implementing policies such that employees are not financially adversely affected by staying home.

47. It is the responsibility of the FBO managers to carry out monitoring to ensure that personnel are undertaking good hygienic practices. Monitoring includes regular observation of personnel hand washing prior to entry into food handling areas and regular observations that food handlers are following appropriate procedures before they return to handling food after touching unclean surfaces.

48. It is the responsibility of the FBO personnel to inform the supervisor/ manager or employer when ill with diarrhoea or vomiting, or when having symptoms indicative of hepatitis or gastrointestinal illnesses.

49. It is the responsibility of all personnel to adhere to strict hand washing instructions after returning from the toilet or after being in contact with faecal or vomitus matter. It is also the responsibility of all personnel involved in slaughtering and/or processing of meat parts and organs to comply with hand hygiene after being in contact with animal parts and fluids.

10.2 Training programmes

50. Refer to Section 10.2 of the *General Principles of Food Hygiene* (CXC 1-1969). In addition:

51. Training programmes should contain information on the following, but not limited to:

- The potential for food, raw ingredients, and hands to be a vehicle of virus transmission if contaminated.
- The potential sources and routes of transmission of enteric viruses.
- The potential for persistence of infectious enteric viruses in/on contaminated foods and food production settings.
- The incubation periods of diseases caused by enteric viruses.
- The duration of virus shedding during and after recovery from clinical symptoms, and the possibility of pre- and post- symptomatic shedding.
- The potential of contamination by asymptomatic food handlers.
- The potential for faeces, vomitus, animal parts (e.g. liver) and fluids (i.e. blood or bile) to contain infectious virus.
- Procedures for cleaning and disinfection of contaminated surfaces.
- Procedures to ensure appropriate use of personal protective equipment, including where and when to use, donning/doffing, and change frequency.
- Proper hand washing practices and the importance of strict compliance with hand washing instructions at all

times, particularly after being in contact with faecal or vomit matter, as well as animal parts and fluids (i.e. blood or bile).

- The possibility that if one staff member or household member has a viral illness, other staff members or household members may also be infected or become ill.
- The need to stay away from work when having symptoms of viral illness (e.g. gastroenteritis, acute hepatitis).
- The need to keep children away from food growing fields and food preparation areas, to the extent possible, especially in HAV endemic areas (since in many endemic areas asymptomatic children are a primary source of the virus).
- Procedures for the disposal of contaminated food items.

10.3 Instruction and supervision

52. Refer to Section 10.3 of the *General Principles of Food Hygiene* (CXC 1-1969). In addition:

53. Training and instruction should be given to all new personnel on the infectivity, transmission and management of foodborne viruses. Incorporation of these instructions into the National codes of hygienic practice would be advisable.

54. Also, inspectors or other relevant authorities who inspect farms, fields, post-harvest processing plants, and eating facilities should be provided with the above training and be aware of the instructions.

55. Managers, supervisors and operators/workers should understand the importance of applying good hygiene practices and maintaining personnel health and hygiene. Particularly in aspects such as:

- ensuring the availability of adequate washing and toilet facilities, including a sufficient supply of water fit for handwashing purposes;
- strictly following the hand washing procedures;
- exclusion from the premises of food handlers or any persons, including children, with symptoms of viral illness (e.g. gastroenteritis, acute hepatitis) or those recovering from these infections (refer to Section 12.2 Illness and injuries);
- adequately cleaning and disinfecting contaminated surfaces (refer to Section 11);
- promptly reporting any cases of viral illness and ensuring appropriate follow-up measures for each case.

11. ESTABLISHMENT MAINTENANCE, CLEANING AND DISINFECTION, AND PEST CONTROL

56. Refer to the *General Principles of Food Hygiene* (CXC 1-1969). In addition:

OBJECTIVES: To provide specific guidance on preventive maintenance and especially cleaning and disinfection procedures after an event of vomiting, diarrhoea and/or notification of hepatitis.

RATIONALE: Vomiting/diarrhoea events and persons shedding viruses are likely to cause widespread contamination of food production premises, and measures to eliminate this contamination should be taken.

11.1 Maintenance and cleaning

57. Refer to Section 11.1 of the *General Principles of Food Hygiene* (CXC 1-1969). In addition:

11.1.1 General

58. FBOs should have control measures in place for responding to events involving the presence of vomitus or faeces onto surfaces. These should set out specific actions to take to minimize the potential for spread of viral contamination and exposure of employees, consumers, food, and surfaces to vomit, faeces and blood.

11.1.2 Cleaning and disinfection methods and procedures

Cleaning and disinfection:

59. Each establishment should have documented regular cleaning and disinfection procedures. Disinfection should always be preceded by cleaning. It is also recommended that establishments have a specific procedure for cleaning and disinfecting surfaces that may be contaminated with enteric viruses. Cleaning and disinfection should take place immediately after any vomiting event in the premises, any reported symptoms of gastroenteritis or any symptoms indicative of hepatitis in personnel. Cleaning and disinfection should include all surfaces potentially contaminated with

viruses, both in the hygiene facilities and toilets, and (as a preventive measure) in food production areas (e.g. equipment, utensils, telephones, keyboards, door handles, etc.), as viruses in vomitus, aerosols and faeces are persistent and can stay infectious for a long period.

60. When cleaning and disinfecting surfaces potentially contaminated with enteric viruses (e.g. after a vomiting event), personal protective equipment such as gloves, facemasks, aprons or smocks should be worn by a person trained in cleaning up infectious material. Any spillage or contamination with faeces or vomitus should be dealt with immediately, and food handling in the same area(s) should be stopped. Absorbent material such as paper towels and tissues may be used to limit the spread of contaminated fluids but should then be properly disposed of, e.g. in closed plastic bags, so as not to be a vehicle for further contaminating foods, surfaces or personnel.

Surface disinfection:

61. Surfaces should always be cleaned prior to disinfection to ensure effective disinfection. For surface disinfection, solutions of ≥ 1000 ppm free chlorine applied for 5 to 10 min at room temperature consistently show $> 3 \log_{10}$ reduction in viral infectivity. Freshly constituted hypochlorite solutions are preferable. Alternatively, chlorine dioxide solutions at concentrations of 200 ppm may be used. The solutions are corrosive and need to be thoroughly rinsed with water fit for purpose from food contact surfaces afterwards. Adequate precautions should be taken during cleaning or disinfection of rooms, equipment or utensils to prevent food from being contaminated by wash water, detergents and disinfectants. Food processing and preparation should only begin after thorough disinfection has taken place.

62. Experiments have demonstrated that a vaporized hydrogen peroxide (VHP) treatment at >100 ppm for 1 h is effective against a range of viruses including poliovirus, rotavirus, adenovirus, and murine norovirus. This treatment can be applied to whole rooms, including kitchens, and results in disinfection of various surfaces such as stainless steel and framing panel and is a less labour-consuming alternative to manual disinfection using chlorine solutions.

63. UV irradiation at > 40 mWs/cm² (=mJ/cm²) causes $> 3 \log_{10}$ reduction of feline calicivirus and murine norovirus, which have been used as models for human norovirus. This treatment can be considered for reducing viral infectivity on surfaces, in aerosols and in water.

64. Most other surface disinfectants lack efficacy (i.e. consistently cause less than a $3 \log_{10}$ reduction in infectivity) against many viruses at manufacturer's recommended concentrations and exposure times. It is well recognized that the majority of chemical disinfectants currently used in institutional and domestic environments and in the food industry do not effectively inactivate norovirus and HAV. New compounds and/or methods can be considered if they show virucidal activity of $> 3 \log_{10}$ for non-enveloped viruses in standardized carrier tests and are approved for use on food contact surfaces. Interpretation of results from the use of human norovirus surrogates, specifically feline calicivirus, murine norovirus and Tulane virus, in the evaluation of disinfectants should be made with caution as these surrogates may exhibit different physicochemical properties as compared to norovirus.

65. Cleaning and disinfection methods and procedures should be in place (including the name, volume and concentration of disinfectants, time, temperature and/or pH to be applied and equipment to be used) at the establishment. They should include specific cleaning and disinfection procedures (including manual and automatic dishwashing) that are able to inactivate enteric viruses and include a checklist of which surfaces should be disinfected and at what frequency.

11.1.3 Monitoring of effectiveness

66. Refer to Section 11.1.3 of the *General Principles of Food Hygiene* (CXC 1-1969). In addition:

67. When cleaning and disinfection are needed for potential virus contamination, proper documentation and monitoring of the cleaning and disinfection are recommended. Example of information to be documented include date, time, name of person doing the cleaning and the nature of the incident (e.g. vomiting).

11.2 Waste management

68. Refer to Section 11.3 of the *General Principles of Food Hygiene* (CXC 1-1969). In addition:

69. Food possibly contaminated with virus particles should be discarded in a manner such that contact between this food and any person, food or food contact surface is prevented.

12. PERSONAL HYGIENE

70. Refer to Section 12 of the *General Principles of Food Hygiene* (CXC 1-1969). In addition:

OBJECTIVES: To prevent food handlers from contaminating food with viruses, in particular norovirus and/or HAV due to poor personal hygiene.

RATIONALE: Food handlers may shed virus and the infectious dose may be very low. There is a need for strict personal hygiene of food handlers, particularly in relation to the prevention of norovirus and/or HAV, contamination.

12.1 Health status

71. Diarrhoea and vomiting may be caused by infectious (e.g. norovirus, *Salmonella*) or non-infectious (e.g. toxins) agents. All cases of gastroenteritis should, however, be regarded as infectious unless good evidence suggests otherwise. Fever, headache, fatigue combined with dark urine and light stools, or jaundice, are indicative of hepatitis, which should also be regarded as an infectious condition. Persons with the above symptoms should therefore be excluded from being present in the premises, to reduce the likelihood of transmission of any infectious agents via food.

72. Refer to the Introduction section of these guidelines for the incubation and contagious periods of norovirus, HAV and HEV.

12.2 Illness and injuries

73. Food handlers with clinical symptoms of gastroenteritis or with symptoms of acute hepatitis should be excluded from the premises to reduce the likelihood of transmission of the human enteric viruses, norovirus and HAV. Worker(s) should leave the food handling area, if possible, before the onset of any vomiting or diarrhoea event and in any case directly after these events. Any person with symptoms of acute hepatitis should seek medical advice.

74. Persons who have had gastroenteritis should only be allowed to return to work after a period (e.g. 48h) without symptoms of diarrhoea and vomiting. Persons who have had hepatitis should only be allowed to return to work after disappearance of jaundice, confirmed through clinical observations and/or laboratory testing.

75. As shedding of viruses, such as norovirus or HAV, may continue for several weeks after symptoms have subsided (e.g. norovirus may be post-symptomatically present on average for 2 or more weeks in the stools of recently infected persons), training and instruction should be given to all personnel on the infectivity, transmission and disinfection of foodborne viruses, and the importance of following strict hand hygiene instructions at all times.

76. When one of the staff members has symptoms of gastroenteritis or hepatitis, other staff members may be or may become (asymptomatically) infected at that point. Similarly, when a family/house member of a staff member has symptoms of gastroenteritis or hepatitis, that staff member may be (asymptomatically) infected, and/or serve as a vector carrying infectious virus. In these specific situations, it is the responsibility of the employee to inform their employer/manager/supervisor, and follow FBO procedures including compliance with strict hand hygiene measures to reduce the risk of further spread of the virus.

77. Applicable vaccination of food handlers (e.g. against HAV) should be recommended where necessary to reduce the risk of viral contamination of the food, taking into account the epidemiological situation and/or immune status of the local population, e.g. where HAV is endemic or where the population has low immunity. Where feasible and appropriate, checking for HAV immune status of food handlers could be useful.

12.3 Personal cleanliness

78. Personal hygiene of food handlers is critical. Food handlers should be aware of the infectious nature and transmission routes of enteric viruses, such as norovirus and HAV. As asymptomatic shedding can occur, food handlers should adhere to hand washing instructions at all times. Training should be provided for food handlers, managers and other company personnel (see Section 10).

79. Hands should be thoroughly washed and dried before handling of food as it is the most effective way of preventing spread of norovirus and HAV. Hands should be washed with soap and water, then rinsed and dried in a manner that does not re-contaminate the hands. The use of disposable hand towels and non-hand operable taps should be encouraged wherever possible, if this is not feasible, suitable hand washing and hand drying systems should be available. Hands should be washed in sinks dedicated to such a purpose and not washed in dishwashing sinks or food preparation sinks, to the extent possible.

80. Everyone should always wash their hands, especially before handling food, after using the toilet or after being in contact with faeces (also after changing diapers/nappies, cleaning toilets), or after being in contact with vomitus.

Personnel involved in slaughtering and/or further processing of meat parts and organs should comply with hand hygiene after being in contact with animal parts and fluids.

81. If gloves are used, a procedure for glove use should be developed and followed. If gloves are used in the handling of food products, they should be in a sound, clean and sanitary condition. If disposable gloves are used, they should be discarded when they become torn, soiled, or otherwise contaminated, and replaced. When gloved hands have been in contact with potentially contaminated items, new gloves should be put on before preparing and handling food. The wearing of gloves or the use of hand sanitizers does not exempt the person from thoroughly washing their hands before putting on gloves.

82. Clothes of food handlers who have been infected, or suspected to have been infected, should be washed. It has been shown that conventional household washing detergents have a good virucidal efficiency at 40°C.

12.4 Personal behaviour

83. Personal items such as money, keys, phones etc., should not be handled by operators at the same time they are handling/preparing food. After any contact with materials that are potentially contaminated with foodborne viruses, hands should be thoroughly washed and new gloves, when used, should be put on before handling or preparing food.

13. CONTROL OF OPERATION

84. Refer to Section 13 of the *General Principles of Food Hygiene* (CXC 1-1969). In addition:

OBJECTIVES: Processing operations should be controlled to prevent contamination of food with viruses.

RATIONALE: Preventive measures against the identified hazards or risks may help reduce virus contamination.

85. Control of enteric viruses in food will typically require a stringent application of hygiene control systems, e.g. Good Hygiene Practices (GHPs) and sanitation standard operation procedures. These prerequisite programs, together with validated interventions, e.g. as part of a HACCP-based system, provide a framework for the control of enteric viruses.

13.1 Key aspects of GHPs

86. Refer to Section 13.2 of the *General Principles of Food Hygiene* (CXC 1-1969). In addition:

87. Any food possibly contaminated by vomitus or by aerosols containing vomitus should be disposed of. Any food handled by an ill person should be evaluated to determine whether it should be disposed. Food handled by someone with norovirus during that day (or the day before) should be considered a risk and disposal of implicated products should be considered. Given that HAV may be shed at the highest levels two weeks before symptoms appear, it is important to assess the risk of foods which had been handled by someone with hepatitis A at least two weeks before the illness occurred. In this situation, disposal of the implicated food should be considered.

88. If an outbreak has been traced back to an establishment, the necessary steps should be taken to find the source, to eliminate the virus, and to avoid future outbreaks.

13.1.1 Time and temperature control

89. Refer to Section 13.2.1 of the *General Principles of Food Hygiene* (CXC 1-1969). In addition:

- **Cooling and freezing:** Cooling and freezing processes should not be considered suitable for the control of foodborne viruses as they do not reduce virus infectivity to levels considered safe.
- **Heat treatment:** The effects of heat treatment on virus infectivity in foods are highly dependent on virus (sub)-type, food matrix and the initial level of viral contaminants. Temperature and time combinations of cooking procedures are important in determining the adequacy of a treatment to inactivate infectious virus. For example, cooking procedures in which an internal temperature of the food reaches at least 90°C for 90 seconds are considered adequate treatments to inactivate infectious virus. However, light cooking, e.g. steaming, searing, may not be adequate to inactivate infectious virus leading to unsafe foods. Low temperature pasteurization (e.g. 63 °C for 30 min or 70 °C for 2 min) is more effective than High Temperature Short Time (HTST; 72 °C for 15–20 seconds) pasteurization, and likely yields at least a 3 log₁₀ inactivation of norovirus. However, given the potential for contamination of foods with millions of viral particles and an infectious dose as low as a few viral particles, even conventional pasteurization may not adequately inactivate norovirus in a contaminated food. Commercial canning is considered an adequate treatment to destroy viral infectivity in foods.

13.1.2 Specific process steps

90. Refer to Section 13.2.2 of the *General Principles of Food Hygiene* (CXC 1-1969). In addition:
91. Where necessary, processes and treatments should be validated to ensure their effectiveness. Refer to the *Guidelines for the Validation of Food Safety Control Measures* (CXG 69-2008).
92. Various processes have been shown to reduce virus load in selected food items but are subject to substantial variability depending on virus type and subtype, food matrix and location of virus on food matrix. As such, these processes by themselves will be inadequate to protect the consumer, but when the processes are combined, the additive effect of the processes may enhance the level of inactivation of viruses present. Processing combinations should be subject to rigorous validation to ensure consumer protection.
- Washing: The washing of food ingredients or products in water fit for purpose, may not be effective if the food surface is rough, broken or pitted or if viruses are internalized.
 - Reduce pH: Human enteric viruses are very stable at low pH levels. More than 3 log₁₀ inactivation of HAV may occur at pH < 3, a pH that is not always acceptable for the sensorial quality of foods.
 - Reducing water activity (RA_w): RA_w may accelerate degradation or inactivation rates of viruses, but its effect on virus infectivity in foods (or on fomites) is highly dependent on virus (sub)type and food matrix and thus RA_w cannot be considered an effective generic measure to reduce viral loads at present. The drying/desiccation of human enteric viruses on processing equipment surfaces may reduce the level of infectious virus.
 - High hydrostatic pressure (HHP): HPP can be considered a measure to reduce viral infectivity and loads in foods, although its effectiveness is dependent on the combination of virus type and food matrix, and the pressure applied.
 - Ultraviolet (UV) Irradiation: UV irradiation cannot be considered an effective generic measure to reduce viral loads on or in food, although it can be effective for the inactivation of viruses on surfaces for food preparation and for the inactivation of viruses in water and aerosols. While it does reduce virus infectivity in foods, its effectiveness is highly dependent on the virus being present on the surface of the food, the virus (sub)-type, the food matrix, the wavelength of UV used, and distance of the UV source from the food.
93. When new virucidal technologies or treatment combinations are being developed, they should be validated with the appropriate hazard/food combination prior to their implementation in the food production chain. Their effectiveness should be evaluated using virus infectivity assays where possible. When such assays do not exist for the specific virus, use of suitable surrogate viruses, or molecular assays, which can evaluate decline in virus genome copies, should be considered. The results should be evaluated with caution as the surrogates may not always mimic the resistance of the intended foodborne viruses, and decline in infectivity may be higher than decline in genome copies. Some treatments might be subject to prior approval by the competent authority.

13.1.3 Incoming material

94. Refer to Section 13.2.8 of the *General Principles of Food Hygiene* (CXC 1-1969). In addition:
95. Raw ingredients contaminated with viruses may lead to contamination of food handlers' hands, other foods, or food contact surfaces. Raw ingredients from suppliers or production establishments with an adequate food hygiene system should be used.

13.1.4 Packaging

96. Refer to Section 13.2.9 of the *General Principles of Food Hygiene* (CXC 1-1969). In addition:
97. Various types of packaging that are aimed at inhibiting bacterial or fungal growth are often not effective against enteric viruses because enteric viruses do not grow in foods and remain preserved while retaining their infectivity.

13.2 Documentation and records

98. Refer to Section 13.4 of the *General Principles of Food Hygiene* (CXC 1-1969). In addition:
99. It is recommended that control procedures used for viruses be monitored to ensure their continuing effectiveness.

13.3 Recall procedures – removal from the market of unsafe food

100. Refer to Section 13.5 of the *General Principles of Food Hygiene* (CXC 1-1969). In addition:
101. Based on the determined level of risk associated with the presence of viruses in a given food product, a decision

may be taken to recall the contaminated product from the market. The need for public information and communicated warnings should be considered.

14. PRODUCT INFORMATION AND CONSUMER AWARENESS

102. Refer to Section 14 of the *General Principles of Food Hygiene* (CXC 1-1969).

14.1 Lot identification and traceability

103. Refer to Section 14.1 of the *General Principles of Food Hygiene* (CXC 1-1969). In addition:

104. Enteric viruses can persist for long periods of time in food. As distribution of food between areas and countries complicates traceability, lot identity and integrity should be maintained to facilitate trace back.

14.2 Consumer education

105. Refer to Section 14.4 of the *General Principles of Food Hygiene* (CXC 1-1969). In addition:

106. Countries should develop educational programs to make consumers more alert to the potential risk of viral contamination of certain foods as applicable to their region.

15. TRANSPORTATION

107. Refer to Section 15 of the *General Principles of Food Hygiene* (CXC 1-1969).

HAZARD ANALYSIS AND CRITICAL CONTROL POINT (HACCP) SYSTEM AND GUIDELINES FOR ITS APPLICATION

16. INTRODUCTION TO HACCP

108. Refer to Section 16 of the *General Principles of Food Hygiene* (CXC 1-1969).

17. PRINCIPLES OF THE HACCP SYSTEM

109. Refer to Section 17 of the *General Principles of Food Hygiene* (CXC 1-1969).

18. GENERAL GUIDELINES FOR THE APPLICATION OF THE HACCP SYSTEM

110. Refer to Section 18 of the *General Principles of Food Hygiene* (CXC 1-1969).

19. APPLICATION

111. Refer to Section 19 of the *General Principles of Food Hygiene* (CXC 1-1969).

ANNEX I

CONTROL OF NOROVIRUS AND HEPATITIS A VIRUS (HAV) IN BIVALVE MOLLUSCS**1. INTRODUCTION**

1. For bivalve molluscs, the major, well-documented route of contamination is via human faecal contamination in growing or harvesting areas. Viruses have been observed to persist for 8 to 10 weeks in contaminated live bivalve molluscs and can be detected in the digestive tissue of bivalve molluscs. Some norovirus genotypes bind specifically to bivalve molluscs' tissue receptor sites, which could explain why some viruses persist after depuration procedures as currently practiced in the industry.

2. Furthermore, there may be a risk of infection if contaminated bivalve molluscs are consumed after insufficient heat treatment. Thus, once viral contamination of bivalve molluscs has occurred, removal or inactivation of the viruses by processes that retain the sensory characteristics of the live molluscs is difficult. Measures should be taken to prevent viral contamination of bivalve molluscs by improving environmental conditions (particularly water quality) in production and harvesting areas. Long-term relay of bivalve molluscs to clean environmental water is effective for eliminating the risk of illness from viruses. While this may add costs or be challenging because of the lack of clean areas in reasonable proximity to contaminated harvest sites, its effectiveness warrants consideration by competent authorities.

2. OBJECTIVES

3. The primary purpose of this annex is to provide competent authorities with guidance on how to prevent or minimize the presence of norovirus and HAV in bivalve molluscs in order to protect the health of consumers and ensure fair practices in food trade. The annex will also be of interest to food business operators (FBOs), food handlers, and consumers, among others.

3. SCOPE

4. This annex applies to bivalve molluscs and outlines control measures aimed at minimizing and/or preventing contamination with norovirus and HAV to prevent or reduce foodborne illness.

4. USE

5. This annex on the *Control of Norovirus and Hepatitis A Virus (HAV) in Bivalve Molluscs* (Annex I) is a supplement to the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012) and provides additional recommendations for this specific virus-commodity combination. This annex should also be used in conjunction with Sections 2 and 7 of the *Code of Practice for Fish and Fishery Products* (CXC 52-2003). Furthermore, guidance for implementation of bivalve mollusc sanitation programme within the framework of the Section 7 of the *Code of Practice for Fish and Fishery Products* (CXC 52-2003) is outlined in the FAO and WHO (2021) *Technical guidance for the development of the growing area aspects of Bivalve Mollusc Sanitation Programmes*.

5. GENERAL PRINCIPLES

6. Refer to the *General Principles of Food Hygiene* (CXC 1-1969).

6. DEFINITIONS

7. For the purpose of this Annex, definitions from the *General Principles of Food Hygiene* (CXC 1-1969), the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012) and the definitions from the *Code of Practice for Fish and Fishery Products* (CXC 52-2003) for clean water, depuration, growing areas and relaying apply.

GOOD HYGIENE PRACTICES**7. INTRODUCTION AND CONTROL OF FOOD HAZARDS**

8. Refer to the *General Principles of Food Hygiene* (CXC 1-1969).

8. PRIMARY PRODUCTION

9. Refer to Section 8 of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012). In addition:

10. The main risk known for the production of bivalve molluscs is microbiological contamination of the waters in which they grow, especially as bivalve molluscs are often consumed live, raw or partially treated. Since bivalve molluscs are filter feeders, they concentrate any microbiological contaminants present in the surrounding water. Growing areas should be managed to prevent contamination from pathogens including bacteria and viruses and appropriate techniques applied, such as further processing, to ensure end product specifications are met.

11. It is important to ensure the water quality of growing areas to prevent or minimize viral contamination of bivalve mollusc growing areas. A sanitary survey of growing areas should be conducted prior to the initiation of growing and/or harvesting operations. The sanitary survey of growing areas should include an assessment of possible human faecal contamination sources. An analysis should be made to identify situations that are likely to disrupt the normal sanitary conditions, such as heavy rainfall, the criteria (not necessarily microbiological) for stopping harvest when these situations arise, and for resuming harvest after the risk has passed. Sanitary surveys should be updated periodically to identify changes to possible sources of contamination and any consequential changes to the criteria.

12. The following are examples of factors that should be addressed during the sanitary survey and where possible should be supplemented by a practical shoreline survey:

- location and extent of the bivalve mollusc fishery;
- growing and harvest practices (species, type of harvest, location in the water column, method of harvest, seasonality of harvest);
- location, type and volume of sewage discharges;
- location of river inputs and other potentially contaminated water courses (from maps/nautical charts);
- location of harbours and marinas (from maps/nautical charts);
- hydrographic and hydrometric data;
- existing microbiological data from water quality or bivalve molluscs monitoring undertaken in the same area or adjacent areas; and
- location of areas of recreational boating and bathing.

13. The level of faecal contamination may indicate the potential for the presence of human enteric viruses. To control the hazards, identification and monitoring of growing areas is very important for bivalve mollusc safety. *E. coli* and faecal coliforms are used as indicators of faecal contamination, often for determining product and water quality, respectively. Male specific coliphage (MSC) can be used as an additional indicator for potential human enteric virus contamination in certain circumstances. For example, the use of MSC to examine bivalve molluscs for sanitary surveys and emergency closure events. Guidance on the use of MSC is outlined in the FAO and WHO (2021) *Technical guidance for the development of the growing area aspects of Bivalve Mollusc Sanitation Programmes*. Monitoring data should be interpreted within the context of the sanitary survey, as viruses may be present in the absence of these indicators.

14. When an outbreak associated with the consumption of bivalve molluscs is caused by an identified pathogen such as norovirus or HAV, and the harvesting area has been closed, appropriate measures should be taken before reopening to ensure product safety. Viral testing of the bivalve molluscs using standardized methods or alternative validated methods could be used, alternatively, other approaches consistent with the requirements of the competent authority may also be used as part of the reopening process. Other conditions, including meeting the sanitary survey requirements, should also have been satisfied before reopening the area. Ideally, they should include the identification of sources of pollution/contamination and prevention of future contamination events.

8.1 Environmental control

15. Refer to Section 8.1 of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012). In addition:

16. With regard to risks for virus contamination, some of the specific areas to be addressed in growing area management plans are as follows:

- Growing areas that are contaminated by sewage discharge or disposal of faecal matter from ships, recreational boats and bivalve mollusc harvesting vessels.

- Overflow from sewage treatment plants that may contaminate the growing waters after heavy rainfall.
 - Quality of sewage collecting network and private septic tanks.
17. Every effort should be made to eliminate the overflow of untreated or partially treated sewage into growing waters.
18. Sewage treatments should ensure adequate reduction of viral loads and aim to achieve significant reduction of norovirus and HAV (Refer to *WHO Guidelines for the safe use of wastewater, excreta and grey water. Volume 3 Waste water and excreta use in aquaculture* (<https://iris.who.int/handle/10665/78265>)). Whenever possible, sewage treatment should involve a tertiary treatment step such as UV or ultra-filtration treatment. The use of a prohibition zone for the harvest of bivalve molluscs near a wastewater treatment plant is another option the competent authority may use. Treatment plants should be designed to minimize storm overflows that may affect the fishery.
19. Systems should be put in place to monitor sewage spills and provide prompt notification to the appropriate competent authority as well as the bivalve molluscs industry so that appropriate action (i.e. cessation of harvesting) can be taken.
20. When events occur that can potentially contaminate growing areas with untreated or partially treated sewage (e.g. heavy rainfall and overflow from sewage treatment plants), harvesting of bivalve molluscs should cease for a period, until the water and/or bivalve mollusc quality of the harvesting area has been assessed and has been returned to normal background levels for the area. If there is evidence that the area has been impacted by human sewage, testing of water or bivalve molluscs for the presence of indicators of faecal contamination and/or norovirus or HAV, as determined by the competent authority, or an equivalent safety measure, may be an option prior to re-opening.
21. When untreated or partially treated sewage is known or suspected to have entered a growing area, it is recommended that bivalve molluscs already harvested from this area during the suspected timeframe should be designated exclusively for virucidal heat treatment (see Section 13.2.1 of the main document and Section 13.2.2 of this Annex) by the processor before release to retail sales. Long-term relaying or a combination of depuration and relaying may be an alternative option considered by the competent authority.
22. In addition, suitable precautions should be taken to protect bivalve molluscs from being contaminated by human faeces, in particular:
- No overboard discharge of human faeces should occur from vessels around bivalve molluscs growing areas.
 - All necessary measures should be taken to prevent contamination of bivalve molluscs by faecal materials on board of harvest vessels.
 - Facilities and toilets should be designed to ensure that an appropriate degree of personal hygiene can be maintained, especially on harvest vessels.

8.2 Hygienic production

23. Refer to Section 8.2 of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012). In addition:
24. Efforts should be made to restrict the growing and harvesting of bivalve molluscs to areas of clean water only.
25. Records, such as results of water quality and/or bivalve molluscs quality testing, including test results for viruses from the harvest area, should be kept and reviewed alongside historical records to identify risk periods for each growing area. During such periods, monitoring of both water and the bivalve molluscs in risk areas for norovirus and HAV should be increased.
26. In addition to the use of clean water during primary production, other possible control measures for enteric viruses such as norovirus and HAV, include long term relaying or a combination of depuration and relaying.
27. If using short-term or long-term relaying to reduce microbial contaminants, the effectiveness of the treatment is dependent upon the water quality and conditions of the location to which the bivalve molluscs are relayed. The time used for relaying bivalve molluscs should be verified as appropriate by the competent authority having jurisdiction, using standardized protocols for specific virus/mollusc species pairings. The holding time and minimum temperature during long term relaying should be based on the degree of contamination before relaying, the temperature of the water, the

bivalve mollusc species involved and local geographic or hydrographic conditions to ensure that contamination levels will be adequately reduced. A short-term depuration process commonly reduces low levels of bacterial contamination and thus contributes to the safety of bivalve molluscs but depuration alone is inadequate in the elimination of viruses.

28. When there is a high likelihood or evidence of virus contamination through epidemiological information, environmental events or detection of virus, closure of the area, destruction of contaminated bivalve molluscs and/or virucidal heat treatment (see Section 13.2.1 of the main document and Section 13.2.2 of this Annex) before consumption of already harvested bivalve molluscs is recommended. Another option, if verified by the competent authority, is long term relaying or a combination of depuration and relaying.

9. ESTABLISHMENT - DESIGN OF FACILITIES AND EQUIPMENT

29. Refer to Section 9 of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012).

10. TRAINING AND COMPETENCE

30. Refer to Section 10 of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012).

10.1 Training programmes

31. In addition to the training content mentioned in the General Section of the Guidelines (Section 10.2), personnel involved in the growing and harvesting of bivalve molluscs should have appropriate training in:

- Recognizing the conditions or situations in which the growing and harvesting of bivalve molluscs is not safe with respect to foodborne viruses and when actions should be taken to prevent potentially contaminated molluscs from entering the marketplace.
- Control measures to prevent faecal contamination of growing and harvesting areas.
- Awareness of the lack of correlation between bacterial indicators and viral contamination.
- Control measures to prevent bivalve molluscs from becoming contaminated by contagious food handlers.

11. ESTABLISHMENT MAINTENANCE, CLEANING AND DISINFECTION, AND PEST CONTROL

32. Refer to Section 11 of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012).

12. PERSONAL HYGIENE

33. Refer to Section 12 of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012).

13. CONTROL OF OPERATION

34. Refer to Section 13 of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012).

13.1 Key aspects of GHPs

13.1.1 Specific process steps

35. Refer to Section 13.1.2 of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012). In addition:

- Heat Treatment: Heat treatments of bivalve molluscs should be validated for their ability to inactivate viruses. An internal temperature of 85 to 90 °C for at least 90 seconds is considered to be a virucidal treatment for bivalve molluscs. However, this degree of cooking would probably render specific bivalve molluscs, such as oysters, unpalatable to consumers. Even though cooking temperatures typically used by consumers may not achieve 90 °C for at least 90 seconds and thus ensure inactivation of viruses, any cooking would reduce viral levels and depending on the initial level of contamination possibly would reduce the risk of causing foodborne infection. For example, it has been reported that an internal temperature of steamed shellfish maintained at 85 to 90 °C for 1 min reduced titres of HAV in cockles by more than 4 log₁₀. The possible inability of home or restaurant cooking to provide adequate assurance of consumer protection from consuming virally contaminated bivalve molluscs in

certain circumstances or forms of consumption underlines the importance of preventing virus contamination of water used for growing and harvesting bivalve molluscs.

- High Hydrostatic Pressure (HHP): HHP may reduce virus titres in bivalve molluscs but may reduce the quality of the mollusc meat. The HHP conditions for inactivation depend upon pressure as well as time, temperature and the water salinity, e.g. a pressure of 600 MPa applied at 6 °C for five minutes has been shown to inactivate norovirus in oysters, although organoleptic properties will be impacted at these parameters. The use of HHP alone or in combination with other inactivation procedures should be validated for the virus of concern in the specific bivalve mollusc species prior to its application.

14. PRODUCT INFORMATION AND CONSUMER AWARENESS

36. Refer to Section 14 of the *General Principles of Food Hygiene* (CXC 1-1969).

14.1 Lot identification and traceability

37. Refer to Section 14.1 of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012). In addition:

38. Norovirus and HAV can persist for long periods of time in bivalve molluscs. As movements between growing areas and countries complicate traceability of bivalve molluscs, lot identity, harvest site and date should be maintained to facilitate trace back to all the growing areas (i.e. there may be more than one growing area when relaying is used). Because of viral persistence, it is recommended that growing areas be registered for a two-month period prior to harvest and that harvest areas also be registered.

14.2 Product labelling

39. Refer to Section 14.3 of the *General Principles of Food Hygiene* (CXC 1-1969). In addition:

40. Refer to the *General Standard for Labelling of Prepackaged Foods* (CXS 1-1985) and to the labelling provisions of the *Standard for Live and Raw Bivalve Molluscs* (CXS 292-2008). Where appropriate, product labels should include information on safe handling practices and storage recommendations.

41. Unpackaged live or raw bivalve molluscs should be adequately labelled, so that consumers are properly informed with respect to the safety and nature (whether for consumption raw or cooked) of these products.

14.3 Consumer education

42. Refer to Section 14.2 of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012). In addition:

43. Each country has specific consumption habits; therefore, communication programmes pertaining to viruses in relation to the consumption of bivalve molluscs are most effective when established by national governments. Consumers should be made aware of the risk of becoming infected with norovirus or HAV after consuming raw or partially treated bivalve molluscs, and of the recommended cooking time and temperature to achieve viral inactivation.

15. TRANSPORTATION

44. Refer to Section 15 of the *General Principles of Food Hygiene* (CXC 1-1969).

HAZARD ANALYSIS AND CRITICAL CONTROL POINT (HACCP) SYSTEM AND GUIDELINES FOR ITS APPLICATION

16. INTRODUCTION TO HACCP

45. Refer to Section 16 of the *General Principles of Food Hygiene* (CXC 1-1969).

17. PRINCIPLES OF THE HACCP SYSTEM

46. Refer to Section 17 of the *General Principles of Food Hygiene* (CXC 1-1969).

18. GENERAL GUIDELINES FOR THE APPLICATION OF THE HACCP SYSTEM

47. Refer to Section 18 of the *General Principles of Food Hygiene* (CXC 1-1969).

19. APPLICATION

48. Refer to Section 19 of the *General Principles of Food Hygiene* (CXC 1-1969).

ANNEX II

CONTROL OF NOROVIRUS AND HEPATITIS A VIRUS (HAV) IN FRESH AND FROZEN PRODUCE**1. INTRODUCTION**

1. Fresh produce is now grown on a large scale in many countries and is transported globally. Outbreaks of foodborne viruses associated with contaminated berries, green onions, and fresh leafy vegetables are well documented. Frozen berries predominate 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.
2. The viral contamination of fresh produce may occur at any stage from production to consumption.
3. Fresh and frozen produce may become contaminated with viruses through contact with human sewage, e.g. through (a) the use of sewage-contaminated waters for irrigation, washing, frost protection; (b) the application of fertilisers and agrichemicals; or (c) through the seepage of untreated or partially treated sewage into the soil.
4. Fresh and frozen produce may also become contaminated by viruses via contaminated hands of food handlers especially if they do not practice appropriate personal hand hygiene (i.e. hand washing). Another important aspect of food-handler associated spread of viruses is vomiting, which can lead to widespread contamination of the environment.
5. In countries where HAV infection is endemic, children in and around production fields may play an important role in the spread of viruses during primary production. Children who are asymptomatic or have undiagnosed HAV infection often shed virus and may contaminate fresh produce when present in the production field or when being cared for by a food handler.
6. Preventing contamination is key given that infectious norovirus and HAV can persist on fresh and frozen produce for long periods of time, and depending on the level of contamination, type of virus, virus load, food matrix, storage time and temperature, they may survive throughout the shelf-life of the products.

2. OBJECTIVES

7. The primary purpose of this annex is to provide competent authorities with guidance on how to prevent or minimize the presence of norovirus and HAV in fresh and frozen produce in order to protect the health of consumers and ensure fair practices in food trade. The annex will also be of interest to food business operators (FBOs), food handlers, and consumers, among others.

3. SCOPE

8. This annex covers general hygienic practices for the production, harvesting, processing, packing and storage of fresh and frozen produce for human consumption particularly for fresh and frozen produce intended to be consumed raw or partially treated. This annex focuses on norovirus and HAV in fresh and frozen produce and preventing fresh produce from becoming contaminated by these viruses during primary production.
9. Recommendations for handling practices to maintain the safety of fresh and frozen produce at wholesale, retail, food services or in the home are covered in the *General Principles of Food Hygiene* (CXC 1-1969), the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CXC 53 – 2003) and the main part of this document.

4. USE

10. This Annex on the *Control of Norovirus and Hepatitis A Virus (HAV) in Fresh and Frozen Produce* (Annex II) is a supplement to the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012) and provides additional recommendations for this specific virus-commodity combination.

5. GENERAL PRINCIPLES

11. Refer to the *General Principles of Food Hygiene* (CXC 1-1969).

6. DEFINITIONS

12. For the purpose of this Annex, definitions from the *General Principles of Food Hygiene* (CXC 1-1969) and the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012) apply.

Fresh produce –[see section 6 of the General section]

Frozen produce –[see section 6 of the General section]

GOOD HYGIENE PRACTICES

7. INTRODUCTION AND CONTROL OF FOOD HAZARDS

13. Refer to the *General Principles of Food Hygiene* (CXC 1-1969).

8. PRIMARY PRODUCTION

14. Refer to Section 8 of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012). In addition:

15. Fresh produce is grown and harvested under a wide range of climatic and diverse geographical conditions and using various agricultural inputs and technologies. Farms can be of different sizes and operate under varying socioeconomic and epidemiological circumstances that influence the selection of measures to ensure hygienic performance. The risk of virus contamination may therefore vary considerably from one type of production to another. In each primary production area, it is necessary to consider the particular agricultural practices that promote the production of safe fresh produce, taking into account the conditions that are specific to the primary production area, type of produce, and methods used. Primary production activities should be conducted following good hygienic practices in order to minimize potential risks of contamination of fresh and frozen produce with norovirus and HAV.

8.1 Environmental control

16. Refer to Section 8.1 of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012). In addition:

17. For fresh produce, the main sources of contamination by norovirus and HAV of the production sites are sewage treatment plant effluents, untreated human excreta used as fertilizer, agricultural workers, and inadequate toilet facilities and on-site personnel hygiene (Refer to *WHO Guidelines for the safe use of wastewater, excreta and grey water. Volume 2: Wastewater use in agriculture* (World Health Organization 2006 ISBN 92 4 154683 2,v.2; <https://iris.who.int/handle/10665/78265>). If these sources contaminate water and soil that come into contact with fresh produce, there is a potential risk of contamination with norovirus and HAV. Infectious norovirus and HAV can persist in the environment for long periods of time, and depending on the level of contamination, virus, and environmental conditions, they may survive for a long time in the primary production environment.

18. Sewage treatments should ensure adequate (maximal) reduction of viral loads in treated sewage, as the following could be potential sources of contamination:

- Water contaminated with untreated or partially treated sewage discharges, by overflow from sewage and septic tank systems or from run-off associated with a heavy rainfall, that is used for irrigation, washing of produce, or application of fertilizers and agrichemicals.
- Seepage of untreated or partially treated sewage onto/into agricultural soil.

8.2 Hygienic production

8.2.1 Water for primary production

19. Refer to the *Guidelines for the Safe Use and Reuse of Water in Food Production and Processing* (CXG 100-2023).

20. Water fit for purpose should be used for the production of food. The assessment of the microbial quality of the sources of water used on the farm for the presence of norovirus and HAV should include an assessment of possible human faecal contamination sources of the water (sanitary survey) and, if deemed necessary, testing for faecal contamination. In the case of identified contamination sources of the water used on the farm, corrective actions should be taken to minimize the risk of contamination with norovirus and HAV. The effectiveness of corrective actions should be verified.

21. Testing for *E. coli* / faecal coliforms is useful to determine the level of faecal contamination of the water. *E. coli* originates from human and animal sources; however, currently it is assumed that norovirus and HAV originate from

human sources only. The level of faecal contamination may indicate the potential for the presence of norovirus and HAV; however, these viruses may be present in the absence of faecal indicators (e.g. if from vomitus). The frequency of testing for indicators of faecal contamination and which particular indicators may best correlate with enteric virus presence should be established according to the source of the water (e.g. ground water, surface water, wells) and the conditions of the irrigation system.

22. The risk of norovirus and HAV contamination is considered higher with irrigation techniques such as overhead sprinklers that result in direct water contact with the edible portion of fresh produce, compared to other types of irrigation, such as drip irrigation.

8.3 Cleaning, maintenance and personnel hygiene

23. Refer to Section 8.4 of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012). In addition:

24. Personnel hygiene facilities and toilets (permanent or portable), including appropriate hand washing facilities, should be present in close proximity of the fields where agricultural workers are working, and be installed such that any runoff from these facilities does not contaminate the fields.

9. ESTABLISHMENT – DESIGN OF FACILITIES AND EQUIPMENT

25. Refer to Section 9 of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012).

10. TRAINING AND COMPETENCE

26. Refer to Section 10 of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012). In addition:

27. Personnel involved in growing, harvesting, processing and storage of fresh and frozen produce should have appropriate training in:

- The general characteristics of norovirus and HAV and their resistance to various environmental conditions, e.g. conditions of sewage treatment, temperature.
- Personal hygiene (see Section 12, main document).
- Control measures to prevent faecally contaminated water being used in primary production and processing.
- The risks associated with the use of human waste excreta as a fertilizer.
- Control measures to prevent fresh and frozen produce becoming contaminated by contagious food handlers.
- How to identify conditions or circumstances when the risk of virus contamination is increased and actions that may need to be taken.

11. ESTABLISHMENT MAINTENANCE, CLEANING AND DISINFECTION, AND PEST CONTROL

28. Refer to Section 11 of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012).

12. PERSONAL HYGIENE

29. Refer to Section 12 of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012). In addition:

12.1 Visitors and other persons from outside the establishment

30. Non-authorized persons and, to the extent possible, children, should not be allowed on the premises where fresh produce is grown, washed, packed or stored.

13. CONTROL OF OPERATION

31. Refer to Section 13 of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012). In addition:

32. The control of norovirus and HAV in fresh and frozen produce should focus on the prevention of contamination of fresh produce with human faecal material, as there are limited effective post-harvest treatments to eliminate viruses available at present.

13.1 Key aspects of GHPs

13.1.1 Specific process steps

33. Refer to Section 13.1.2 of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012). In addition:

- Washing: The washing of fresh produce may not be effective for eliminating viruses as the structure of the produce surface (e.g. rough, broken or pitted) may protect the viruses. Similarly, some fruits are very fragile (e.g. raspberries) and cannot be washed.
- Chemical treatment: Antimicrobial agents, effective for bacteria, may not be as effective for the reduction of norovirus and HAV in fresh and frozen produce.

14. PRODUCT INFORMATION AND CONSUMER AWARENESS

34. Refer to Section 14 of the *General Principles of Food Hygiene* (CXC 1-1969).

15. TRANSPORTATION

35. Refer to Section 15 of the *General Principles of Food Hygiene* (CXC 1-1969).

HAZARD ANALYSIS AND CRITICAL CONTROL POINT (HACCP) SYSTEM AND GUIDELINES FOR ITS APPLICATION

16. INTRODUCTION TO HACCP

36. Refer to Section 16 of the *General Principles of Food Hygiene* (CXC 1-1969).

17. PRINCIPLES OF THE HACCP SYSTEM

37. Refer to Section 17 of the *General Principles of Food Hygiene* (CXC 1-1969).

18. GENERAL GUIDELINES FOR THE APPLICATION OF THE HACCP SYSTEM

38. Refer to Section 18 of the *General Principles of Food Hygiene* (CXC 1-1969).

19. APPLICATION

39. Refer to Section 19 of the *General Principles of Food Hygiene* (CXC 1-1969).

ANNEX III

CONTROL OF HEPATITIS E VIRUS (HEV) IN PORK AND WILD GAME MEAT**1. INTRODUCTION**

1. Foodborne hepatitis E virus (HEV) infections are caused mainly by HEV-3 and, to a lesser extent, HEV-4. The main source of food transmitted HEV is domestic pigs, but game animals, such as wild boar, deer, and mongoose, can also be infected with HEV.

2. Liver from infected animals is the main source of HEV, although blood, and to lesser extent skeletal muscle tissues can also contain HEV. In addition to these edible parts, high viral loads have been detected in bile, intestinal content and manure. Meat and meat products can become contaminated by (i) intrinsic contamination when the animal is infected and the virus has not been fully cleared at the time of slaughter, (ii) cross-contamination with faeces, bile or blood from infected animals at the time of slaughter, or (iii) inclusion of contaminated raw liver or blood in ready-to-eat (RTE) or minimally-processed pork and wild game products.

3. The risk of foodborne HEV infection arises from consuming raw or undercooked liver (products) or pork and wild game (products) as well as from using untreated, contaminated pig manure as fertilizer for crops. However, the latter is outside the scope of this Annex.

2. OBJECTIVES

4. This annex provides advice to competent authorities on a framework for the reduction of infectious HEV in pork and wild game meat and meat products, to protect the health of consumers and ensure fair practices in food trade. The primary purpose of this annex is to minimize the likelihood of human illness arising from the presence of HEV in pork and wild game meat. This annex also provides information that will be of interest to the food industry, consumers, and other interested parties.

3. SCOPE

5. This annex applies to pork and wild game meat and outlines control measures aimed at mitigating and/or preventing contamination of meat and meat products with HEV to prevent or reduce foodborne illness.

4. USE

6. This annex on the *Control of Hepatitis E Virus (HEV) in Pork and Wild Game Meat* (Annex III) is a supplement to the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012) and provides additional recommendations for this specific virus-commodity combination.

5. GENERAL PRINCIPLES

7. Refer to the *General Principles of Food Hygiene* (CXC 1-1969).

6. DEFINITIONS

8. For the purpose of this Annex, definitions from the *General Principles of Food Hygiene* (CXC 1-1969) apply.

GOOD HYGIENE PRACTICES**7. INTRODUCTION AND CONTROL OF FOOD HAZARDS**

9. Refer to the *General Principles of Food Hygiene* (CXC 1-1969).

8. PRIMARY PRODUCTION

10. Refer to Section 8 of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012). In addition:

8.1 Environmental control

11. Refer to Section 8.1 of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012). In addition:

Zoonotically transmitted HEV enters the food chain with infected pigs and wild game animals. Wild boars can serve as reservoirs of HEV for domestic pigs and other wild animals. The presence of infected animals in the primary production

environment should be controlled to the extent practicable. Possible methods to exclude wild animals from the primary production and handling area include the use of physical barriers (e.g. fences) and active deterrents (e.g. noise makers).

12. The primary production and handling areas should be properly designed and maintained to reduce the likelihood of attracting wild animals. Possible methods include minimizing standing water and maintaining production sites and handling areas free of waste and clutter.

8.2 Hygienic production

13. Control measures at primary production should focus on prevention of animal infection, as HEV easily spreads between animals within farms. Biosecurity measures can be useful to reduce the number of animals infected with HEV at the primary production phase. This could include control access to farms, strict hygiene protocols for personnel and equipment, reducing the number of workers on farms, using rubber and steel floor material in fattening stalls, adequate fly control, as well as proper waste disposal, controlling animal movement to minimize contact with faeces and providing adequate space for animals to prevent overcrowding. Reduction of virus transmission may, however, result in animal infections later in life leading to a higher fraction of viraemic animals at slaughter age. Therefore, monitoring the infection status of pigs through PCR-based testing for the presence of HEV RNA and serology to discriminate between naïve pigs and infected pigs (including animals that have cleared the virus) can aid in developing targeted farming strategies to reduce the number of viraemic animals at time of slaughter. Targeted farming strategies could include “all-in, all-out” production systems, age-segregation of pigs, and improved hygiene within farm compartments.

14. In general, measures to reduce faecal contamination of carcasses should be adhered to as they help to control potential viral contamination of the carcasses.

15. Manure must be considered as HEV-contaminated and should be contained as effectively as possible to prevent contamination of food, surfaces and personnel.

16. Manure should be properly managed on farms to reduce HEV contamination from entering the food chain. Viruses in pig manure should be inactivated prior to application in soil as fertilizer, to prevent contamination of fresh produce.

9. ESTABLISHMENT - DESIGN OF FACILITIES AND EQUIPMENT

17. Refer to Section 9 of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012).

10. TRAINING AND COMPETENCE

18. Refer to Section 10 of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012).

10.1 Training programmes

19. In addition to the training content mentioned in the main part of this document (Section 10.2), there is a need to include information about the risk of HEV contamination in pork and game meat, and the risk of infection in humans.

19-bis Persons involved in animal husbandry should have:

- appropriate training in how to properly apply biosecurity measures and targeted farming strategies,
- awareness of these biosecurity measures and targeted farming strategies in reducing the number of animals infected with HEV at the primary production phase,
- appropriate training in manure management to reduce HEV contamination from entering the food chain,
- awareness of the potential for presence of infectious HEV in manure, urine, sewage and the importance of compliance with hand hygiene after being in contact with these to reduce the risk of infection or spread of the virus.

20. Persons involved in harvesting, slaughtering, dressing, and/or further processing of meat parts or organs, as well as hunters involved in disbowelling/eviscerating and cleaning game should have:

- appropriate training in how to reduce faecal contamination of the carcasses,
- appropriate training on control measures to prevent cross-contamination between tissues with high risk of HEV

contamination and low-at risk parts (e.g. liver to meat),

- awareness of the potential for presence of infectious HEV in blood, livers, intestines, and bile and the importance of compliance with hand hygiene after being in contact with these parts to reduce risk of infection or spread of the virus, and
- awareness that HEV is highly resistant to commonly used chemical, physical and environmental inactivation methods, therefore after cleaning, disinfection should be performed using....(to be added during the next review when the JEMRA report Part 2 is published).

21. Persons working in maintenance or cleaning of establishments, vehicles for animal transport, sewage pipes, should have:

- awareness of the potential for presence of infectious HEV in manure, urine, sewage and the importance of compliance with hand hygiene after being in contact with these to reduce the risk of infection or spread of the virus.

11. ESTABLISHMENT MAINTENANCE, CLEANING AND DISINFECTION, AND PEST CONTROL

22. Refer to Section 11 of the of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012). In addition:

Ensure proper cleaning and disinfection of facilities to reduce faecal contamination of carcasses as it helps to control potential viral contamination of the carcasses.

23. Enteric viruses, including HEV, can persist for long periods of time on hard surfaces. The data on inactivation of HEV by surface disinfectants are too limited to draw conclusions but suggest a similarly high degree of resistance as observed for the other enteric viruses.

12. PERSONAL HYGIENE

24. Refer to Section 12 of the of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012). In addition:

25. Compliance with strict hand hygiene measures is important to reduce the risk of infection of the workers themselves after being in contact with potentially HEV-contaminated tissues, liver, intestines, bile, blood or surfaces. It will also reduce spread of the environmentally stable virus to food or surfaces.

13. CONTROL OF OPERATION

26. Refer to Section 13 of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012).

13.1 Key aspects of GHPs

13.1.1 Specific process steps

27. Refer to Section 13.1.2 of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012). In addition:

-Stability: HEV infectivity is only minimally affected by pH 2-9 or high salt conditions, and the virus may still be infectious after drying on surfaces for up to 4 weeks at room temperature or up to 8 weeks at 4°C.

-Heat treatment: Heat treatment can significantly reduce infectious HEV, although sufficient temperature/time combinations have to be applied. For example, treatment at 70-72°C core temperature for 20 minutes was necessary for complete HEV inactivation in pâté-like product. Medium-to-raw cooking conditions do not completely inactivate HEV. Generally, the thermal inactivation patterns of HEV appear to be similar to those of HAV. The required temperature for full inactivation of HEV depends on the food product's composition and initial viral load.

-Product composition: The risk of exposure to HEV can be reduced by excluding viscera which has the potential to be HEV-contaminated, such as liver, unless they undergo adequate thermal processing before being used as ingredients in RTE or minimally-processed foods.

13.1.2 Microbiological contamination

28. Cross-contamination of animal tissues through shared equipment in slaughterhouses should be prevented. For example, separation of high-risk and low-risk processing lines in slaughterhouses.

29. Unless from animals known to be free from HEV, intestine contents, bile and blood must be considered as HEV-contaminated and should be contained as effectively as possible to prevent contamination of food, surfaces and personnel.

14. PRODUCT INFORMATION AND CONSUMER AWARENESS

30. Refer to Section 14 of the *General Principles of Food Hygiene* (CXC 1-1969).

14.1 Lot identification and traceability

31. Refer to Section 14.1 of the of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012). In addition:

32. HEV infectivity can persist for long periods of time in food, depending on storage temperature.

14.2 Product labelling

33. Refer to Section 14.3 of the *General Principles of Food Hygiene* (CXC 1-1969). In addition:

34. Countries should consider labelling both packed and unpacked products that are high-risk for HEV contamination, including raw/inadequately processed porcine liver (products) or game meat, processed products in which raw liver or non-heated blood (products) are included as ingredients, so that the consumers are informed about the risk of these food products. Labelling should specify the risk associated with the products or ingredients to inform at-risk consumers to avoid or cook these products, in line with the legislation in the countries where these products are retailed or sold.

14.3 Consumer education

35. Refer to Section 14.2 of the of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012). In addition:

36. Since each country has specific consumption habits, communication and consumer education programmes should be tailored by the competent authorities to their consumers. Consumers should be made aware of the risk of infection with HEV associated with the consumption of raw or partially cooked pork or game meat products. Specific dietary advice is recommended for persons with pre-existing liver disease and immunocompromised individuals, e.g. transplant patients and patients using immunosuppressive medications.

15. TRANSPORTATION

37. Refer to Section 15 of the *General Principles of Food Hygiene* (CXC 1-1969).

38. Vehicles used for transportation of live animals may become contaminated with HEV (droppings, urine) and require appropriate cleaning and disinfection. Transportation of infected animals, e.g. piglets to fattening farms, may introduce HEV into the receiving farms.

HAZARD ANALYSIS AND CRITICAL CONTROL POINT (HACCP) SYSTEM AND GUIDELINES FOR ITS APPLICATION

16. INTRODUCTION TO HACCP

39. Refer to Section 16 of the *General Principles of Food Hygiene* (CXC 1-1969).

17. PRINCIPLES OF THE HACCP SYSTEM

40. Refer to Section 17 of the *General Principles of Food Hygiene* (CXC 1-1969).

18. GENERAL GUIDELINES FOR THE APPLICATION OF THE HACCP SYSTEM

41. Refer to Section 18 of the *General Principles of Food Hygiene* (CXC 1-1969).

19. APPLICATION

42. Refer to Section 19 of the *General Principles of Food Hygiene* (CXC 1-1969).

List of participants**Chair****Canada**

Martin Duplessis

Marie Breton

Cathy Breau

Neda Nasheri

Co-Chairs**Netherlands**

Ana Viora Alebesque

Ingeborg Boxman

Ecuador

Miguel Ortiz

Egypt

Zeinab Mosaad Abdel Razik

Guatemala

Lesli Archila

Honduras

Maria Sevilla

India

Alka Rao

Shashidhar R

Asish Kumar Mukhopadhyay

Nilanjan Chakraborty

Lijo John

Shri. M. Kaliraj

G. Srinivasan

Jitendra P Dongare

Shri Aditya Jain

Kiran Bhilegaonkar

Indonesia

Dwita Indah Sari

Standar Pangan Segar

Iran

Zahra Ghafoori

Ireland

Denis Carroll

Wayne Anderson

MEMBERS**Argentina**

María Ester Carullo

Erika J. Marco

Josefina Cabrera

Australia

Nora Galway

Mark Phythian

Belgium

Kris De Smet

Katrien De Pauw

Brazil

Carolina Araújo Vieira

Ligia Lindner Schreiner

Viviane Mega

Colombia

Blanca Cristina Olarte Pinilla

Costa Rica

Amanda Lasso Cruz

Denmark

Eva Selsner-Rasmussen

Gudrun Sandø

Brigitte Borck Høg

Japan

Wataru Iizuka
Nami Yamaguchi

Mexico

María Guadalupe Arizmendi Ramírez
Penélope Elaine Sorchini Castro
Mariana Jiménez Lucas

Morocco

Oleya Elhariri
Hicham Benslimane
Samah Tahri

New Zealand

Roger Cook
Nicola Dermer

Peru

Erick Denis Sardon Mamani
Rosa María Curi Ayamani
Libia Liza

Philippines

Kris Jenelyn P. De Las Peñas

Poland

Artur Rzeżutka

Republic of Korea

Minjin Park

Saudi Arabia

Nada G. Saeed
Mohammed M. Al Johani
Suliman M. Al Otabi
Sarah A. Alfaifi

Senegal

Mame Diarra Faye
Idrissa Diallo

Singapore

Tan Yi Ling

Spain

Lorena Solar de Frutos

Thailand

Virachnee Lohachoompol

United Kingdom

Monica Mann

United Arab Emirates

Mohammed Saleh Ali Suwaileh Albreiki
Maitha Saleh Mohamed

United States of America

Eric Stevens
Benjamin Warren
William Shaw
Annemarie Buchholz
Charles Risch
Steven Wilson

Uruguay

Sylvia Vazquez

OBSERVERS**International Commission on Microbiological Specifications for Foods (ICMSF)**

Leon Gorris
Kiran Bhilegaonkar

International Organization for Standardization (ISO)

Nigel Cook

International Fruit and Vegetable Juice Association (IFU)

Tatiana Campos
David Hammond
Aintzane Esturo

International Union of Food Science and Technology (IUFoST)

Samuel Godefroy
Hajar Tiglifet
Silvia Dominguez

Food and Agriculture Organization of the UN (FAO)

Kang Zhou

World Health Organization (WHO)

Akio Hasegawa