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World Health Organization

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Agenda item 7

JOINT FAO/WHO FOOD STANDARDS PROGRAMME

CODEX COMMITTEE ON FOOD HYGIENE

Fifty-sixth Session

Scottsdale, Arizona, United States of America

16-20 November 2026

PROPOSED DRAFT REVISION OF THE G*UIDELINES 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 and co-chaired by the Netherlands)

This version was prepared by the EWG chair and co-chairs taking into consideration the comments received in response to CL 2026/70-FH. All changes compared to the working document (CX/FH 26/56/7) are marked as tracked changes. This document will be used as the basis for discussion at the PWG on Sunday 15th November.

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. Foodborne viral infections are common, despite the measures already in place aimed at reducing bacterial contamination.

2. The enteric viruses most frequently implicated in foodborne outbreaks/sporadic cases 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, which 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. neurotropic enteroviruses). Infections with enteric viruses that cause gastroenteritis are mainly transmitted via the oral route. The viruses are excreted in faeces and, for some viruses, in vomitus. Asymptomatic infections and viral shedding are common and may act as undetected sources of contamination. As such, they represent significant risks in food production and handling environments.

4. Non-enteric viruses transmitted through food are an emerging public health concern, although their epidemiology remains less well characterized than that of the classic enteric viruses. One notable example is the tick-borne encephalitis virus (TBEV) that has been implicated in outbreaks associated with the consumption of raw milk and raw milk cheeses. The risk of emerging non-enteric viruses in food production highlights the importance of implementing integrated surveillance systems.

5. Characteristics of foodborne viruses and the associated infections/illnesses that may be helpful in determining risk management strategies are discussed below. As these characteristics may differ from those of bacterial pathogens, in some cases, the risk management strategies for controlling foodborne enteric viruses may also 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, the presence of viruses in food does not affect the organoleptic properties of the food or cause deterioration of the food.
- 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 transmitted via the faecal-oral route, either through direct person-to-person contact or indirectly through contaminated water and food. The relative importance of these routes varies according to the virus, sanitary conditions and epidemiological context. Foodborne and waterborne transmission are important routes of infection and can give rise to large outbreaks, particularly when water sources or products become contaminated with faecal matter during primary production. 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 enteric viruses, such as norovirus, HAV and HEV, consist of nucleic acid and a capsid. In addition to these, enveloped viruses, such as influenza virus (*Orthomyxoviridae*) or SARS-CoV-2 (*Coronaviridae*), are also surrounded by a lipid membrane envelope. Both The capsid and envelope structures influences environmental persistence by reducing susceptibility to desiccation, and viral resistance to cleaning and chemical disinfection interventions. Non-enveloped viruses tend to be more resistant to chemical inactivation and desiccation.

- Some viruses transmitted by the faecal-oral route can persist for months in/on food (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 allows viruses to persist in cold environments. Heat and drying can be used to inactivate viruses, although sensitivity to these processes differs from virus-to-virus (refer to 13.2.1). The type of matrix (e.g. food, water or fomite surface) and the presence of organic matter, such as faecal material, can influence the effectiveness of heat and drying for inactivation of viruses.

- Adequate hand washing practices (i.e. using soap and water and effective rubbing and rinsing, followed by drying) are more effective than the use of hand sanitizer for reducing the level of infectious viruses in food handling settings. Many commonly used hand sanitizers and disinfectants have reduced efficacy against non-enveloped enteric viruses, such as norovirus, HAV and HEV, compared with enveloped viruses.

- Depending on the virus type and plant species, sSome foodborne viruses maycan become internalized within tissues of plants food products and therefore cannot be effectively removed by washing or surface decontamination procedures. For example, human norovirus may become internalized in berries through contaminated irrigation water or uptake from the growing environment.

- Zoonotic foodborne transmission is common for HEV genotypes 3 and 4. There are no documented cases of zoonotic foodborne transmission of norovirus or HAV.

6. Risk assessments[1] have determined norovirus, HAV and HEV to be the viruses of greatest concern from a food safety perspective, based on (i) the incidence of reported foodborne diseases, (ii) the severity of disease, including mortality, and (iii) their potential for transmission via food. 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. Due to the lack of data, there is currently no global estimation of HEV cases attributed to food. In regions for which data is available, HEV is only considered of high-risk severity in vulnerable people. Norovirus was identified as the leading cause of viral foodborne illness, followed by HAV and HEV. In terms of clinical severity, HAV and HEV were ranked equal but higher compared to norovirus.

7. 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. Rotavirus vaccination programmes for infants may be available in some regions as an effective means to protect this at-risk population. Sapovirus, enterovirus, astrovirus and enteric adenovirus are other emerging viruses that have the potential for foodborne transmission and can cause severe disease, but for which foodborne transmission is poorly characterized. These viruses are common causes of acute gastroenteritis around the world and have been associated with outbreaks in children, but the lack of epidemiological evidence makes this difficult to fully evaluate.

7. *Norovirus*: Norovirus infections occur year-round and cause gastroenteritis in people of all ages. While there are multiple norovirus genogroups (i.e. GI to GX), those infecting humans are primarily human-associated (i.e. GI, GII). Noroviruses are found in a wide range of animal species, but evidence of zoonotic transmission to humans

[1] FAO & WHO. 2024. *Microbiological risk assessment of viruses in foods: Part 1: Food attribution, analytical methods and indicators - Meeting report.* Microbiological Risk Assessment Series, No. 49. Rome. https://doi.org/10.4060/cd3396en

remains limited. 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.

8. Illness is usually 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 are available, the norovirus disease burden peaks in the winter months and is positively associated with rain in the wettest month. Several studies have also shown that norovirus contamination of bivalve molluscs is correlated to the winter season. However, regional differences in the seasonality of documented norovirus outbreaks have been described and foodborne infections can occur year-round.

~~8.~~9. The incubation period is 12-72 hours; however, in most cases, symptoms appear between 24-30 hours. Symptoms are often characterised by the sudden onset of one or several episodes of projectile vomiting and one to several days of diarrhoea. Norovirus infections can also be asymptomatic. While symptomatic, n~~N~~orovirus-infected individuals shed large numbers~~amounts~~ of infectious viral particles (10^6-10^{10} genome copies/g) in their stools~~ while having symptoms.~~ Similar s~~S~~hedding ~~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 immunocompetent individuals. The duration of the disease and shedding period may be longer in immunosuppressed individuals. A vaccine against norovirus is not currently available.

10. *HAV*: Hepatitis A virus causes acute viral hepatitis and is primarily associated with human hosts. Hepatitis can be severe in risk groups comprising individuals with underlying health conditions (e.g. acute hepatitis in individuals with pre-existing liver disease or immunocompromised individuals with liver damage caused by chronic infections leading to cirrhosis). 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.

11. 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 lifelong immunity with ~~and~~ almost all adults in endemic areas ~~are~~ immune and not considered to be infectious or shedding HAV. In contrast, children in ~~HAV~~ endemic areas~~,~~ who have yet to develop immunity may be infected with HAV ~~children with HAV~~ (asymptomatic or symptomatic) and 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 or~~,~~ adequate sanitation and hygiene, very few individuals are infected in early childhood, and as a result, the majority of adults remain susceptible to infection. The increased susceptibility heightens the potential impact of outbreaks of hepatitis A in these regions.

~~9.~~12. The incubation period for HAV ranges from a minimum of 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 discoloration 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. HAV infection is symptomatic in more than 80% of infected individuals over 40 years of age and may result in a more severe disease outcome, including death in 1-2% of cases. Effective vaccines against HAV are available.

13. *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 (e.g. acute hepatitis in individuals with pre-existing liver disease or immunocompromised individuals with liver damage caused by chronic infections leading to cirrhosis). Furthermore, acute HEV infections have been associated with a wide range of neurological sequelae.

14. 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.

15. Both HEV-3 and HEV-4 are transmitted via zoonotic and foodborne routes from several animal reservoirs, most 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

excretaion 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 of food contamination through irrigation or growing waters for bivalve molluscs, though less documented.

10.16. 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. Rotavirus vaccination programmes for infants may be available in some regions as an effective means to protect this at-risk population. Sapovirus, enterovirus, astrovirus and enteric adenovirus are other emerging viruses that have the potential for foodborne transmission and can cause severe disease, but for which foodborne transmission is poorly characterized. These viruses are common causes of acute gastroenteritis around the world and have been associated with outbreaks in children, but the lack of epidemiological evidence makes attributionthis difficult to fully evaluate.

11.17. Risk assessments[2,3] have identified three major sources of viral contamination of food: human sewage/faeces, infected food handlers and animals harbouring zoonotic viruses. The virus-commodity combinations of greatest public health concerns were Similarly, they identified in risk assessments 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[2] as the virus-commodity combinations of greatest public health concerns. Of the sources of contamination mentioned, Iinfected food handlers and exposure of food to sewage-contaminated water during primary production or processing are the most frequent causes of foodborne outbreaks of viral diseases, especially those caused by norovirus.

12.18. Preventing contamination during primary production, harvest and processing (e.g. agricultural water management, worker health and hygiene, sanitary facilities) remains the cornerstone of effective control strategies for controlling foodborne viruses. This is due to their environmental persistence and resistance to many treatments commonly used to inactivate other foodborne pathogens. Effective control strategies need to focus on preventing contamination. Such Pprevention of contamination will have to occur primarily at the pre-harvest level for some products, and at the harvest and post-harvest levels for others.

13.19. In general, sampling and testing of foods for foodborne viruses is often challenging due to complex matrices, and low heterogeneous distribution of viruses within the food and low virus concentration. The available methods consist of a virus particle concentration, a food matrix-dependent nucleic acid extraction followed by and the detection or characterisation of viral genetic material. The detection or characterization of viral nucleic acids in foods (e.g. by using a PCR-based or sequencing-based method) cannot determine viral infectivity.

14.20. Although *in vitro* culture systems for norovirus have been developed, practical culture and detection methods for assessing the inactivation of foodborne viruses in food matrices are still lacking. As a result, surrogate viruses (e.g. the use of murine norovirus or Tulane virus in place of norovirus) are used. When evaluating risk management options, the selection of an appropriate surrogate should be guided by the study's purpose and the characteristics of the virus, recognizing that surrogates do not always mimic the resistance or binding properties of the specific foodborne viruses being studied.

15.21. Evidence of viral contamination is primarily based on the detection of viral nucleic acids, since many foodborne viruses cannot be routinely or reliably cultured *in vitro*. Methods for the detection and quantification of norovirus and HAV ribonucleic acid (RNA), consisting of food type-specific nucleic acid extraction steps followed by reverse transcription quantitative polymerase chain reaction (RT-qPCR), 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 standardized method for the detection (ISO 15216-2) and the quantification (ISO 15216-1) of norovirus and HAV RNA in food matrices. An International Standards Organisation (ISO) standard method for the detection of HEV in liver, liver products and meat products is in development.

16.22. Current standardized methods are based on the detection of viral nucleic acids which do not discriminate whether viral RNA/deoxyribonucleic acid (DNA) was derived from infectious or non-infectious virus particles. Test results can vary depending on the complexity of the food matrix, the level and distribution of viruses within the food matrix, and

[2] FAO & WHO. 2024. *Microbiological risk assessment of viruses in foods: Part 1: Food attribution, analytical methods and indicators - Meeting report.* Microbiological Risk Assessment Series, No. 49. Rome. https://doi.org/10.4060/cd3396en
[3] FAO and WHO. 2026. *Microbiological risk assessment of viruses in foods. Part 2: Prevention and intervention measures. Meeting Report.* Microbiological Risk Assessment Series No. 50. Rome. https://doi.org/10.4060/cd7637en

the presence of PCR inhibitors. Molecular technologies should be validated using a recognized validation framework appropriate to the intended use (e.g. international or national standards) and the interpretation of test results clearly defined. Testing laboratories should be competent and ideally accredited according to appropriate standards where applicable.

2. OBJECTIVES

~~17.~~23. The primary purpose of these guidelines is to provide guidance on how to prevent or minimize the presence of foodborne viruses in food, and outline specific recommendations for norovirus, HAV and HEV. The guidelines provide advice to food business operators (FBOs), including their food handlers, and competent authorities on a framework for the control of enteric viruses in food, to protect the health of consumers and to ensure fair practices in food trade. The guidelines also provide information that will be of interest to 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 (including non-enteric viruses) in foods.

3. SCOPE

~~18.~~24. These guidelines apply to all foods, with a focus on ready-to-eat (RTE) foods, from primary production through consumption, for the prevention and 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

~~19.~~25. 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 *Code of Hygienic Practice for Milk and Milk Products* (CXC 54-2004),
- 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).

~~20.~~26. 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.

5. GENERAL PRINCIPLES

~~21.~~27. Refer to Section 5 of the *General Principles of Food Hygiene* (CXC 1-1969).

6. DEFINITIONS

~~22.~~28. Refer to Section 6 of the *General Principles of Food Hygiene* (CXC 1-1969), together with the following:

Enteric virus – A virus that replicates in the gastrointestinal 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.

Ready-to-eat (RTE) food − Any food (raw or processed) ~~for~~ which ~~it~~ is normally eaten without further validated treatment sufficient to achieve food safety, or for which it is reasonably foreseeable[4], based on evidence of consumer habits or practices, that it will be eaten without such treatment.

[4] Reasonably foreseeable means a frequency that can be anticipated as likely to occur because of data or other information showing habits within a population, supply chain, or region (even though such habits may not be intended for the food). Instructions for storage and preparation on the product label can inform the expected use of the product. Reasonably foreseeable does not mean any conceivable use (or misuse) of the food.

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

~~23.~~29. Refer to Section 7 of the *General Principles of Food Hygiene* (CXC 1-1969).

8. PRIMARY PRODUCTION

~~24.~~30. Refer to Section 8 of the *General Principles of Food Hygiene* (CXC 1-1969), together with the following:

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, food handlers, vomitus, contact with equipment contaminated by human faeces or vomitus, cross-contamination from other food products as well as faeces, blood or bile from infected animals, or intrinsic contamination because the animal is infected.

8.1 Environmental control

~~25.~~31. Potential environmental sources of viral contamination should be identified prior to primary 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. The 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 (e.g. near sewage treatment plants) where there is a reasonable probability that environmental or production conditions could lead to viral contamination of food at unacceptable levels, unless measures are in place to prevent or reduce such contamination. 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

~~26.~~32. Food sources should be protected from faecal contamination, vomitus or vomitus-derived aerosols, as well as blood or bile from potentially infected animals.

~~27.~~33. 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 risk-based guidance on water quality and delivery methods to minimize the potential for contamination by viruses. Water used in primary production should be fit for purpose and not compromise food safety and should be applied using an appropriate method. Water fit for purpose should be used during the harvesting and post-harvest processing of food. (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: Wastewater and excreta use in aquaculture* (https://iris.who.int/handle/10665/78265).

~~28.~~34. Natural fertilizers may contain human and/or zoonotic pathogenic viruses that persist for weeks or months. Proper treatment, such as the 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.

~~29.~~35. Aquaculture operations should not be established in areas susceptible to sewage contamination. This is particularly important for aquaculture products that may be consumed without further treatment to control viruses, i.e. raw consumption.

~~30.~~36. Biosecurity measures should limit the entry and spread of zoonotic viruses at the primary production phase

through reservoir animals, vectors (e.g. ticks, flies), pests, people and equipment. Biosecurity measures[5,6] should be used to reduce the number of animals infected with zoonotic enteric viruses at the primary production phase of animals intended for food. Monitoring the infection status of animals can inform and guide the development of targeted farming strategies to reduce the number of viraemic animals at the time of slaughter. Control 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

~~31.~~37. 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.~~38. Harvesting equipment, tools, utensils and containers should be in a clean condition and in good working order.

8.4 Cleaning, maintenance and personnel hygiene

39. For RTE food that are handled or packed on farm, and for other foods with an elevated risk of viral contamination during primary production or harvesting (e.g. bivalve molluscs), the recommendations in~~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~~ are particularly relevant ~~given its importance~~ for preventing viral contamination~~for virus prevention~~. These recommendations may also be applicable, where appropriate, to other foods.

40. Harvest and primary 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 primary 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.

~~33.~~41. Personnel hygiene facilities and toilets should be appropriate to the characteristics of the primary production environment. Such facilities should:

- be located in close proximity to the primary production areas;
- be in sufficient numbers to accommodate personnel;
- be of appropriate design to ensure hygienic removal of wastes;
- be hygienically designed to prevent seepage into groundwater and contamination of agricultural land, surface waters and coastal waters;
- have adequate means for washing and drying hands;
- be maintained under sanitary conditions and in good repair; and
- be appropriately cleaned and disinfected (see 11.1 Maintenance and cleaning).

42. For marine facilities used in primary production, including aquaculture service vessels and rafts, human faeces should be collected and transported ashore to appropriate treatment or disposal facilities, rather than discharged directly into the marine environment, in accordance with applicable national requirements.

9. ESTABLISHMENT - DESIGN OF FACILITIES AND EQUIPMENT

~~34.~~43. Refer to Section 9 of the *General Principles of Food Hygiene* (CXC 1-1969), together with the following:

OBJECTIVES: ~~Equipment and F~~facilities and equipment should be designed, constructed and arranged to ensure that surfaces can be cleaned and, where necessary, disinfected.

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

[5] FAO. 2007. *FAO Biosecurity Toolkit*. Rome. https://www.fao.org/4/a1140e/a1140e.pdf

[6] World Organisation for Animal Health. 2024. Section 4. General Recommendations: Disease Prevention and Control. In: *Terrestrial Animal Health Code*. Volume I/II. Paris. WOAH. https://www.woah.org/en/what-we-do/standards/codes-and-manuals/

9.2 Facilities

9.2.3 Personnel hygiene facilities and toilets

35.44. 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.

36.45. Food establishment Harvest and primary production may be subject to a seasonal influx of personnel to meet the needs of FBOsproducers and may vary for different products. An inherent risk at the farm and primary 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.

37.46. Personnel hygiene facilities and toilets should:

- be located in close proximity to the primary production or food production areas;
- be located in areas adjacent to the food 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 noto prevent seepage into groundwaterunderground water or entry intoand contamination of the agricultural land, surface waters and coastal waters 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.

38.47. Hand washing facilities should be supplied with hand cleanser (e.g. soap). Where possible, hand-washing facilities should have non-hand operable (i.e. leg or foot operated or motion-sensedtouchless) 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 displayed to encourage compliance with proper hand hygiene practices among all users of these facilities.

39.48. Hand washing and drying facilities should be suitably located in primary production areas and in food establishments 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

40.49. Refer to Section 10 of the *General Principles of Food Hygiene* (CXC 1-1969), together with the following:

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 symptoms of viral illnesses and 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, and subsequent control steps during production may not be adequate to remove contamination.

10.1 Awareness and responsibilities

41.50. FBOs (primary producers, manufacturers, distributors, retailers and food service/ institutional establishments) are responsible for providing specific instructions and training for the control of viruses. All personnel involved in the production, handling, processing, distribution, and sale of food, including managers and supervisors, should be aware of the risk of disease outbreaks due to viral contamination of food andfact that prevention through good hygiene practices (GHPs) is the primary control measure for foodborne viruses. There is a need to increase awareness of the risk of disease outbreaks due to viral contamination of food. Industry and trade associations may be able to assist with this awareness raising.

42.51. FBO managers should educate and train their personnel, verify personnel understanding and competencecontrol the level of awareness of the training content, and have both cleaning and disinfection programmes operational.

~~43.~~52. FBO managers should educate and inform personnel on ~~so they can recognize~~ the symptoms of enteric viral illnesses.

~~44.~~53. FBO managers should ensure that personnel who are ill (refer to section 12.1 Health status) are aware of their responsibility to stay away from work in accordance with any public health recommendations (refer to section 12.2 Illness and injuries) ~~until symptoms are resolved or as recommended by a medical professional~~, and especially if their work duties involve the handling or preparation of ready-to-eat foods.

~~45.~~54. FBO personnel should inform the supervisor/ manager or employer when ill with diarrhoea or vomiting, or when having symptoms indicative of hepatitis or gastrointestinal illnesses.

~~46.~~55. FBO managers should 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.

~~47.~~56. All personnel should adhere to strict hand washing instructions after returning from the toilet or after being in contact with faecal or vomitus matter. All personnel involved in the slaughtering and/or processing of meat parts and organs should also comply with hand hygiene after being in contact with animal parts and fluids.

10.2 Training programmes

~~48.~~57. Training programmes should contain information on the following, but not limited to:

- The potential for food, raw ingredients, and hands to be a vehicle for virus transmission.
- The potential sources and routes of transmission of enteric viruses.
- The potential for persistence of infectious enteric viruses in/on contaminated food 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 for~~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 viruses.
- Procedures for cleaning and disinfection of contaminated surfaces.
- Procedures to ensure appropriate use and disposal of personal protective equipment, including where and when to use, how to put on and take off, 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 matter, vomitus matter, or animal parts and fluids (i.e. blood or bile).
- The possibility that if one personnel member or household member has a viral illness, other personnel 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, to the extent possible, children away from food-growing fields and food preparation areas, 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 and packaging items.

10.3 Instruction and supervision

~~49.~~58. Instructions should be given to all personnel on the infectivity, transmission and management of foodborne viruses. Incorporation of these instructions into prerequisite programmes ~~codes of hygienic practice~~ is advisable.

~~50.~~59. 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.

~~51.~~60. All personnel involved in the production, handling, processing, distribution, and sale of food, including managers

and supervisors, should understand the importance of applying good hygiene practices and maintaining personal 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 hand washing purposes;
- strictly following the hand washing procedures;
- adequately cleaning and disinfecting contaminated surfaces (refer to Section 11);
- exclusion from the premises of food handlers or any individuals, 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); and
- 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

~~52.~~61. Refer to Section 11 of the *General Principles of Food Hygiene* (CXC 1-1969), together with the following:

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 individuals 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

11.1.1 General

62. FBOs should have documented regular cleaning and disinfection procedures. FBOs should also have control measures in place for responding to events involving the presence of vomitus or faeces on surfaces. These should set out specific actions ~~to take~~ to minimize the potential for the spread of viral contamination and exposure of personnel~~employees~~, consumers, food, and surfaces to vomitus, faeces and blood. Examples of such measures may include isolation of the affected area, assessment and disposition of potentially exposed food, designation of cleaning and disinfection responsibilities, criteria for reopening affected areas, and maintenance of records, as appropriate.

~~53.~~63. Dedicated cleaning and disinfection programmes should be established for personnel hygiene facilities and toilets, including the corresponding procedures and frequencies. These areas should also be considered contaminated and managed in a way that prevents cross-contamination of food production areas, food, equipment and utensils.

~~54.~~64. Non-enveloped viruses, such as norovirus, HAV and HEV, tend to be less sensitive to chemical inactivation and desiccation than enveloped viruses. Therefore, control measures must consider appropriate compounds with proven antiviral efficacy and that are safe for use in food manufacturing processes.

11.1.2 Cleaning and disinfection methods and procedures

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.

~~55.~~66. When selecting cleaning and disinfection methods and procedures, the circumstances should be taken into account. For example, routine cleaning and disinfection versus cleaning and disinfection after a vomiting or faecal contamination event. 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 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 may~~are~~ persist~~ent~~ and can stay infectious for a long period.

~~56.~~67. 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 materials. Any spillage or contamination with faeces or vomitus should be dealt with immediately**,** and food handling and preparation in the affected areas should be stopped and any RTE food potentially exposed to aerosols from the incident discarded . 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 or in closed leakproof waste containers, so as not to be a vehicle for further contaminating foods, surfaces or personnel.

68. Surfaces should always be properly cleaned prior to disinfection to ensure effectiveness. The effectiveness of disinfection measures may vary according to the operational setting and conditions of used. Consequently, examples of disinfectant concentrations, exposure times and treatment conditions described in the scientific literature, as well as the examples below, should be considered illustrative and should not replace the validation of control measures under the specific conditions of the establishment.

69. Most other surface disinfectants lack efficacy (i.e. consistently cause less than a 3 $\log_{10}$ reduction in infectivity) against many viruses at the 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. This is an active area of research, but it is complicated by the inherent resistance of viruses to many commonly used surface disinfectants, and by the fact that virus cultivation is often difficult and study designs are not always comparable. New compounds and/or methods can be considered if they demonstrateshow virucidal activity of > 3 $\log_{10}$ for against non-enveloped viruses in standardized carrier tests and are approved for use on food contact surfaces.

70. Reductions of > 3 $\log_{10}$ may serve as an indicator of efficacy; however, such values should be interpreted with caution and in the context of factors such as the initial level of contamination, the virus involved, and the conditions of application. A reduction of > 3 $\log_{10}$ does not necessarily indicate that a treated surface is free of infectious virus or that the risk has been eliminated in all circumstances.

57.71. Interpretation of results from the use of human norovirus surrogates, specifically feline calicivirus, murine norovirus and Tulane virus, in the evaluation of disinfectants should also be made with caution, as these surrogates may exhibit different physicochemical properties compared with human norovirus and may react differently to disinfectants. For example, feline calicivirus has been shown to be more sensitive than human norovirus in many treatments.

58.72. Surfaces should always be properly cleaned prior to disinfection to ensure effectiveness. For surface disinfection, solutions of ≥ 1000 ppm free chlorine applied for 5 min at room temperature show ≥ 3 $\log_{10}$ reduction against Tulane virus and > 5 $\log_{10}$ reduction against feline calicivirus, both surrogates for human norovirus. Freshly constituted hypochlorite solutions are preferable. Alternatively, chlorine dioxide solutions at concentrations of 200 ppm may be used. The solutions are corrosive and food contact surfaces should be thoroughly rinsed afterwards using water fit for purpose. 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 recommence after thorough disinfection has taken place.

59.73. Experimental studies have shown that treatment with vaporized hydrogen peroxide (VHP) at concentrations exceeding 100 ppm for 1 h is effective against murine norovirus 1, a widely used surrogate for human norovirus, achieving reductions of more than 4 $\log_{10}$ in infectious viral particles. This treatment can be applied to entire rooms, including kitchens, and has demonstrated efficacy on a variety of surfaces, such as stainless steel and framing panels. In addition, VHP treatment may offer a less labour-intensive alternative to manual disinfection using chlorine-based solutions.

60.74. Ultraviolet (UV) irradiation, including both continuous and pulsed UV systems, can inactivate foodborne viruses on surfaces. UV-C irradiation at 260 nm and a dose of 300 mWs/cm^2 UV-C has been shown to achieve 4.4 $\log_{10}$ reduction of murine norovirus 1, a surrogate for human norovirus, and a 2.6 $\log_{10}$ reduction of HAV. Similarly, pulsed UV light treatment at doses of 60 mWs/cm^2 and 91 mWs/cm^2 have been reported to achieve 5 $\log_{10}$ reduction of murine norovirus 1 and HAV, respectively, on stainless steel surfaces in the absence of organic matter. These treatments can be considered for reducing viral infectivity on surfaces, in aerosols and in water.

~~Most other surface disinfectants lack efficacy (i.e. consistently cause less than a 3 $\log_{10}$ reduction in infectivity) against many viruses at the 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. This is an active area of research, but it is complicated by the inherent resistance of viruses to many commonly used surface disinfectants, and by the fact that virus cultivation is often difficult and study designs are not always comparable. 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 human norovirus.~~

11.1.3 Monitoring of effectiveness

~~61.~~75. When cleaning and disinfection are needed for potential virus contamination, proper documentation and monitoring of the cleaning and disinfection are recommended. ~~Examples of information to be documented include the date, time, the name of the person doing the cleaning and the nature of the incident (e.g. vomiting).~~

~~62.~~76. Testing for viruses or viral indicators is generally not informative for verifying the effectiveness of cleaning after contamination events, given that viral infectivity cannot be determined through viral nucleic acid detection methods. However, environmental testing may still provide useful information for food safety investigations, trend analysis or assessment of contamination spread.

11.3 Waste management

~~63.~~77. Food, harvest boxes and packaging materials possibly contaminated with virus particles should be discarded in a manner such that direct contact between this food and any person, food or food contact surface is prevented.

12. PERSONAL HYGIENE

~~64.~~78. Refer to Section 12 of the *General Principles of Food Hygiene* (CXC 1-1969), together with the following:

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

~~65.~~79. Diarrhoea and vomiting may be caused by infectious (e.g. norovirus, HAV) or non-infectious (e.g. toxins) agents. All cases of gastroenteritis should be regarded as infectious unless 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.

~~66.~~80. Individuals with the above symptoms should, therefore, be excluded from being present on the premises, to reduce the likelihood of transmission of any infectious agents via food (refer to section 10.1). Refer to the Introduction section of these guidelines for the incubation and contagious periods of norovirus, HAV and HEV.

12.2 Illness and injuries

~~67.~~81. 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 human enteric viruses, norovirus and HAV. Personnel 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.

~~68.~~82. Individuals who have had gastroenteritis should only be allowed to return to work after a period (e.g. 48 h, depending on the illness involved) without symptoms of diarrhoea and vomiting, in accordance with any applicable~~existing~~ public health recommendations~~, if applicable~~. Individuals who have had hepatitis should only be allowed to return to work after the disappearance of jaundice, confirmed through clinical observations and/or laboratory testing.

~~69.~~83. Individuals who are returning to work after having hepatitis or gastroenteritis should be reminded of the potential for shedding of viruses, such as norovirus and HAV, to continue for several weeks after symptoms have subsided, and therefore the importance of following strict hand hygiene instructions at all times. ~~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 individuals), training and instruction should be given to all personnel, but especially those returning to work after recovery from gastroenteritis, on the infectivity, transmission and disinfection of foodborne viruses, and the importance of following strict hand hygiene instructions at all times~~.

~~70.~~84. When one of the employees~~personnel members~~ has symptoms of gastroenteritis or hepatitis, other employees ~~personnel members~~ may be or may become (asymptomatically) infected at that point. Similarly, when a family/house member of an employee ~~personnel member~~ has symptoms of gastroenteritis or hepatitis, that ~~personnel~~

~~member~~employee may be (asymptomatically) infected, and/or serve as a vector carrying infectious virus. ~~In these specific situations,~~ ~~I~~it is the responsibility of the employee to inform their employer/manager/supervisor of any symptoms of gastroenteritis and follow FBO procedures, including compliance with strict hand hygiene measures to reduce the risk of further spread of the virus.

~~71.~~85. ~~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.~~ Competent authorities may provide advice on the prevention of hepatitis A among food handlers in accordance with national public health policies.

12.3 Personal cleanliness

~~72.~~86. 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).

~~73.~~87. Hands should be thoroughly washed and dried, according to the established procedure, before the handling of food, as it is the most effective way of preventing the 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. Hand~~s~~ washing should take place ~~be washed~~ in designated hand washing basins~~sinks. dedicated to such a purpose and not washed in dishwashing sinks or~~Using food preparation or equipment washing sinks for hand washing may increase the risk of cross-contamination~~, to the extent possible~~. The use of disposable hand towels and non-hand operable taps should be encouraged wherever possible, and if this is not feasible, suitable hand washing and hand drying systems should be available. Where appropriate, hand sanitizers or hand disinfectants may be used as a complementary measure following proper hand washing as part of comprehensive hand hygiene programmes.

~~74.~~88. Everyone should always wash their hands, especially before harvesting, packing or 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.~~

~~75.~~89. 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, the gloves should be removed and discarded, hands thoroughly washed and dried, and new gloves ~~should be~~ put on before preparing and handling food. The wearing of gloves or the use of hand sanitizers does not replace the need to thoroughly wash hands.

~~76.~~90. Clothes of food handlers that have been contaminated ~~infected~~ (for example, after vomiting or after diarrhoea), or are suspected of being contaminated~~infected~~, should be washed thoroughly using appropriate detergents. It has been shown that conventional household washing detergents have good virucidal efficiency.

12.4 Personal behaviour

~~77.~~91. 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

~~78.~~92. Refer to Section 13 of the *General Principles of Food Hygiene* (CXC 1-1969), together with the following:

> **OBJECTIVES:** Processing operations should be controlled to prevent contamination of food with viruses.
>
> **RATIONALE:** Preventive measures against identified hazards or risks help reduce virus contamination.

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

13.1.5 Verification

~~79.~~94. Finished product testing should not be relied upon as the only activity to verify the absence of enteric viruses from food.

13.2 Key aspects of GHPs

~~80.~~95. Any food, harvest boxes and packaging materials that may be ~~possibly~~ contaminated by vomitus or by aerosols containing vomitus should be disposed of and details documented. Any food handled by an ill person should be evaluated to determine whether it should be disposed of. 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 symptoms appeared. In this situation, disposal of the implicated food could be necessary.

~~81.~~96. If an outbreak has been traced back to an establishment, the necessary steps should be taken to identify and isolate/discard any affected product, to find the source of the virus and take appropriate measures, ~~to control any product affected, to eliminate the virus, and~~ to prevent future outbreaks.

13.2.1 Time and temperature control

- 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: Norovirus, HAV and HEV have relatively high heat stability. The effects of heat treatment on virus infectivity in foods are highly dependent on virus type and subtype, food matrix and the initial level of viral contaminants. Temperature and time combinations of heat treatments~~cooking procedures~~ are important in determining the adequacy of a treatment to inactivate infectious virus. Where necessary, product-specific heat treatments should be validated to ensure their effectiveness. Refer to the *Guidelines for the Validation of Food Safety Control Measures* (CXG 69-2008). For example, under experimental conditions, over 4 $\log_{10}$ reduction of foodborne viruses can be achieved after 95°C for ≥ 1 minute treatment in some food matrices. However, heating to an internal temperature of 70-72°C for 2 minutes reduces infectious titres but often does not exceed a 4 $\log_{10}$ reduction of foodborne viruses in food matrices. Heating to temperatures lower than 60°C for ≤ 1 minute rarely leads to more than 1 $\log_{10}$ reduction in food matrices. Commercial canning sufficient for low acid foods is considered an adequate treatment to destroy viral infectivity in foods.

13.2.2 Specific process steps

~~82.~~97. 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).

~~83.~~98. Various processes have been shown to reduce virus load in selected foods, but their effectiveness is subject to substantial variability, depending on virus type and subtype, food matrix and location of the virus on the food matrix. As such, these processes by themselves will be inadequate to protect the consumer, but when applied adequately and~~or~~ combined, the 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. Examples of processes that may reduce the viral load in foods include:

- Washing: The washing of food ingredients or products using water fit for purpose may not be effective if the food surface is rough, broken or pitted or if viruses are internalized.
- Reduce pH: While enteric viruses are generally stable at low pH levels, more than 3 $\log_{10}$ reduction of HAV (i.e., under experimental conditions in buffer systems) has been demonstrated at pH 2 for 60 minutes at room temperature, although~~but~~ the organoleptic properties of the foods are adversely affected.
- Reducing water activity (a_w): Reducing a_w may accelerate the degradation or inactivation rates of viruses, but its effect on virus infectivity in foods ~~(or on fomites)~~ is highly dependent on virus type and subtype and food matrix. Therefore, reducing a_w cannot be considered an effective generic measure to reduce viral loads in foods. Separately, t~~T~~he drying or ~~/~~desiccation of ~~human enteric viruses on~~ processing equipment surfaces may reduce the level of infectious human enteric viruses; however, the extent of this reduction is also dependent on the virus and environmental conditions.
- High-pressure processing (HPP): 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 subtype and food matrix, the pressure applied, treatment time, temperature and pH. HPP can also adversely affect the organoleptic properties of the food, making its application limited to specific food types (e.g. shellfish and meat).

- Ultraviolet (UV) Irradiation: UV irradiation is generally of limited effectiveness for reducing viral contamination on ~~or in~~ foods and should not be relied upon as a primary control measure. Its effectiveness in reducing virus infectivity in foods is highly variable and depends on factors such as whether the virus is present on the food surface, the virus type and subtype, the food matrix, surface characteristics and composition, the UV wavelength used, and the distance between the UV source and the food. However, UV irradiation can be effective for inactivating viruses on clean, unsoiled food-contact surfaces and in water and aerosols.

99. 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.

100. When such assays do not exist for the specific virus, the use of suitable surrogate viruses, or molecular assays, which can evaluate a decline in virus genome copies, should be considered. Molecular assay results may support studies but should not, on their own, be interpreted as evidence of reduces infectivity or used to validate virucidal efficacy. The results should be evaluated with caution, as the surrogates may not always mimic the resistance of the intended foodborne viruses and the decline in infectivity may be higher than the decline in genome copies.

~~84.~~101. Furthermore, the interpretation results should consider the assay endpoint used, since methods targeting viral nucleic acids and those targeting capsid integrity may provide different indication of treatment effectiveness and may not directly correlate with infectivity. Some treatments might be subject to prior approval by the competent authority.

13.2.8 Incoming material

~~85.~~102. Raw ingredients contaminated with viruses may lead to contamination of food handlers' hands, other foods, or food contact surfaces. Raw ingredients from suppliers or processing facilities with an adequate food hygiene system should be used.

13.2.9 Packaging

~~86.~~103. Various types of packaging designed to limit microbial growth (e.g. modified-atmosphere packaging, oxygen-scavenging systems, or antimicrobial packaging technologies) ~~that are aimed at inhibiting bacterial or fungal growth~~ are often not effective against enteric viruses because enteric viruses do not grow in food and remain preserved while retaining their infectivity.

13.3 Water

~~87.~~104. Refer to the *Guidelines for the Safe Use and Reuse of Water in Food Production and Processing* (CXG 100-2023).

~~**13.4 Documentation and records**~~

~~88. It is recommended that control procedures used for viruses be monitored to ensure their continuing effectiveness.~~

13.5 Recall procedures – removal from the market of unsafe food

~~89.~~105. Based on the determined level of risk associated with the presence of viruses in a given food product, a decision may be taken to remove~~recall~~ the contaminated product from the market. ~~or withdraw the contaminated product from the supply chain.~~ The need for public information and communicated warnings should be considered.

14. PRODUCT INFORMATION AND CONSUMER AWARENESS

~~90.~~106. Refer to Section 14 of the *General Principles of Food Hygiene* (CXC 1-1969), together with the following:

14.1 Lot identification and traceability

~~91.~~107. Enteric viruses can persist for long periods of time in contaminated food (e.g. weeks in refrigeration and months to years in freezing). As the distribution of food between areas and countries complicates traceability, lot identity and integrity should be maintained to facilitate trace back.

14.4 Consumer education

~~92.~~108. Countries should develop educational programmes to make consumers more alert to the potential risk of viral contamination of certain foods as applicable to their region.

15. TRANSPORTATION

~~93.~~109. 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

~~94.~~110. Refer to Section 16 of the *General Principles of Food Hygiene* (CXC 1-1969).

17. PRINCIPLES OF THE HACCP SYSTEM

~~95.~~111. Refer to Section 17 of the *General Principles of Food Hygiene* (CXC 1-1969).

18. GENERAL GUIDELINES FOR THE APPLICATION OF THE HACCP SYSTEM

~~96.~~112. Refer to Section 18 of the *General Principles of Food Hygiene* (CXC 1-1969).

19. APPLICATION

~~97.~~113. 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. In addition, virus that has persisted ~~Additionally, previous outbreaks have demonstrated viruses to persist~~ for more than a year in certain frozen molluscan shellfish has been associated with outbreaks.

2. There is an increased risk of infection if contaminated bivalve molluscs are consumed after insufficient heat treatment. Once viral contamination of bivalve molluscs has occurred, the removal or inactivation of 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 primary production. Long-term relay of bivalve molluscs in clean environmental water is effective at reducing 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 FBOs and 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 handlers, consumers and other interested parties.

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) and the *Guidelines for the Safe Use and Reuse of Water in Food Production and Processing* (CXG- 100-2023). Furthermore, guidance for the implementation of bivalve mollusc sanitation programmes 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 Section 5 of the *General Principles of Food Hygiene* (CXC 1-1969).

6. DEFINITIONS

7. Refer to Section 6 of the *General Principles of Food Hygiene* (CXC 1-1969) and of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012). Also refer to the definitions of clean water, depuration, growing areas and relaying from the *Code of Practice for Fish and Fishery Products* (CXC 52-2003).

GOOD HYGIENE PRACTICES

7. INTRODUCTION AND CONTROL OF FOOD HAZARDS

8. Refer to Section 7 of 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) and the Annex II Fish and Fishery Products of the *Guidelines for the Safe Use and Reuse of Water in Food Production and Processing* (CXG 100-2023), together with the following:

10. The main risk associated with ~~the~~ primary 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 control measures applied, such as further processing, to ensure end product specifications are met.

11. It is important to ensure adequate water quality in growing areas to prevent or minimize viral contamination of bivalve molluscs. 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 and~~. An analysis should be conducted to~~ identify situations that could disrupt normal sanitary conditions, such as heavy rainfall. The assessment~~analysis~~ should also establish criteria (not necessarily microbiological) for stopping harvest when these situations arise, and for resuming harvest after the risk has passed. Sanitary surveys should be reviewed and updated periodically to identify changes to possible sources of contamination, environmental conditions, or other events that may affect the sanitary status of the area 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 mollusc 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 hazards, identification and monitoring of growing areas are 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, 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 other validated methods appropriate to their intended use could be used. Alternatively, other approaches consistent with the requirements of the competent authority may also be used as part of the reopening process. Testing laboratories should be competent and ideally accredited according to appropriate standards where applicable. 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 the prevention of future contamination events.

8.1 Environmental control

15. With regard to risks of 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.

16. Every effort should be made to eliminate the overflow of untreated or partially treated sewage into growing waters.

17. Sewage treatments should ensure an adequate reduction of viral loads and aim to achieve a 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)). Where appropriate and feasible~~never possible~~, taking into account national circumstances, sewage treatment should involve a tertiary treatment step such as UV or ultrafiltration ~~treatment~~. The use of a prohibition zone for the harvest of bivalve molluscs around a wastewater discharge or other point source of contamination is another option the competent authority may use. Where competent authority establishes a prohibition zone, the boundaries of the zone should be determined on the basis of sanitary surveys and assessments of dilution and dispersion, taking into account relevant technical guidance, such as the FAO and WHO (2021). *Technical guidance for the development of the growing area aspects of Bivalve Mollusc Sanitation Programmes*. Where appropriate and feasible, taking into account national circumstances, t~~T~~reatment plants should be designed to minimize storm overflows that may affect the fishery.

18. Systems should be ~~put in place~~established to monitor sewage spills and ensure that ~~provide prompt notification to the appropriate~~relevant competent authority is notified promptly by the sewage treatment plant operator and that ~~as well as~~ the bivalve molluscs industry is informed in a timely manner, either directly of through the competent authority, so that appropriate action (i.e. cessation of harvesting) can be taken.

19. When events occur that can potentially contaminate growing areas with untreated or partially treated sewage (e.g. heavy rainfall or~~and~~ overflow from sewage treatment plants), harvesting of bivalve molluscs should cease.

20. Procedures and criteria for suspending and resuming harvesting should be established, taking into account sanitary surveys, risk assessments and other information relevant to the harvesting area. Such procedures may include predefined closure and reopening criteria associated with specified contamination events or environmental, microbiological, or sanitary conditions. Harvesting should resume only when the harvesting area has been assessed in accordance with these criteria and the conditions for reopening have been met. ~~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.~~

~~19.~~21. 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 reopening.

~~20.~~22. 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 discarded or, when necessary, 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.

~~21.~~23. 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 ~~or vomitus~~ should occur from vessels operating in designated ~~around~~ bivalve molluscs growing areas and any buffer zones established around such areas by the competent authority.
- Human vomitus should be contained and disposed of in a sanitary manner. Vomitus may be collected in suitable sealed containers for transport ashore for appropriate disposal, in accordance with applicable national requirements, or, where contained within the vessel's toilets and sewage system, managed as part of the

disposal of faecal waste.

- All necessary measures should be taken to prevent contamination of bivalve molluscs by faecal materials on board harvest vessels.
- Facilities and toilets should be provided and maintained~~designed~~ to ensure that an appropriate degree of personal hygiene can be maintained, especially on harvest vessels. Where fixed toilets are not practicable, suitable alternatives such as portable toilets should be made available.

8.2 Hygienic production

~~22.~~24. Efforts should be made to restrict the growing and harvesting of bivalve molluscs to areas of clean water only.

~~23.~~25. Records, such as results of water quality and/or bivalve mollusc 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, where appropriate. During such periods, monitoring of both water and the bivalve molluscs in risk areas for norovirus and/or HAV should be increased.

~~24.~~26. Additional possible control measures for enteric viruses, such as norovirus and HAV, include long-term relaying or a combination of depuration and relaying.

~~25.~~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, 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. While~~A~~ short-term depuration process commonly reduces low levels of bacterial contamination and thus contributes to the safety of bivalve molluscs; ~~however~~they are ineffective~~, depuration processes alone are inadequate~~ on their own to ~~effectively~~ reduce levels of viruses sufficiently to~~contamination by viruses to levels that~~ eliminate the risk of illness.

~~26.~~28. When there is a high likelihood or evidence of virus contamination through epidemiological information, environmental events or detection of the 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

~~27.~~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

~~28.~~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), together with the following:

10.2 Training programmes

~~29.~~31. Personnel involved in the growing and harvesting of bivalve molluscs should have appropriate training, including but not limited to:

- 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 (e.g. *Escherichia coli* / faecal coliforms) and viral contamination; and
- control measures to prevent bivalve molluscs from becoming contaminated by contagious food handlers.

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

~~30.~~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

~~31.~~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

~~32.~~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), together with the following:

13.2 Key aspects of GHPs

13.2.2 Specific process steps

- Heat Treatment: Heat treatments for 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, would possibly 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 $\log_{10}$. Because common cooking practices for bivalve molluscs in the home or at a restaurant may not provide adequate inactivation of viruses, it is critical to prevent viral contamination of water used for growing and harvesting bivalve molluscs.
- High-Pressure Processing (HPP): HPP may reduce virus titres in bivalve molluscs but may reduce the quality of the mollusc meat. The HPP conditions for inactivation depend upon pressure as well as time, temperature and water salinity, e.g. a pressure of 600 MPa applied at 6 ºC for five minutes has been shown to inactivate norovirus in oysters, although organoleptic properties will be impacted by these parameters. In shellfish artificially contaminated with HAV, HPP treatment at 400 MPa for 1 minute produced > 3 $\log_{10}$ reduction. The use of HPP 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.

13.3 Water

Refer to the Annex II Fish and Fishery Products of the *Guidelines for the Safe Use and Reuse of Water in Food Production and Processing* (CXG 100-2023).

14. PRODUCT INFORMATION AND CONSUMER AWARENESS

~~33.~~35. Refer to Section 14 of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012), together with the following:

14.1 Lot identification and traceability

~~34.~~36. Norovirus and HAV can persist for long periods of time in bivalve molluscs. As movements between growing areas and countries complicate the traceability of bivalve molluscs, lot identity, harvest sites and dates should be maintained to facilitate traceback 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 Information

~~35.~~37. 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.

~~36.~~38. For unpackaged live or raw bivalve molluscs, information should be provided where appropriate, so that consumers are properly informed with respect to the safety and nature (whether for consumption raw or cooked) of these products.

14.4 Consumer education

~~37.~~39. 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 food safety.

15. TRANSPORTATION

~~38.~~40. 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

~~39.~~41. Refer to Section 16 of the *General Principles of Food Hygiene* (CXC 1-1969).

17. PRINCIPLES OF THE HACCP SYSTEM

~~40.~~42. 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.~~43. Refer to Section 18 of the *General Principles of Food Hygiene* (CXC 1-1969).

19. APPLICATION

~~42.~~44. 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, as freezing preserves virus infectivity and allows contaminated products to be distributed globally and consumed over an extended period due to their long shelf life of the products.

2. The viral contamination of fresh produce may occur at any stage from primary production to consumption.

3. Fresh and frozen produce may become contaminated with viruses through contact with human sewage, for example, by~~though~~:

- the use of sewage-contaminated waters for irrigation, washing, frost protection or in the application of fertilisers and agrichemicals; and
- 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 the 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 various factors, including 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 FBOs and competent authorities with guidance on how to prevent or minimize the introduction 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 handlers, consumers, and other interested parties.

3. SCOPE

8. This annex covers general and sector-specific 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. It~~This annex~~ focuses on norovirus and HAV in fresh and frozen produce and the prevention of contamination of~~prevents~~ 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.~~9. 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. This annex should also be used in conjunction with the *Code of Practice for Fresh Fruits and Vegetables* (CXC 53-2003) and the *Guidelines for the Safe Use and Reuse of Water in Food Production and Processing* (CXG 100-2023).

5. GENERAL PRINCIPLES

~~11.~~10. Refer to Section 5 of the *General Principles of Food Hygiene* (CXC 1-1969).

6. DEFINITIONS

~~12.~~11. Refer to Section 6 of the *General Principles of Food Hygiene* (CXC 1-1969) and of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012).

Fresh produce – Any fresh fruit, nuts, mushrooms, herbs, and vegetables that are likely to be offered 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.

Frozen produce – Fresh produce, including produce that may have undergone pre-freezing treatments such as blanching, which has been subjected to a freezing process sufficient to reduce the temperature of the whole product to a level low enough to preserve its~~the inherent~~ quality ~~of the produce~~ during transportation, storage and distribution up to and including the time of final sale.

GOOD HYGIENE PRACTICES

7. INTRODUCTION AND CONTROL OF FOOD HAZARDS

~~13.~~12. Refer to Section 7 of the *General Principles of Food Hygiene* (CXC 1-1969).

8. PRIMARY PRODUCTION

~~14.~~13. 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), together with the following:

~~15.~~14. 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 conditions and epidemiological contexts 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 and according to the local conditions regarding the existing hazards in the environment and ~~,~~ practices ~~and people~~. 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 agricultural practices and GHP~~good hygienic practices~~ in order to minimize potential risks of contamination of fresh and frozen produce with viruses~~norovirus and HAV~~.

8.1 Environmental control

~~16.~~15. For fresh produce, the main sources of contamination by norovirus and HAV of the primary production sites are sewage treatment plant effluents, direct water contamination where there are no public wastewater disposal services, untreated human excreta used as fertilizer, inappropriate practices by agricultural workers, ~~and~~ inadequate toilet facilities and poor 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.

~~17.~~16. 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 heavy rainfall, which is used for irrigation, washing of produce, or application of fertilizers and agrichemicals; and
- seepage of untreated or partially treated sewage onto/into agricultural soil.

8.2 Hygienic production

8.2.1 Water for primary production

~~18.~~17. Refer to the *Guidelines for the Safe Use and Reuse of Water in Food Production and Processing* (CXG 100-2023).

~~19.~~18. Water fit for purpose should be used for the primary production of food. The assessment of the microbial quality for the presence of norovirus and HAV 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, immediate corrective actions should be taken to minimize the risk of contamination with norovirus and HAV. The effectiveness of corrective actions should be verified.

~~20.~~19. Testing for *Escherichia coli* / faecal coliforms can be useful to determine the level of faecal contamination of the water. *E. coli* originates from human and animal sources; however, norovirus and HAV are primarily associated with human hosts. 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 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. Monitoring data should be interpreted within the context of the production, as viruses may be present in the absence of these indicators.

~~21.~~20. 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. Where feasible, mitigation measures may include reducing direct water contact with edible portions, selecting lower-risk application methods, applying treatment where appropriate, and managing the intervals between irrigation and harvest as part of a risk-based water management strategy.

8.4 Cleaning, maintenance and personnel hygiene

~~22.~~21. 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 effluents from these facilities do not contaminate the fields. On-farm toilets should be cleaned and disinfected daily using appropriate disinfectants, while ensuring that wash water does not contaminate soil, drainage channels or water sources.

9. ESTABLISHMENT – DESIGN OF FACILITIES AND EQUIPMENT

~~23.~~22. 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

~~24.~~23. 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), together with the following:

~~25.~~24. Personnel involved in the production, harvesting, processing, handling, packing and storage of fresh and frozen produce should have appropriate training, including but not limited to:

- the general characteristics of norovirus and HAV and their resistance to various environmental conditions, e.g. conditions of sewage treatment, temperature;
- personal hygiene and hand washing (see Section 12, main document);
- control measures to prevent water contaminated with faecal matter 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; and
- how to identify conditions or circumstances when the risk of virus contamination might be~~is~~ increased and actions that may need to be taken.

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

~~26.~~25. 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

~~27.~~26. 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), together with the following:

12.5 Visitors and other persons from outside the establishment

~~28.~~27. 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

~~29.~~28. 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), together with the following:

~~30.~~29. The control of norovirus and HAV in fresh and frozen produce should focus on preventing the initial contamination of fresh produce, as there are limited effective post-harvest treatments once produce is contaminated.

13.2 Key aspects of GHPs

13.2.2 Specific process steps

- Washing: Post-harvest washing is an important step in the processing of fresh produce.~~,~~ The proper management of wash water may prevent cross-contamination of viruses among produce, and the washing of some types of produce may ~~which can~~ remove viral pathogens.~~, but~~ T~~t~~he physical structure of some produce surfaces (e.g. rough, broken or pitted) may protect viruses from removal by washing. Similarly, some fruits are very fragile (e.g. raspberries) and cannot be washed. The effectiveness of washing for reducing viral contamination should, therefore, be verified for the specific virus, type of produce and washing conditions used.
- Chemical treatment: Oxidizing chemical disinfectants have been studied for their antiviral efficacy in berries.~~,~~ ~~but at the current time~~Currently, no single~~one~~ oxidizing disinfectant has been shown to be consistently~~stands out as superior~~ more effective for reducing foodborne viruses on berry~~the~~ surface~~s of berries, and~~ Eefficacy is highly dependent~~impacted by~~ on concentration, contact time, and soil load. In addition, antimicrobial agents that are effective against bacteria may not be as effective for the reduction of norovirus and HAV in fresh and frozen produce. The effectiveness of any chemical treatment against the target viruses should, therefore, be validated ~~verified~~ under the intended conditions of use.
- Partial heat-treatment: Partial heat-treatments such as blanching have limited effectiveness for controlling foodborne viruses in frozen produce because this step is primarily designed to preserved product quality rather than achieve virus inactivation. The level of virus reduction depends on factors such as time, temperature, product characteristics, and heating uniformity, and some viruses may survive standard blanching conditions. In addition, many frozen fruits, particularly berries, are not blanched, and recontamination can occur after processing. The effectiveness of any partial heat-treatment against the target viruses should, therefore, be verified under the intended conditions of use.

13.3 Water

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

14. PRODUCT INFORMATION AND CONSUMER AWARENESS

~~31.~~30. Refer to Section 14 of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012).

15. TRANSPORTATION

~~32.~~31. 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

~~33.~~32. Refer to Section 16 of the *General Principles of Food Hygiene* (CXC 1-1969).

17. PRINCIPLES OF THE HACCP SYSTEM

~~34.~~33. Refer to Section 17 of the *General Principles of Food Hygiene* (CXC 1-1969).

18. GENERAL GUIDELINES FOR THE APPLICATION OF THE HACCP SYSTEM

~~35.~~34. Refer to Section 18 of the *General Principles of Food Hygiene* (CXC 1-1969).

19. APPLICATION

~~36.~~35. 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 genotype 3 (HEV-3) and, to a lesser extent, HEV genotype 4 (HEV-4). Domestic pigs are the primary source of foodborne HEV; however, other animals, including wild boar, deer, and mongoose, can also serve as reservoirs. HEV spreads easily among animals. Pigs and wild boars are reservoir hosts for HEV-3 and HEV-4 and usually do not have clinical signs of infection.

2. Liver from infected animals is the main source of HEV, although blood, and to a 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) the 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 mainly arises from consuming raw or undercooked liver, ~~or~~ liver products (e.g. dry liver sausages), ~~or~~ pork, ~~and~~ wild game meat and related meat 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 FBOs and 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 food handlers, 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. This annex should also be used in conjunction with the *Code of Hygienic Practice for Meat* (CXC 58-2005) and the *Guidelines for the Safe Use and Reuse of Water in Food Production and Processing* (CXG 100-2023).

5. GENERAL PRINCIPLES

7. Refer to Section 5 of the *General Principles of Food Hygiene* (CXC 1-1969).

6. DEFINITIONS

8. Refer to Section 6 of 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).

GOOD HYGIENE PRACTICES

7. INTRODUCTION AND CONTROL OF FOOD HAZARDS

9. Refer to Section 7 of 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), together with the following:

8.1 Environmental control

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 wild 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).

11. 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 primary production sites and handling areas free of waste and clutter.

8.2 Hygienic production

12. Control measures at primary production should focus on the prevention of animal infections, 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. The following measures may be considered where appropriate, taking into account local production systems, epidemiological conditions and practical feasibility.

13. This could include:

- controlling access to farms, reducing the number of people entering and unnecessary movements;
- strict hygiene protocols for personnel, visitors, premises, facilities and equipment;
- cleaning pig driving boards regularly;
- implementing flooring and drainage systems (e.g., using rubber and steel floor material in fattening stalls) that facilitate faeces removal and support the frequent cleaning of pens ~~(e.g., using rubber and steel floor material in fattening stalls)~~;
- adequate fly control;
- adequate pest control;
- ~~proper waste disposal;~~
- minimising exposure to wild animals and pests;
- proper waste disposal;
- providing adequate space for animals to prevent overcrowding; and
- ensuring the hygiene of animal drinking water and feed.

14. Manure must be managed assuming that it is contaminated with HEV. Manure should be contained as effectively as possible to prevent contamination of food, surfaces and personnel.

15. Where feasible and practicable, monitoring the infection status of pigs through PCR-based testing for the presence of HEV ribonucleic acid (RNA) and serology to discriminate between infected pigs and non-infected pigs (including animals that have cleared the virus) can aid in developing targeted farming strategies to reduce the number of viraemic animals at the time of slaughter. Targeted farming strategies could include “all-in, all-out” production systems, age segregation of pigs (i.e. by early age before the decay of maternal antibodies), and improved hygiene within farm compartments.

16. Control measures at slaughter and processing should be focused on reducing faecal contamination of carcasses and to reduce cross-contamination of animal tissues with enteric viruses via intestinal~~e~~ contents, bile and blood. In wild game, proper handling of carcasses and prevention of cross-contamination during field dressing and meat preparation are critical to reduce the risk of HEV. Cross-contamination can occur between animal tissues with a higher risk of HEV (e.g. liver) and tissues with a low risk of HEV contamination (e.g. muscle/meat) as well as between meat and potentially contaminated blood, faeces and bile.

8.3 Handling, storage and transport

17. Biosecurity measures should extend from the farm to include transport. Vehicles used for the transportation of live animals may become contaminated with HEV through droppings and urine and require appropriate cleaning and disinfection. Transportation of infected animals, e.g. piglets to fattening farms, may introduce HEV into the receiving

farms.

18. Vehicles used for transportation of wild game animal carcasses may become contaminated with HEV (i.e. blood droppings from the carcass) and require appropriate cleaning and disinfection.

9. ESTABLISHMENT - DESIGN OF FACILITIES AND EQUIPMENT

~~18.~~19. 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

~~19.~~20. 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

~~20.~~21. Training programmes should include information about the risk of HEV contamination in pork and game meat, and the risk of infection in humans.

~~21.~~22. Individuals involved in animal husbandry should have:

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

~~22.~~23. Individuals involved in harvesting, slaughtering, dressing, and/or further processing of meat parts or organs, as well as hunters involved in ~~the~~ disembowelling/eviscerating and cleaning game should have:

- appropriate training on how to reduce faecal contamination of the carcasses and how to avoid cross-contamination between carcasses;
- appropriate training on control measures to prevent cross-contamination between tissues with a high risk of HEV contamination and low-at risk parts (e.g. liver to meat);
- awareness of the potential 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 the risk of infection or spread of the virus;
- awareness that HEV is less sensitive to commonly used chemical, physical and environmental inactivation methods than bacteria and other enteric viruses; and
- appropriate training for correct disposal of liver, bile, intestines and intestinal content ~~high-risk offal~~ by hunters during field evisceration of wild game.

~~23.~~24. Individuals working in the maintenance or cleaning of establishments, vehicles for animal transport, and wastewater~~sewage~~ pipes should have:

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

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

~~24.~~25. 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), together with the following:

~~25.~~26. Ensure adequate~~proper~~ cleaning and disinfection of facilities, including animal holding areas, equipment and

utensils to reduce faecal contamination of carcasses, as it helps to control their potential viral contamination. ~~of the carcasses.~~

~~26.~~27. Enteric viruses, including HEV, can persist for long periods of time on hard surfaces. The data on ~~the~~ inactivation of HEV by surface disinfectants are too limited to draw conclusions but suggest a similarly high degree of resistance as observed for other enteric viruses.

12. PERSONAL HYGIENE

~~27.~~28. 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), together with the following:

~~28.~~29. Compliance with strict hand hygiene measures is important to reduce the risk of infection of personnel after being in contact with potentially HEV-contaminated tissues, liver, intestines, bile, blood or surfaces. It will also reduce the spread of the environmentally stable virus to food or surfaces.

13. CONTROL OF OPERATION

~~29.~~30. 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), together with the following:

13.2 Key aspects of GHPs

13.2.2 Specific process steps

- Stability: HEV infectivity is only minimally inactivated across a ~~by~~ pH range of 2 to ~~-~~9 or by 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: Generally, the thermal inactivation patterns of HEV appear to be similar to those of HAV. The required temperature for sufficient inactivation of HEV to achieve food safety depends on the food product's composition and initial viral load. For example, treatment at 71°C core temperature for 20 minutes has been shown~~was necessary for~~ to completely inactivate HEV ~~inactivation~~ in pâté-like products. Medium-to-raw cooking conditions do not completely inactivate HEV. For instance, incubation of HEV contaminated commercial pork liver homogenates at 56°C for 1 hour did not inactivate the virus.
- Product composition: The risk of exposure to HEV can be reduced by excluding high-risk tissues~~offal~~, which has the higher potential to be contaminated with HEV (e.g. liver and blood), compared to meat cuts, unless they undergo adequate thermal processing before being used as ingredients in RTE or minimally processed foods.

13.2.4 Microbiological contamination

~~30.~~31. Cross-contamination of animal tissues through shared equipment in slaughterhouses should be prevented. For example, the use of separate processing lines for tissues with a higher risk of HEV (e.g. liver) and tissues with low risk of HEV contamination (e.g. muscle/meat) in slaughterhouses represent an appropriate good manufacturing practice (GMP).

~~31.~~32. Intestinal contents, bile and blood should be considered as potentially ~~Unless from animals known to be free from HEV, intestine contents, bile and blood must be considered as~~ HEV-contaminated and should be contained and identified as effectively as possible to prevent cross-contamination of food, surfaces and personnel unless from animals known to be free from HEV or risk assessment indicates the risk of HEV is negligible.

14. PRODUCT INFORMATION AND CONSUMER AWARENESS

Refer to Section 14 of the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012), together with the following:

14.4 Consumer education

~~32.~~33. Since each country has specific consumption habits, communication and consumer education programmes should be tailored by the competent authorities to their consumers. Where there is evidence that the risk of HEV from consuming pork or game meat is not negligible, c~~C~~onsumers should be made aware of the risk of infection with HEV associated with the consumption of raw or undercooked pork or game meat and meat products, and the recommended cooking time and temperature to achieve food safety. Specific advice on the risk of HEV is recommended for individuals with pre-existing liver disease and immunocompromised individuals, e.g. transplant patients and patients using immunosuppressive medications.

~~33.~~34. Consumers should also be made aware of the importance of purchasing wild game meat from sources or establishments that comply with the applicable hygiene requirements and can provide appropriate assurance of fitness for human consumption in accordance with the relevant national control system.~~(e.g. documentation associated with a trained person or in organized hunts, an on-site veterinarian).~~

15. TRANSPORTATION

~~34.~~35. Refer to Section 15 of the *General Principles of Food Hygiene* (CXC 1-1969)~~., together with the following:~~

~~35. Biosecurity measures should extend from the farm to include transport. Vehicles used for the transportation of live animals may become contaminated with HEV through droppings and urine and require appropriate cleaning and disinfection. Transportation of infected animals, e.g. piglets to fattening farms, may introduce HEV into the receiving farms.~~

~~36. Vehicles used for transportation of wild game animal carcasses may become contaminated with HEV (i.e. blood droppings from the carcass) and require appropriate cleaning and disinfection.~~

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

16. INTRODUCTION TO HACCP

~~37.~~36. Refer to Section 16 of the *General Principles of Food Hygiene* (CXC 1-1969).

17. PRINCIPLES OF THE HACCP SYSTEM

~~38.~~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

~~39.~~38. Refer to Section 18 of the *General Principles of Food Hygiene* (CXC 1-1969).

19. APPLICATION

~~40.~~39. Refer to Section 19 of the *General Principles of Food Hygiene* (CXC 1-1969).