

CODEX ALIMENTARIUS COMMISSION

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Food and Agriculture
Organization of the
United Nations



World Health
Organization

Viale delle Terme di Caracalla, 00153 Rome, Italy - Tel: (+39) 06 57051 - E-mail: codex@fao.org - www.codexalimentarius.org

REP26/FH

JOINT FAO/WHO FOOD STANDARDS PROGRAMME

CODEX ALIMENTARIUS COMMISSION

Forty-ninth Session

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REPORT OF THE FIFTY-FIFTH SESSION OF THE CODEX COMMITTEE ON FOOD HYGIENE

Nashville, Tennessee, United States of America

15 – 19 December 2025

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SUMMARY AND STATUS OF WORK

Responsible Party	Purpose	Text/Topic	Code	Step	Para.
Members, CCEXEC90 and CAC49	Adoption	Consequential amendments to the <i>Code of practice on food allergen management for food business operators</i>	CXC 80-2020	adoption	Para 12, App.II
		Annex II on Fish and fishery products and Annex IV on Water fit-for-purpose assessment, safety management, and technologies for recovery and treatment of water for reuse of the <i>Guidelines for the safe use and reuse of water in food production and processing</i>	CXG 100-2023	5/8	55i, App.III
		Amendments to the General Section and Annexes I and III of the <i>Guidelines for the safe use and reuse of water in food production and processing</i>	CXG 100-2023	adoption	55ii, App.IV
		Amendments to the <i>Guidelines for the control of Taenia saginata in meat of domestic cattle</i> (CXG 85-2014), the <i>Guidelines for the control of Trichinella spp. in meat of Suidae</i> (CXG 86-2015) and the <i>Guidelines on the application of general principles of food hygiene to the control of foodborne parasites</i> (CXG 88-2016)	CXG 85-2014, CXG 86-2015, CXG 88-2016	adoption	17, 72i., App.V
		Revised <i>Guidelines for the control of Campylobacter and Salmonella in chicken meat</i>	CXG 78-2011	5/8	109 App.VI
		Revised <i>Guidelines on the application of general principles of food hygiene to the control of Listeria monocytogenes in foods</i>	CXG 61-2007	5/8	144i App.VII
CCEXEC90, CAC49, CCFFP	Action	Request to CAC to return the work to develop the appropriate sampling plans for histamine for the 11 fish and fishery product commodity standards to CCFFP			15
Relevant committees	Information/ Action	Completion of the work on the <i>Guidelines for the safe use and re-use of water in food production and processing</i> (CXG 100-2023)			55iv
CCFFP	Information/ Action	Completion of Annex II on Fish and fishery products of CXG 100-2023 and consideration on whether it was necessary to update the <i>Code of practice for fish and fishery products</i> (CXC 52-2003) and other Codex texts under their remit;			55iii
EWG (Japan, Honduras, Morocco and New Zealand) CCFH56	Revising	Review and revise as appropriate the text in square brackets in the revision of the <i>Guidelines on the application of the general principles of food hygiene to the control of pathogenic Vibrio species in seafood</i> (CXG 73-2010), following the completion of Annex II on Fish and Fishery Products of CXG 100-2023	CXG 73-2010	6/7	57
EWG (China, United Kingdom, Kenya)	Alignment	Continue the alignment exercise for those texts prioritized in the forward workplan	CXC 47-2001, CXC 48-2001, CXC 33-1985	N/A	72ii, iii, 148

Responsible Party	Purpose	Text/Topic	Code	Step	Para.
Members and Observers CCFH56					
EWG (Canada and the Netherlands) Members and Observers CCFH56	Redrafting	Revision of <i>Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food</i>	CXG 79-2012	2/3	89ii
China, Australia and Ghana CCFH56	Review / Drafting	To prepare a discussion paper and a project document for the revision of the <i>Code of practice on food allergen management for food business operators</i> (CXC 80-2020)			151
Chile, Australia and Brazil CCFH56	Review / Drafting	Revise the proposal on the revision of the <i>Code of practice for the processing and handling of quick frozen foods</i> (CXC 8-1976)			161ii
PWG (the United States of America) Members and Observers CCFH56	Comments/ Discussion	New work proposals / Forward workplan			156iv, 171i App.VIII
Codex Secretariat	Action	To prepare a background document on definitions of RTE foods in food hygiene texts			144iii
		Issue a Circular Letter requesting proposals for new work			171ii
CCFH56		Consider using a harmonized definition for RTE foods across its hygiene texts as well as its potential inclusion in CXC 1-1969 in view of the concerns raised on different definitions for RTE foods across Codex hygiene texts			144ii
FAO and WHO	Action	To provide scientific advice on the holding frozen temperature threshold to guarantee food safety for a range of different food commodities as indicated in CXC 8-1976			161i
JEMRA	Action	To conduct a risk assessment on spore-forming pathogens including <i>Clostridium botulinum</i> and <i>Bacillus cereus</i> in powdered infant formula; update the existing risk assessment and scientific advice on environmental pathogens; provide other relevant scientific advice on control measures for powdered infant formula that would inform a revision of the <i>Code of hygienic practice for powdered formulae for infants and young children</i> (CXC 66-2008) To develop the risk assessment tool in support of the revised <i>Guidelines on the application of general principles of food hygiene to the control of viruses in food</i> (CXG 79-2012)			168 89iii
Members	Action	Contribute to the work of CCFH by taking leadership roles in committee working groups			9i
Members and Observers	Action	Submit discussion papers /new work proposals in response to the relevant Circular Letter by 1 September 2026			171ii

LIST OF ACRONYMS

AMR	Antimicrobial Resistance
CAC	Codex Alimentarius Commission
CCASIA	Codex Coordinating Committee for Asia
CCEXEC	Executive Committee of the Codex Alimentarius Commission
CCFFP	Codex Committee on Fish and Fishery Products
CCFH	Codex Committee on Food Hygiene
CCFL	Codex Committee on Food Labelling
CCMAS	Codex Committee on Methods of Analysis and Sampling
CL	Circular Letter
CRD	Conference Room Document
CXC	Codex Code of Practice
CXG	Codex Guideline
CXS	Codex Standard
EMP	Environmental Monitoring Programme
EU	European Union
EWG	Electronic Working Group
FAO	Food and Agriculture Organization of the United Nations
FBOs	Food Business Operators
HACCP	Hazard Analysis and Critical Control Point
HEV	Hepatitis E Virus
IDF	International Dairy Federation
ISO	International Organization for Standardization
JEMRA	Joint FAO/WHO Expert Meetings on Microbiological Risk Assessment
MAP	Modified Atmosphere Packaging
MRA	Microbiological Risk Assessment
PAL	Precautionary Allergen Labelling
PIF	Powdered Infant Formula
PWG	Physical Working Group
RTE	Ready-to-Eat
USA	United States of America
VBNC	Viable But Non-Culturable
WHO	World Health Organization
WOAH	World Organisation for Animal Health

INTRODUCTION

1. The Codex Committee on Food Hygiene (CCFH) held its 55th session in Nashville, Tennessee, United States of America, from 15 to 19 December 2025, at the kind invitation of the Government of the United States of America (USA). Dr Evelyne Mbandi, Director, Microbiological and Chemical Hazards Staff, Food Safety and Inspection Service, United States Department of Agriculture (USDA) chaired the session, which was attended by 51 Member Countries, one Member Organization and 13 Observer Organizations and one United Nations Agency. The list of participants is contained in Appendix I.

OPENING

2. Ms Michelle Bekkering, Deputy Under Secretary for Trade and Foreign Agricultural Affairs, opened the meeting, and welcomed participants by emphasizing that Codex forms the foundation for safe and fair agricultural and food systems globally. She noted that agriculture served as a bridge connecting nations and driving economic opportunity and reiterated the United States' firm commitment to science-based international standards.
3. Deputy Under Secretary Bekkering stressed that Codex standards were vital not only for consumer protection but also for supporting livelihoods and economic growth. She concluded by expressing gratitude to Codex delegates for their work which contributed to ensuring safer food, securing jobs for food business operators, and showcasing the capabilities of farmers, ranchers, and producers.
4. Dr Allan Azegele, Chairperson of the Codex Alimentarius Commission (CAC), through Dr Jing Tian, vice-Chairperson of CAC, and Dr Evelyne Mbandi, Chairperson of CCFH, also addressed the session.
5. In memoriam: CCFH55 observed one minute of silence in memory of the late: Claus Heggum, delegate of Denmark and the International Dairy Federation (IDF), who for many years supported the work of CCFH and directly contributed to the development of its hygiene texts; Lisa Ralph, Codex Senior Policy Analyst, and Codex Contact Point, New Zealand; and Tom Billy, Chairperson of the Codex Alimentarius Commission, 1999-2003, USA.

Division of competence¹

6. CCFH55 noted the division of competence between the European Union (EU) and its Member States in accordance with Rule II, paragraph 5, of the CAC Rules of Procedure.

ADOPTION OF THE AGENDA (Agenda item 1)²

7. CCFH55 adopted the provisional agenda.

MATTERS REFERRED BY THE CODEX ALIMENTARIUS COMMISSION AND/OR OTHER CODEX SUBSIDIARY BODIES TO THE COMMITTEE (Agenda Item 2)³

8. The Codex Secretariat introduced the item, noting that it included both matters for information and matters for action.

Matters for information

9. CCFH55 noted the information presented and;
 - i. encouraged more Members to take leadership roles in committee working groups, noting the availability of the *Codex electronic working groups handbook* to support Members in this role;
 - ii. noted the importance of forward planning with regard to scientific advice needs to facilitate resource allocation/mobilization and timely development of standards and agreed to discuss/address this further under item 10; and
 - iii. noted the adoption of the Codex Strategic Plan 2026–2031, the goals for the next six years and the monitoring framework, which would reflect the activities of, and participation in CCFH.

¹ Division of Competence and voting right between the European Union and its member states (CRD01)

² CX/FH 25/55/1 Rev.1

³ CX/FH 24/54/2; CX/FH 25/55/2 Add.1; CRD05 (Codex Secretariat); CRD07 (Kenya, Malaysia, Morocco and Nigeria); CRD20 (Mali).

Matters for action

Consequential amendments to the Code of practice on food allergen management for food business operators (CXC 80-2020)

10. CCFH55 considered the proposal to align CXC 80-2020 with the *General standard for the labelling of prepackaged foods* (CXS 1-1985), specifically regarding the list of foods and ingredients known to trigger food allergy or coeliac disease or allergenic foods and relevant definitions, and agreed to the consequential amendments proposed in CRD5 with the following modifications:
 - i. Correction of typographical errors in the cross-referenced section numbers from 4.2.1.4 and 4.1.2.5 to 4.2.1.4 and 4.2.1.5;
 - ii. Deletion of the phrase "on a global basis" in the "Scope" to ensure consistency with the Hazard Characterization section; and
 - iii. Removal of the new definition for "food allergen" at this stage, to avoid any conflict with the existing definition for "allergen" noting that a discussion on the most appropriate definition for the Code of Practice (i.e. allergen or food allergen) could be considered in any future revision of CXC 80-2020.

Guidelines on the use of precautionary allergen labelling (PAL): Annex to CXS 1-1985

11. CCFH55 noted the progress on PAL in CCFL, and that the work may be completed as soon as 2026, and that as a result a more in-depth revision of CXC 80-2020 may need to be considered by CCFH56.

Conclusion

12. CCFH55 agreed to forward the consequential amendments to CXC 80-2020 for adoption by CAC49 (Appendix II), noting that additional work will be required upon completion of the work on precautionary allergen labelling (PAL) by CCFL.

Sampling plans for histamine

13. CCFH55 discussed the outstanding work on sampling plans for histamine for 11 fish and fishery product commodity standards, which had previously been suspended pending updates from the Codex Committee on Methods of Analysis and Sampling (CCMAS).
14. Following information provided by the Codex Secretariat, CCFH55 considered two options; i) whether to restart the work within CCFH or ii) request CAC to return it to the Codex Committee on Fish and Fishery Products (CCFFP), noting that CCFFP had been reactivated to work by correspondence. While there was general support for option ii, views were also expressed regarding the challenges of working by correspondence on complex issues. The Codex Secretariat recalled that recent revisions to the *Codex Procedural Manual* by CAC48 included the possibility for committees working by correspondence to hold virtual meetings as deemed necessary to facilitate discussions on specific matters. The Codex Secretariat further noted that CCFFP would need to be engaged in the work regardless of which committee would take the lead and that the decision should be based on technical competence rather than the working modality of the committee.

Conclusion

15. CCFH55 agreed to request CAC49 to return the work to develop the appropriate sampling plans for histamine for the 11 fish and fishery product commodity standards to CCFFP; and inform CCFFP of this request, as well as the existing work of CCFH and the related electronic working group (EWG)⁴ on this issue.

Guidelines for the control of Trichinella spp. in meat of Suidae (CXG 86-2015)

16. CCFH55 favourably considered the proposed amendments to the *Guidelines for the control of Trichinella spp. in meat of Suidae* (CXG 86-2015), noting these were primarily of an editorial nature, with the exception of the definition of "compartment" which had been recently revised by the World Organisation for Animal Health (WOAH). It was also highlighted that chapter titles rather than numbers were used when referencing WOAH texts to support the longevity of the references noting that the chapter numbers in the WOAH *Terrestrial Animal Health Code* were subject to change with future updates to the Code.

Conclusion

17. CCFH55 agreed on the proposed amendments to CXG 86-2015 and forwarded these for adoption by CAC49 (Appendix V, Part B).

⁴ REP19/FH, paragraphs 40-47; CX/FH 18/50/6; CX/FH 18/50/6 Add 1; CX/FH 18/50/6 Add 2; FH50/CRD06

MATTERS ARISING FROM THE WORK OF FAO AND WHO (INCLUDING JEMRA) (Agenda Item 3)⁵

18. The FAO and WHO Representatives introduced the item and thanked delegates for their support to JEMRA.
19. The FAO Representative recalled the scientific advice provided on foodborne viruses, *Campylobacter*, *Salmonella*, *Listeria monocytogenes*, and food allergens. The Representative further informed CCFH55 that a workshop on food allergens was held in the margins of CCASIA23 to aid understanding of related FAO and WHO work and recommendations on this issue. Recalling the discussions on scientific advice at CAC48, the Representative recognized the importance of timely responses to Codex scientific advice requests to support efficient standard setting and encouraged CCFH to identify its upcoming scientific advice needs as early as possible. The Representative also noted that an expert consultation on the use of omics-based technologies in microbiological risk assessment was planned for 2026.
20. The FAO Representative advised CCFH55 that FAO had recently convened expert meetings on foodborne toxigenic clostridia, protozoal parasites, and helminths, for which reports were under development, as well as workshops on water reuse in fisheries, antimicrobial resistance (AMR) co-selection and risk communication. The Representative also informed CCFH55 that “The Good Hygiene Practices and HACCP toolbox” was also available in French on the FAO website.
21. The WHO Representative updated delegates on the web-based listeriosis risk assessment tool, new guidelines for traditional food markets, the Global Strategy for Food Safety 2022-2030, and the 2025 Foodborne Disease Burden Estimates. The Representative encouraged Codex Members and Observers to use and provide feedback on the listeriosis tool.
22. Following the intervention by an Observer on the recent illnesses in infants caused by *Clostridium botulinum* in powdered infant formula (PIF), the FAO Representative indicated that FAO had considered clostridia in PIF in its recent expert meeting on foodborne toxigenic clostridia, the report of which would be published soon. However, the Representative noted that data were limited, and the meeting had been convened prior to the current outbreak, but that JEMRA would provide further advice on *C. botulinum* and other pathogens in PIF if requested by CCFH.

Conclusion

23. CCFH55:
 - i. expressed appreciation for the valuable work that had been undertaken by FAO and WHO since CCFH54, noting its importance for progressing the ongoing work in CCFH, and that further details could be provided during the relevant agenda items;
 - ii. noted the importance of scheduling new work for JEMRA in a forward-looking manner;
 - iii. encouraged Members and Observers to use the “WHO Risk Estimation Tool for *Listeria monocytogenes* in Foods” and liaise directly with WHO regarding the support, interpretation and further development of this tool;
 - iv. recalled the importance of using the most up-to-date tools and innovative approaches to provide scientific advice, as recommended by CAC48 and encouraged JEMRA to ensure its methodology was up to date and in this regard welcomed work on the use of omics-based technologies in microbiological risk assessment; and
 - v. welcomed the availability of the Good Hygiene Practices and HACCP toolbox in French.

MATTERS OF INTEREST ARISING FROM OTHER INTERNATIONAL ORGANIZATIONS (Agenda Item 4)⁶International Organization for Standardization (ISO)

24. The Representative of ISO provided an overview of the activities of ISO Technical Committee 34, Subcommittee 9 (*Microbiology of the food chain*) highlighting that the subcommittee had published over 100 standards. These standards primarily dealt with horizontal reference methods for the detection and enumeration of microorganisms (including bacteria, toxins, viruses, and parasites) applicable across the entire food chain, from primary production to the food production environment. The standards also covered general aspects such as good laboratory practices, method validation, and the use of whole genome sequencing.
25. The Representative emphasized the importance of collaboration between ISO and CCFH, citing Goal 3 of the *Codex Strategic Plan 2026–2031*, reaffirmed ISO’s objective to develop internationally recognized reference methods that would also meet the needs of CCFH, and welcomed the referencing of ISO methods in CCFH guidelines to ensure a coordinated approach to global food safety challenges.

⁵ CX/FH 25/55/3; CRD08 (Kenya and Nigeria), CRD20 (Mali)

⁶ CX/FH 25/55/4; CRD09 (Kenya and Nigeria), CRD20 (Mali)

World Organisation for Animal Health (WOAH)

26. The Codex Secretariat presented a statement on behalf of WOAH updating CCFH55 on relevant activities. In this statement, WOAH highlighted the revisions to the *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals* and the *Terrestrial Animal Health Code* regarding infection with *Trichinella*, which were adopted by the World Assembly of Delegates in May 2023 and May 2024, respectively.
27. WOAH also informed CCFH55 of the launch of the WOAH Standards Navigation Tool in April 2025, designed to streamline access to digitized standards, and the publication of the second Observatory monitoring report, which provides insights into the implementation of WOAH standards by its Members.

Conclusion

28. CCFH55 noted:
 - i. the information provided by ISO and WOAH and recognized the importance of ongoing collaboration between CCFH and relevant international organizations; and
 - ii. that this collaboration aligned with Goal 3 of the *Codex Strategic Plan 2026–2031*, which aimed to strengthen relationships with relevant international organizations to promote a coordinated approach to addressing global challenges.

GUIDELINES FOR THE SAFE USE AND REUSE OF WATER IN FOOD PRODUCTION AND PROCESSING (CXG 100-2023): PROPOSED DRAFT ANNEX II ON FISH AND FISHERY PRODUCTS AND ANNEX IV ON WATER FIT-FOR-PURPOSE ASSESSMENT, SAFETY MANAGEMENT, AND TECHNOLOGIES FOR RECOVERY AND TREATMENT OF WATER FOR REUSE (Agenda item 5)⁷

29. The European Union, as Chair of the EWG and the Physical Working Group (PWG), speaking also on behalf of the co-Chairs Honduras, India, Mauritania, Morocco, and the International Dairy Federation (IDF), introduced the item by providing a brief history of the work. The EWG/PWG chair noted that the EWG had revised Annex II on fish and fishery products, taking into consideration the JEMRA scientific advice and its practical implementation, and the extensive comments received over two rounds of consultations. The EWG had further developed Annex IV on water fit-for-purpose assessment, safety management and technologies for recovery and treatment of water for reuse and also proposed amendments to the General Section and other Annexes of CXG 100-2023 to include a cross-reference to Annex IV.
30. The EWG/PWG Chair provided an overview of how the comments had been addressed, noting that the annexes had been further revised to address written comments received in response to CL 2025/58-FH in preparation for the PWG. The EWG/PWG Chair further emphasized that consensus had been reached on the majority of revisions during the PWG as documented in its report (CRD02); however, differences in views remained on Figure 4 and it was agreed that the second option for this figure would be presented as a basis for further discussion in plenary.
31. The EWG/PWG Chair informed the Committee that the updated draft annexes, reflecting the outcomes of the PWG discussions, were presented in CRD02.

Discussion

32. CCFH55 agreed to consider the revised Annexes as presented in CRD02.

Proposed draft Annex II on Fish and Fishery Products

33. CCFH55 supported the text presented with the following comments and decisions, in addition to editorial corrections, and amendments for clarity and consistency.

1. Introduction

Paragraph 6

34. It was agreed to insert the wording "*and application of control measures as needed.*" at the end of the paragraph to clarify that it was not the assessment that made water fit for purpose but the actions taken as a result of that assessment.

⁷ CX/FH 25/55/5; CX/FH 25/55/5 Add.1 (Comment of Argentina, Australia, Canada, Chile, Colombia, Ecuador, Egypt, European Union, Honduras, Japan, Kenya, Malaysia, Maldives, Mexico, Morocco, New Zealand, Norway, Peru, Philippines, Thailand, United Arab Emirates, United Kingdom, Uruguay, Zambia, Institute of Food Technologists (IFT) and WHO); CRD02 (Report of the EWG Chairs); CRD10 (India, Malaysia, Morocco, Nigeria, Republic of Korea, Russian Federation, Singapore, Uganda, United Republic of Tanzania (URT) and United States of America (USA)); CRD16 (El Salvador); CRD17 (Ghana); CRD19 (Senegal); CRD20 (Mali); CRD21 (African Union (AU));); CRD24 (Cabo Verde); CRD25 (International Union of Food Science and Technology (IUFoST))

5. Water Source: paragraph 11 – bullet point 1

35. “*potable (drinking) water*” was replaced with “*drinking water*” as this was considered to better reflect the content of the paragraph which referred to water sources rather than water quality.

6. Water Use

Paragraph 12

36. This was substantially revised to ensure there was a clear distinction as to when an in-depth water fit-for-purpose assessment was required in contrast to when a simple identification of the water source linked to an analysis of its microbiological quality was sufficient for use of clean water and potable water. The last sentence was also revised to refer to prerequisite programmes as the commonly used and defined term.

Paragraph 16

b) Clean water – bullet point 3

37. CCFH55 agreed to delete “*artificial seawater*” and the associated footnote as an example due to a lack of clarity on the source of the base ingredient water.

c) Other sources of water

38. Views were expressed on the appropriate heading, including proposals to refer to “*other fit-for-purpose water*” or “*fit-for-purpose water*.” Following discussion, recalling the JEMRA recommendations, and taking into account the need for consistency with the categorization of potable water and clean water, CCFH55 agreed to retain the heading “*other sources of water*.”

Paragraph 19

39. There were requests for clarity on the use of the term “*in-depth water fit-for-purpose assessment*” compared to a “*water fit-for-purpose assessment*” highlighting the need for consistent terminology across the document. It was clarified that the concept of an “*in-depth water fit-for-purpose assessment*” was introduced, discussed and agreed during the PWG as a means of describing the nature of the risk assessment required when applying a risk-based approach to determine if water was fit for purpose. This was described in detail in paragraph 36 of the Annex. While a fit-for-purpose assessment of water for a specific use should always be undertaken, this distinction recognized that the nature of the assessment can vary according to water source. For example, water that was already categorized as clean or potable would not require an “*in-depth water fit-for-purpose assessment*” while water from other sources would. Noting this explanation, it was acknowledged that in some places the term “*in-depth water fit-for-purpose assessment*” would be used whereas in others, when the context was more general or specific to clean or potable water, the term “*water fit-for-purpose assessment*” would be the most suitable. A proposal to add “*in-depth water fit-for-purpose assessment*” to the third bullet of this paragraph was not accepted based on the above explanation. Changes were made to paragraphs 32, 65 and 69 and Figure 2 (Question 6) to clarify the need for an “*in-depth water fit-for-purpose assessment*”.

Paragraph 25

40. Acknowledging the distinction between the terms “*offshore*” and “*coastal*,” it was agreed to add “*or coastal*” after “*offshore*”, in recognition that coastal water might also be of suitable quality, if it met specific conditions.

7. Water Intended for Reuse: Paragraph 30

41. CCFH55 agreed to insert the wording “*that could come in direct or indirect contact with food*” after “fish and fishery products” to clarify that the provision applies only where there is potential food contact.

8. Water Use or Reuse Fit-for-Purpose Assessment

Paragraph 34 – bullet point 5

42. In response to a question regarding its deletion, the EWG/PWG Chair explained that the bullet point was removed as it did not align with the introductory sentence and was repetitive of content already addressed elsewhere in the text. CCFH55 confirmed their agreement to the deletion.

Paragraph 41

43. The second sentence was revised by replacing “*It is impossible*” with “*It may be impossible*” to avoid a categorical statement. Concerns were expressed regarding the ambiguity of the term “undercooked,” and the EWG/PWG Chair clarified that the terminology was in line with JEMRA reports, had also been used in other Codex texts and was important to reflect consumption practices where fish may be eaten raw or undercooked. To provide further clarity, the term “*adequately*” was included before “*cooked*” in the subsequent sentence to clarify the degree of cooking being referenced.

Proposed draft Annex IV on water fit-for-purpose assessment, safety management, and technologies for recovery and treatment of water for reuse

44. CCFH55 agreed with most of the revisions to Annex IV as presented in CRD02 and in addition to further editorial corrections, and amendments for clarity and consistency, CCFH55 made the following comments and decisions.

6. Water Safety Management

Paragraphs 20 and 21

45. Recalling that there had been some discussion in the PWG regarding these paragraphs and in particular the reference to hazard analysis, a Member was of the view that this could be interpreted to mean that a full HACCP-based water safety management plan was always needed, but considered this would not be feasible in all contexts.
46. The EWG/PWG Chair explained that to address this concern, an alternative text to paragraphs 20 and 21 was also presented in the CRD02 for consideration of the plenary.
47. Mixed views were expressed on the alternative wording, with some supporting it and others of the view that it still did not address the challenges that had been identified and that the flow of information was less clear than the original.
48. As there was no consensus on the alternative text, it was agreed to review the existing paragraphs 20 and 21 to address concerns. An introductory paragraph was inserted before paragraph 20 on development of a water safety management plan noting that it may comprise prerequisite programmes or a full HACCP-based programme, therefore clarifying that a full HACCP-based plan was not always needed. It was also clarified that a water safety management plan could be part of an overall food safety management plan. With this new paragraph, the last sentence of paragraph 20 was deleted as redundant. Paragraph 21 was tailored to those situations when a full HACCP-based water safety management plan should be developed and shortened to remove content now covered in the previous two paragraphs. With these modifications, consensus was reached on the text.

Paragraph 29

49. It was agreed to replace “*foreseeable hazard*” with “*potential hazards*” and to amend “*potential severity*” to “*severity of associated adverse health effects*” in line with language used in the *General principles of food hygiene* (CXC 1-1969) and for greater clarity.

Figure 2

50. The question in the second bullet of the left-hand box was revised to “*Which water supply sources are used?*” to ensure it was complete and understandable.

Paragraph 30

51. The term “*high-risk hazards*” was replaced with “*hazards not controlled by prerequisite programmes only*” to better reflect that a full HACCP-based approach applies where prerequisite programmes are insufficient.

Paragraph 31– bullet point 6

52. It was agreed to split the bullet combining the microbiological profile and the use of disinfectant chemicals into separate bullets, and to add a new bullet on “*the presence of nutrients for microorganisms in the water*”, noting that particularly in water reuse, nutrients present may represent an important risk factor for the establishment and growth of microorganisms.

General section and annexes I and III of CXG 100-2023

53. With the completion of Annex IV, CCFH55 agreed with the proposals of the EWG (see CX/FH 25/55/5 paragraph 17) to make cross-references to Annex IV in Section 1 of the General Section of CXG 100-2023, Sections 7 and 8 of Annex I and Sections 7, 8 and 9 of Annex III.

Conclusion

54. CCFH55 noted that all issues had been addressed and that the annexes were ready to advance in the Step procedure.
55. CCFH55 agreed to:
- i. forward Annexes II and IV to CAC49 for adoption at Step 5/8 and inclusion in the *Guidelines for the safe use and re-use of water in food production and processing* (CXG 100-2023) (Appendix III);

- ii. submit the corresponding amendments to include cross-references to Annex IV in the General Section and Annexes I and III of CXG 100-2023 to CAC49 for adoption (Appendix IV);
- iii. inform CCFFP of the completion of Annex II and propose that CCFFP may consider whether it was necessary to update the *Code of practice for fish and fishery products* (CXC 52-2003) and other Codex texts under their remit;
- iv. inform other relevant committees of the completion of the work on the *Guidelines for the safe use and re-use of water in food production and processing* (CXG 100-2023); and
- v. ensure that the texts developed by CCFH would be aligned with the *Guidelines for the safe use and re-use of water in food production and processing* (CXG 100-2023) in relation to water provisions.

Revision of the *Guidelines on the application of the general principles of food hygiene to the control of pathogenic Vibrio species in seafood* (CXG 73-2010)

56. Following the extensive work on the revision of CXG 73-2010, CCFH54 forwarded the proposed draft revision to CAC47 where it was adopted at Step 5, noting that all references to water remained in square brackets. CCFH54 also agreed to revisit this text as soon as Annex II on Fish and Fishery Products of CXG 100-2023 was completed. With CCFH55 completing work on Annex II, it was agreed to revisit the text related to water in CXG 73-2010 and finalize its revision in a manner that was consistent with CXG 100-2023 Annex II.

Conclusion

57. CCFH55 agreed to establish an EWG chaired by Japan and co-chaired by Honduras, Morocco and New Zealand, working in English and Spanish, to review the text in square brackets in the revision of CXG 73-2010 (REP24/FH Appendix V) taking into account CXC 100-2023 Annex II, and prepare a report for consideration by CCFH56, to be submitted no less than 3 months prior to CCFH56.

ALIGNMENT OF CODEX TEXTS DEVELOPED BY CCFH WITH THE REVISED *GENERAL PRINCIPLES OF FOOD HYGIENE* (CXC 1-1969) (Agenda Item 6)⁸

58. China, as Chair of the EWG, speaking also on behalf of the co-Chairs, the United Kingdom and the European Union, introduced the item and recalled that CCFH54 had agreed to initiate full structural alignment of existing CCFH texts with the revised *General principles of food hygiene* (CXC 1-1969), starting with the most recently modified texts. The EWG Chair emphasized that the scope of work had been limited to editorial adjustments, including section numbering, headings, and internal logic, without introducing technical changes.
59. The EWG Chair explained that document CX/FH 25/55/6 had been prepared, presenting three aligned texts: the *Guidelines for the control of Taenia saginata in meat of domestic cattle* (CXG 85-2014), the *Guidelines for the control of Trichinella spp. in meat of Suidae* (CXG 86-2015), and the *Guidelines on the application of general principles of food hygiene to the control of foodborne parasites* (CXG 88-2016). The document also identified key issues related to referencing principles and numbering approaches and proposed a workplan for future alignment of CCFH texts with CXC 1-1969. The EWG Chair noted that challenges encountered included differences in structure and terminology between older CCFH texts and CXC 1-1969, apparent jumps in numbering, and the need to verify cross-references.
60. The EWG Chair further reported that, based on comments received, the EWG Chairs had revised the three aligned texts and developed a decision tree intended as a working tool to promote a consistent and transparent approach. The revised document was presented as CRD22, and the EWG Chair proposed that CRD22 be used as the basis for discussion. In addition, the EWG Chair also proposed that CCFH55 consider the workplan for future alignment as presented in CX/FH 25/55/6 Appendix VI.

Discussion

61. CCFH55 held a general discussion and subsequently considered the three appendices contained in CRD22.

General discussion

62. Members expressed their appreciation for the work undertaken by the EWG and indicated broad support for the alignment approach and the recommendations proposed.
63. A view was expressed on the need to review other texts to be considered by CCFH55 to ensure that missing sections were appropriately titled and numbered consistently, should the proposed format under this agenda item be agreed upon.

⁸ CX/FH 25/55/6; CX/FH 25/55/6 Add.1 (Comments of Argentina, Australia, Canada, Egypt, European Union, Kenya, Morocco, Qatar, Thailand, United Arab Emirates); CRD11 (India, Russian Federation and United Republic of Tanzania (URT)), CRD17 (Ghana); CRD19 (Senegal); CRD20 (Mali); CRD22 (Report of the EWG Chairs on alignment); CRD 24 (Cabo Verde)

64. In response to a query regarding the apparent jump in section numbering for example in CRD22 Appendix II from Section 8 to Section 8.5, the Codex Secretariat clarified that, under CXC 1-1969, Section 8 comprised Sections 8.1 to 8.4. The Codex Secretariat explained that the aligned text used the expression “refer to Section 8 of the *General principles of food hygiene* together with the following” to indicate to the user to apply Sections 8.1 to 8.4 together with Section 8.5, thereby avoiding duplication while maintaining structural alignment and readability; and that this approach was also applicable to other sections as appropriate. The Codex Secretariat further clarified that this approach had already been common practice in CCFH texts that followed the structure of CXC 1-1969 prior to its 2022 revision.

Challenges in achieving structural alignment

65. The Chairperson invited CCFH55 to consider situations where full structural alignment was difficult and circumstances that might require additional technical review beyond alignment. The Chairs of other CCFH EWGs shared their experiences with alignment during the conduct of their work.
66. The United States of America, as Chair of the EWGs for the revision of the *Guidelines on the application of general principles of food hygiene to the control of Listeria monocytogenes in foods* (CXG 61-2007) and the *Guidelines for the control of Campylobacter and Salmonella in chicken meat* (CXG 78-2011), highlighted that alignment was more manageable when undertaken in parallel with technical revision but remained challenging for texts with complex structures, such as those containing extensive process flow diagrams.
67. Canada, as Chair of the EWG for the revision of the *Guidelines on the application of general principles of food hygiene to the control of viruses in food* (CXG 79-2012), also noted that alignment was more straightforward when conducted alongside technical revision and emphasized the need for a strategic and flexible approach to ensure Codex texts continued to provide clear and effective guidance to users.

Consideration of the future alignment workplan

68. The Codex Secretariat noting the lessons learned and the benefit of undertaking alignment together with technical revision of a text, stressed the importance of incorporating alignment activities into CCFH's forward workplan to avoid potential duplication of effort and ensure efficient use of resources.
69. In response to the EWG Chair's suggestion to continue work by aligning three CCFH texts and refining the decision tree within the EWG, the Chairperson emphasized the need for transparency, whether through the decision tree or other means, and proposed that the identification of specific texts and the approach for continuing this work be further considered under the forward workplan (agenda item 10).
70. CCFH55 considered the three appendices included in CRD22, with particular attention to the texts highlighted in yellow, and agreed to all amendments for alignment.

Conclusion

71. CCFH55 noted the lessons learned in the process of undertaking alignment, namely that structural alignment should prioritize texts unlikely to be revised in the medium term, and emphasized the importance of integrating the alignment workplan with the forward workplan to ensure consistency in CCFH's work planning.
72. CCFH55 agreed to:
- i. forward the proposed amendments to CXG 85-2014, CXG 86-2015 and CXG 88-2016, resulting from alignment with CXC 1-1969, to CAC49 for adoption (Appendix V);
 - ii. establish an EWG, chaired by China and co-chaired by the United Kingdom and Kenya, working in English, to continue the alignment exercise for those texts prioritized in the forward workplan (see Agenda item 10) and clearly document the alignment approach through a decision tree or other means; and
 - iii. request that the EWG submit the report to the Codex Secretariat at least three months prior to CCFH56.

PROPOSED DRAFT REVISION OF THE *GUIDELINES ON THE APPLICATION OF GENERAL PRINCIPLES OF FOOD HYGIENE TO THE CONTROL OF VIRUSES IN FOOD* (CXG 79-2012) (Agenda Item 7)⁹

73. Canada, as Chair of the EWG, introduced the item also on behalf of the Netherlands as co-Chair. The EWG Chair highlighted that the revision considered the available scientific advice from JEMRA¹⁰ but noted that the full JEMRA report from its second meeting on prevention and intervention measures was still pending. The work to date also included the updating/modification of definitions, alignment with CXC 1-1969, and the addition of Annex 3 on controlling hepatitis E virus (HEV) in pork and wild game meat. Extensive feedback had been gathered over two rounds of consultations.
74. The EWG Chair provided an overview of how comments had been addressed to date but noted that those on prevention and intervention measures would only be addressed once the second JEMRA report was published. The EWG Chair highlighted a number of issues on which feedback was required from CCFH55 including a frozen produce definition, harmonization of water related terminologies, guidance around employees staying out of work when ill, and aspects related to Annex 3 such as product labelling. The EWG Chair recommended that CCFH55 focus its discussion on these aspects and that the guidelines could then be returned to Step 2 for further elaboration, integrating information from the second JEMRA report on viruses, and addressing all comments with the goal of providing clear and consistent guidelines for completion at CCFH56.
75. The FAO Representative confirmed that the second JEMRA report on viruses would be published early 2026. The WHO Representative updated CCFH55 on the review of risk assessment models for foodborne viral disease. Following an extensive literature review, eight models had been identified for in-depth review. While each had advantages, none of the models were suitable for adoption as simplified risk calculators. Nevertheless, data in the related papers, when combined with information in the recent MRA documents and inputs from the JEMRA experts, could be useful in the development of a simplified risk calculator.
76. The FAO Representative presented a conceptual prototype of a commodity-based simplified risk calculator and sought feedback from CCFH55 on whether this was in line with CCFH's expectations. The Representative noted that upon entry of a minimum number of data points, the calculator would provide an assessment of risk, highlight areas of vulnerability (e.g. pre-harvest management, processing, etc.) and provide tips or references on how to address these risk factors.

Discussion

General comments

77. Members expressed support and appreciation for the overall direction of the work done by the EWG, noting that good progress had been made and welcomed the opportunity to provide further input at this time. Some concerns were expressed regarding the feasibility of measures at the primary production stage, and for small-scale FBOs or small-holder farmers in particular, and it was requested that there should be flexibility that also took into account the capacity of these stakeholders. A concern was expressed that disinfectant options in paragraph 61 were overly prescriptive and suggested that they be included as examples.
78. On the specific issues raised by the EWG Chair, Members shared the following views and CCFH55 made the following recommendations:

⁹ CX/FH 25/55/7; CX/FH 25/55/7 Add.1 (Comments of Argentina, Australia, Chile, Colombia, Ecuador, Egypt, European Union, Kenya, Malaysia, Mexico, New Zealand, Peru, Philippines, Thailand, United Kingdom, Uruguay, Zambia and Institute of Food Technologists (IFT)); CRD12 (India, Kenya, Malaysia, Morocco, Nigeria, Republic of Korea, Russian Federation, Singapore, Uganda and United Republic of Tanzania (URT)); CRD17 (Ghana); CRD20 (Mali); CRD21 (African Union (AU)); CRD24 (Cabo Verde); CRD25 (International Union of Food Science and Technology (IUFOST))

¹⁰ 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>

Definition of frozen produce

79. Regarding the two options presented in the report of the EWG (CX/FH 25/55/7), there were mixed views on whether a specific freezing temperature (e.g. –18 °C) should be indicated in the definition of frozen produce. Some Members supported its inclusion for clarity, to support enforcement and alignment with existing Codex texts, while others preferred its deletion to avoid prescriptiveness, noting that any freezing temperature below –12 °C was a quality-related rather than a food safety parameter and deletion of the specific temperature could provide flexibility. Members that supported Option 2 noted that competent authorities could establish specific temperatures in their national legislation if concerns existed regarding control during transportation, storage, or the freezing process.
80. Three options emerged from the discussion: (i) Option 1, as presented specifying a defined freezing temperature to be maintained throughout transportation, storage and distribution; (ii) Option 2, as presented focusing on freezing below the freezing point sufficient to preserve product quality without specifying a temperature; and (iii) Option 3 retaining the text of option 1 but without specifying a particular temperature.
81. As there was no agreement and noting that there would be further discussions on freezing or frozen storage temperatures under agenda item 10, CCFH55 agreed that this aspect would need further consideration in the EWG.

Harmonisation of terminology describing water including “clean water”, “water fit-for-purpose” and “potable water”

82. CCFH55 agreed with the recommendation of the EWG co-Chairs to review all these terms in light of the completed CXG 100-2023 and to cross-reference CXG 100-2023 as appropriate.

Paragraph 46: FBOs should consider implementing policies such that employees are not financially adversely affected by staying home

83. A Member clarified that the rationale for including this guidance was to ensure economic concerns of employees did not negatively impact measures to ensure food safety. Nevertheless, Members generally agreed to the deletion of this sentence from paragraph 46, noting that issues related to financial compensation and labour conditions fell outside the scope of CCFH texts and were more appropriately addressed through national labour and employment frameworks.

Paragraph 74: Persons who have had gastroenteritis should only be allowed to return to work after a period (e.g. 48h)

84. There was a proposal to remove the example of 48 hours, citing the differences in the length of illness associated with different enteric pathogens. The WHO Representative clarified that it had no guidelines on this matter.
85. The EWG Chair recalled that there had been requests to provide some guidance in this area and that 48h was only provided as an example. CCFH55 agreed to retain this in the text.

Paragraph 34 on product labelling on Annex III Control of HEV in Pork and Wild Game Meat

86. CCFH55 agreed with the recommendation of the EWG co-Chairs to remove this paragraph noting that consumer education rather than product labelling was a more appropriate way to address any risks and that product labelling for this purpose had not been used in Codex texts addressing other pathogen-commodity combinations.

Other issues

Definition of ready-to-eat food

87. CCFH55 noted an observation on inconsistencies in the definition of *ready-to-eat foods* in the Guidelines compared to other Codex texts and highlighted the need to harmonize this definition across different Codex texts.
88. In this regard, the Chairperson observed that the matter would also be addressed under agenda item 9, where the harmonization of the definition could be further considered.

Conclusion

89. CCFH55:
 - i. agreed to return the proposed draft guidelines to Step 2 for further elaboration and to update the prevention and intervention measures based on the JEMRA virus report Part 2, once published, and then for circulation for comments at Step 3;

- ii. agreed to re-establish the EWG, chaired by Canada and co-chaired by the Netherlands, working in English (comments in French would also be accepted), to:
 - a) continue with the revision of the guidelines based on the written comments submitted and the discussions in plenary for further consideration by CCFH56; and
 - b) prepare a report and a revised text to be submitted to the Codex Secretariat three months before CCFH56 for circulation for comments at Step 3; and
- iii. encouraged JEMRA to continue to develop the risk assessment tool in a manner that would support implementation of the revised guidelines.

PROPOSED DRAFT REVISION OF THE GUIDELINES FOR THE CONTROL OF CAMPYLOBACTER AND SALMONELLA IN CHICKEN MEAT (CXG 78-2011) (Agenda Item 8)¹¹

90. The United States of America, as Chair of the EWG and PWG, speaking also on behalf of the co-Chairs Australia, Brazil, Denmark, Honduras, and India, introduced the item and explained that the PWG had met prior to the session to consider a revised draft of the guidelines prepared by the co-Chairs. This draft had incorporated comments from CX/FH 25/55/8, Add.1, and various CRDs.
91. The EWG/PWG Chair informed CCFH55 that the PWG discussions had focused on key topics, including alignment, scope, AMR, risk profiles of free-range and controlled-environment chickens, and temperature recommendations for storage and distribution. It was noted that the PWG had agreed on a hybrid alignment approach, which included technical updates, partial structural alignment with CXC 1-1969, revised headings, updated definitions, and a modernized flowchart to facilitate ease of use.
92. On scope, the EWG/PWG Chair explained that the PWG had recommended limiting the guidelines to raw chicken meat from broiler carcasses and parts, with targeted guidance on chicken liver in view of recent reports of foodborne illness. Future annexes might address other preparations. The PWG had also supported inclusion of recommendations for free-range systems where appropriate, recognizing differences in risk profiles.
93. The EWG/PWG Chair further explained that although AMR was outside the scope of the guidelines, the PWG had acknowledged its importance and added text referencing the prudent use of antimicrobials in accordance with CXC 61-2005. Regarding storage temperatures, the PWG had agreed to remove specific values and recommended maintaining less than 5 °C where applicable.
94. The EWG/PWG Chair informed the Committee that a revised version of the Guidelines, reflecting the outcomes of the PWG discussions, had been presented in CRD03.

Discussion

95. CCFH55 agreed to use CRD03 as the basis for discussion.
96. CCFH55 held a general discussion and subsequently considered the document section by section based on CRD03.

General Discussion

97. Members expressed broad support to advance the revised Guidelines for adoption, noting that the revisions were comprehensive and reflected the latest scientific advice provided by JEMRA.

Section-by-Section Discussion

98. In addition to editorial corrections and amendments aimed at improving clarity (e.g., replacing the word “mitigate” with “minimize or eliminate” in Section 9), reflecting flexibility (e.g., specific control measures for flock management to address *Salmonella*), ensuring consistency, and aligning with other Codex texts (e.g., definitions of water fit-for-purpose and potable water) and WOH texts (e.g., definition of flock), CCFH55 made the following comments and decisions.

1. Introduction

99. CCFH55 agreed to revise the statement concerning viable but non-culturable (VBNC) states for both *Campylobacter* spp. and *Salmonella* spp., and to also include information highlighting some of the challenges associated with their control. The revised text was as follows:

¹¹ CX/FH 25/55/8; CX/FH 25/55/8 Add.1 (Comments of Argentina, Australia, Canada, Chile, Colombia, Ecuador, Egypt, European Union, Ghana, Japan, Kenya, Malaysia, Mexico, New Zealand, Peru, Philippines, Thailand, United Kingdom, Uruguay, Zambia); CRD03 (Report of the PWG Chairs); CRD13 (India, Malaysia, Morocco, Nigeria, Singapore, Uganda and United Republic of Tanzania (URT)); CRD16 (El Salvador); CRD17 (Ghana); CRD20 (Mali); CRD21 (African Union (AU)); CRD 24 (Cabo Verde); CRD 25 (International Union of Food Science and Technology (IUFOST))

Both Campylobacter spp. and Salmonella spp. can survive diverse environmental conditions and can persist in chicken production systems. It should also be emphasized that these microorganisms can exist in viable but non-culturable (VBNC) states, which makes their control and detection difficult by traditional methods. VBNC states induced by some control measures may limit their apparent effectiveness.

9. Primary production to consumption approach to control measures

General flock management control measures for Campylobacter and Salmonella: bullet g

100. A Member proposed revision of this bullet point, including deletion of the text related to testing, noting that it should not be necessary to test each batch of litter subjected to inactivation treatments as such an approach was neither feasible nor necessary. A concern was expressed that the revision included no reference to testing, which might be necessary to ensure inactivation treatments were effective. Reflecting on the different considerations, CCFH55 agreed to include text to recognize that testing might be carried out now and then for verification purposes and revised the sentence to read as follows:

Reused litter should be subjected to treatments that inactivate pathogens (e.g., composting, chemical treatments). These control measures should be validated and treated litter tested on occasion for verification purposes.

Specific flock management control measures for Salmonella: bullet a

101. A Member expressed the view that the first sentence should be amended to read: "The use of *Salmonella*-infected eggs will most likely result in the flock being infected." The Member further proposed deleting the second sentence, noting that the risk of infection during hatching was high due to conditions such as humidity and temperature. The Member stated that cleaning and sanitizing hatching eggs was not recommended in the JEMRA report (MRA 45), as contradictory opinions existed regarding its effectiveness for *Salmonella* control and because such practices may damage the egg cuticle.
102. The EWG/PWG Chair clarified that the second sentence was consistent with the relevant requirements in the WOA *Terrestrial Animal Health Code* and that its deletion could create potential conflicts with WOA guidance.
103. CCFH55 agreed to amend the first sentence as proposed and to retain the second sentence, with reference to cleaning and sanitizing measures but with a qualifier to provide flexibility.

9.2 Depopulation and Transport to Slaughterhouse

General depopulation and transport control measures for Campylobacter and Salmonella: bullet d

104. A Member indicated that when partial depopulation of a chicken house had already occurred, other houses scheduled for total depopulation should be carried out first to mitigate the increased risk associated with prior handling and potential immunosuppressive conditions. The Member explained that handling large numbers of birds could cause stress and increase susceptibility to infection. Partial depopulation might also increase the risk of introducing infection. Therefore, while partial depopulation might be necessary for the reasons outlined in the first part of the bullet point, subsequent handling of the remaining flock should be managed in such a manner to minimize risk of cross contamination or infection from the partially depopulated birds to other birds.
105. The EWG/PWG Chair agreed with this view and further clarified that, when partial depopulation had occurred in one house, total depopulation should first be completed in other houses before returning to finish the partially depopulated house. This approach was considered important to reduce the risk associated with repeated handling.
106. CCFH55 did not agree that there was evidence that partial depopulation increased the risk of development of immune-suppressive conditions; however, it did agree that partial depopulation increased the risk of introducing infection.
107. CCFH55 agreed to add the following sentence at the end of this bullet:

Considering that partial depopulation increases the risk of infection, it is advisable to complete the depopulation of these birds after depopulation of flocks that are less likely to be infected.

11. Validation, implementation, and verification of control measures

Verification: competent body

108. An Observer reiterated that in their view, trade associations should not be included among the options for competent bodies to undertake specific verification activities in relation to the industry's process control systems as this could result in industry verifying its own compliance. It was emphasized that verification should be conducted by independent entities, such as academia or professional societies, to ensure credibility and impartiality.

Conclusion

109. CCFH55 noted that all issues had been addressed and that the guidelines were ready to advance in the Step procedure and agreed to forward the revised guidelines to CAC49 for adoption at Step 5/8 (Appendix VI).

PROPOSED DRAFT REVISION OF THE GUIDELINES ON THE APPLICATION OF GENERAL PRINCIPLES OF FOOD HYGIENE TO THE CONTROL OF LISTERIA MONOCYTOGENES IN FOODS (CXG 61-2007) (Agenda Item 9)¹²

110. The United States of America, Chair of the EWG, speaking also on behalf of the co-Chairs, Canada, China and France, introduced the item and provided a background to the work undertaken by the EWG. The EWG Chair explained that the revised guidelines had incorporated the advice and recommendations from JEMRA as found in MRA 38, 47 and 48 and aimed to build consistency with other Codex texts such as CXC 1-1969 and the *Principles for guidelines for the establishment and application of microbiological criteria related to food* (CXG 21-1997). It was further explained that the EWG Chairs had prepared a revised version of the Guidelines based on comments received in response to CL 2025/62-FH (CRD06).
111. In particular, the EWG Chair highlighted some of the key issues addressed in the revised guidelines, namely that the definition for ready-to-eat (RTE) food had been updated to include the concept of "reasonably foreseeable" which was not new terminology in the Guideline and, in general, was a risk-based concept. Other major issues addressed included a structural alignment with CXC 1-1969, full revision of annex I, reversal of the order for annexes II and III for better logical flow, clarity and usability by the reader, and addition of recommendations for characterizing isolates and text on microbiological studies to determine if RTE foods support growth of *Listeria monocytogenes*.

Discussion

112. CCFH55 agreed to use CRD06 as the basis for discussion.

General Discussion

113. There was general support for the revised Guidelines acknowledging that they took into account the latest scientific developments and recommendations of JEMRA.
114. However, CCFH55 noted some concerns regarding the updated definition for RTE food with respect to the introduction of the "reasonably foreseeable" concept as well as the need for a more harmonized RTE definition across Codex texts. Further concerns were raised about Annex I and the limited resources for small holder farmers, fishers and others small operators involved in primary production to implement environmental monitoring programmes. In this regard, it was proposed that CCFH55 should consider providing more flexibility in this Annex, especially if the food is handled and packed on farm.

Section-by-Section Discussion

115. In addition to editorial corrections and amendments for purposes of clarity and consistency, CCFH55 made the following comments and decisions:

Introduction

Paragraph 3¹³

116. CCFH55 considered changes to paragraph 3 to avoid specific mention of the age with regard to older adults. However, it was agreed to retain the current text as the stipulation of the age group was in line with recommendations of JEMRA that indicated adults 65 years and older were at higher risk to listeriosis.

¹² CX/FH 25/55/9; CX/FH 25/55/9 Add.1 (Comments of Argentina, Australia, Canada, Chile, Colombia, Cuba, Egypt, European Union, Ghana, Honduras, Iran, Japan, Kenya, Malaysia, Mexico, New Zealand, Peru, Philippines, Thailand, United Arab Emirates, United Kingdom, Uruguay, Zambia and IDF/FIL); CRD06 (Report of the EWG Chairs); CRD14 (India, Malaysia, Nigeria, Russian Federation, Singapore, Uganda and United Republic of Tanzania (URT)); CRD16 (El Salvador); CRD17 (Ghana); CRD19 (Senegal); CRD20 (Mali); CRD21 (African Union (AU)); CRD24 (Cabo Verde)

¹³ Unless otherwise specified, all paragraph numbers refer to those in CRD06.

Paragraph 12

117. CCFH55 agreed to change the temperature of refrigeration from 6 °C to 5 °C for consistency with other hygiene texts and also in line with WHO recommendations, while acknowledging that predictive modelling demonstrated that *Listeria monocytogenes* growth was significantly reduced at temperatures below 6 °C. This change was applied throughout the text where applicable.

Paragraph 16

118. CCFH55 agreed to delete the microbiological limits from this paragraph acknowledging that limits were only part of microbiological criteria which should be accompanied by sampling plans and agreed to refer only to Annex III as more appropriate.

Definitions: ready-to-eat (RTE) food

119. CCFH55 had lengthy discussion on the updated definition for RTE. Taking into account the need for a more general definition that could be applicable to other hygiene texts and/or hazards, and incorporated into CXC 1-1969, CCFH55 agreed to replace “listericidal treatment” with a more general statement referencing “validated treatments sufficient to achieve food safety” together with other amendments to improve clarity of the definition.
120. Discussion was held on the inclusion of “reasonably foreseeable” and the difficulty to understand and implement this concept.
121. Views were expressed that reference to “reasonably foreseeable” should be deleted as it was unusual to include non-RTE foods in a definition for RTE since the two food categories were not the same; this terminology was ambiguous and difficult to interpret and would place a burden on FBOs producing non-RTE food, who might be required to implement the same level of hygiene control programmes as FBOs producing RTE food or to comply with microbiological criteria in Annex III which could lead to barriers to international food trade. It was therefore proposed to instead expand the scope of the guidelines to include certain non-RTE food which could be consumed without listericidal treatment by consumers and provide necessary guidance tailored for this specific category.
122. The EWG Chair clarified that “reasonably foreseeable” was explained in the footnote (footnote 7) to the definition and as explained in the introduction was a concept already used in food hygiene texts.
123. In a spirit of compromise, CCFH55 agreed to retain the concept of “reasonably foreseeable” with the clarification on its meaning as per the original proposed wording slightly amended as more appropriate as the updated footnote reference to CXC 1-1969 was not specific to the context of RTE foods.
124. CCFH55 agreed to the amended definition and more general footnote to read as follows:

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 based on evidence of consumer habits or practices that it will be eaten without such treatment.*

** 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.*

125. CCFH55 agreed to align footnote 20 in Annex III with the footnote to the definition.

9.3.2 Food control and monitoring equipmentParagraph 66

126. Noting that this paragraph only addressed the maintenance of cooling and refrigeration equipment, while other equipment such as those for heating and washing were also important for control of *Listeria monocytogenes*, CCFH55 agreed to add an additional paragraph (paragraph 66 bis) to address this aspect.

13.1.1 Product descriptionParagraph 104

127. CCFH55 agreed to replace the example of “soup mixes” with “frozen peas” and “enoki mushrooms” as soup mixes were not associated with listeriosis outbreaks and the new examples were more appropriate for the purposes of illustration in these guidelines.

Other general changes

128. CCFH55 agreed that: (i) in instances where there was cross-referencing to CXC 1-1969, it would refer to the appropriate corresponding section in CXC 1-1969 for better readability and use, and to avoid repetition; and (ii). the term "marketing" was changed to "retail" to align with the terms used in CXC 1-1969 and other Codex texts.
129. CCFH55 also noted that French and Spanish translation errors in the guidelines would be corrected.

Annexes

130. CCFH generally agreed with the revised annexes and in addition to editorial corrections and amendments for clarification, made the following comments and decisions.

Annex ITitle

131. CCFH55 agreed to revert to the original title of the Annex to better reflect the flow of the food chain process, i.e. primary production followed by processing and to make this change throughout the guidelines where applicable.

Paragraph 5

132. CCFH55 agreed to an additional bullet point that the need for and extent of Environmental Monitoring Programmes (EMPs) at primary production should also consider whether RTE food is grown, harvested, handled and packed at primary production to address the concerns raised with regard to the need for flexibility for implementation of EMPs especially for small operators (see Appendix VII, Annex I, paragraph 5).

Annex IIParagraph 10

133. CCFH55 agreed to provide flexibility for accreditation of laboratories carrying out *Listeria* testing recognizing that laboratories should use appropriate laboratory practices, but that laboratory accreditation was not compulsory.

Paragraph 12

134. CCFH55 agreed to amend paragraph 12 to indicate that competent authorities should request FBOs to undertake process control testing instead of requesting that competent authorities should use process control to detect changing patterns of contamination. Process control testing was undertaken over an extended period of time and determined deviations from normal operations and would not be feasible for competent authorities to undertake, but that it was rather the role of competent authorities to oversee process control by FBOs. However, it was acknowledged that competent authorities conducting periodic testing and analysis remained important and useful and that this was sufficiently addressed in paragraphs 2 and 11 which covered testing by competent authorities.

Annex IIIParagraph 9

135. With regard to a question for clarification on the meaning of the last bullet point in paragraph 9, the EWG Chair clarified that the bullet point was inserted to recognize that there were categories of RTE foods that might be defined by a competent authority based on the nature of those foods, such as low moisture foods, that would not require *Listeria* testing.

Paragraph 14

136. CCFH55 considered a proposal to include in paragraph 14, an indication that a short shelf-life of less than 5 days should be considered as an additional measure to control *L. monocytogenes* and there was no need for additional measures in such instance, or alternatively to make this addition to paragraph 9 as an additional bullet point.
137. However, it was clarified that paragraph 14 related to parameters of the food that prevent growth and not parameters outside of the food itself. In addition, there was debate as to what defined a short shelf-life and whether 5 days was appropriate for all foods. Even if some foods had a short shelf-life, testing would still be required.
138. CCFH55 therefore did not agree with the proposal.

Paragraph 20

139. This paragraph was amended to clarify that in addition to evaluating results from challenge studies, competent authorities should also verify the results of these studies as part of their overall oversight of FBOs. It was clarified that protocols for the challenge studies themselves need not be validated by competent authorities as most competent authorities would not have the capacity to do so and that it was the role of competent authorities to provide guidance to FBOs so that they can conduct appropriate challenge studies. Other roles of competent authorities were clarified in a new paragraph (Appendix VII, Annex III, paragraph 21).

Paragraph 30 (2nd bullet point)

140. CCFH55 considered a proposal to delete the type of packaging system that affect oxygen content as it did not align with the JEMRA risk assessment, viz. MRA47, which indicated that *L. monocytogenes* can survive under vacuum packaging and modified atmosphere packaging (MAP) conditions and reduced oxygen did not guarantee inhibition of *Listeria monocytogenes* growth, therefore this point would be misleading.
141. The EWG Chair clarified that the paragraph discussed the effect on growth rate and that the type of packaging system and oxygen content could affect the growth rate of *L. monocytogenes*.
142. CCFH55 agreed to retain the bullet point but amended it to indicate that oxygen content was an example of the effect of packaging systems, since there were advances in packaging systems e.g. inclusion of antimicrobials in packaging, which might also impact the growth rate of *L. monocytogenes*.

Paragraph 31

143. CCFH55 agreed to delete the last bullet point relating to durability studies and to amend paragraph 31 bis for purposes of clarity to indicate that once the shelf-life of an RTE food was established and validated, FBOs should consider ongoing verification activities such as durability studies to confirm the presence and growth of *L. monocytogenes* remained within established safety limits throughout the expected shelf-life.

Conclusion

144. CCFH55 noted that all issues had been addressed and agreed:
- i. to forward the revised guidelines to CAC49 for adoption at Step 5/8 (Appendix VII);
 - ii. that CCFH56 would consider using a harmonized definition for RTE foods across its hygiene texts as well as its potential inclusion in CXC 1-1969 in view of the concerns raised on different definitions for RTE foods across Codex hygiene texts; and
 - iii. to request the Codex Secretariat to prepare a background document on definitions of RTE foods in food hygiene texts to support the above discussion at CCFH56.

OTHER BUSINESS AND FUTURE WORK (Agenda Item 10)¹⁴

145. The United States of America, as the Chair of the PWG, presented the recommendations of the PWG (CRD04), and noted some of the factors that had been considered in reviewing the forward work plan, including the availability of scientific advice and the management of work, as well as the information in the relevant discussion papers and project documents. The PWG Chair recalled that the PWG did not have time to review the forward workplan or priorities for alignment but that some follow-up discussions had taken place to further inform consideration of these aspects.
146. CCFH55 considered the recommendations of the PWG, and additional proposals relevant to the forward workplan, noted the considerations included in CRD04 and made the following comments and decisions.

Proposed texts for structural alignment with *General principles for food hygiene* (CXC 1-1969)

147. CCFH55 considered a proposal by the Codex Secretariat, supported by the EWG Chairs on alignment, which took into consideration lessons learned in the alignment efforts to date, structure of the texts, available information on scientific information or interest in technical revisions in the medium term as well as comments from Members.

Conclusion

148. CCFH55 agreed to request the EWG on the alignment of Codex texts developed by CCFH with the revised *General principles of food hygiene* (CXC 1-1969), to prioritize the work on the:
- *Code of hygienic practice for the transport of food in bulk and semi-packed food* (CXC 47-2001);

¹⁴ CX/FH 25/55/10; CRD04 (Report of the PWG); CRD15 (India, Kenya, Republic of Korea, Thailand and IBFAN); CRD18 (Brazil, supported by Uruguay); CRD23 (Singapore).

- *Code of hygienic practice for bottled/package drinking waters (other than natural mineral waters)* (CXC 48-2001); and
- *Code of hygienic practice for collecting, processing and marketing of natural mineral waters* (CXC 33-1985). (see also agenda item 6, paragraph 72. i)

Revision of the *Guidelines on the application of the general principles of food hygiene to the control of pathogenic Vibrio species in seafood* (CXG 73-2010)

149. CCFH55 noted that work would restart on the revision of CXG 73-2010 following the completion of Annex II (Fish and Fishery Products) of the *Guidelines on the safe use and re-use of water in food production* (CXG 100-2023) and that an EWG to complete the work on CXG 73-2010 had already been established. (see agenda item 5, paragraph 57)

Revision of the *Code of practice on food allergen management for food business operators* (CXC 80-2020)

150. CCFH55 recalled that based on the completion of the revision to the *General standard for the labelling of pre-packaged foods* (CXS 1-1985), it had agreed to forward consequential amendments to the *Code of practice on food allergen management for food business operators* (CXC 80-2020) to ensure alignment with the updated CXS 1-1985 on the list of allergenic foods (see agenda item 2, paragraph 13). However, noting that the Codex Committee on Food Labelling (CCFL) was expected to complete its work on *Guidelines on the use of precautionary allergen labelling (PAL)*: as an annex to CXS 1-1985 at its next meeting in May 2026, and that this was expected to have implications for CXC 80-2020, it was timely to start preparing for a revision of CXC 80-2020.

Conclusion

151. CCFH55 agreed on the importance of being ready to review CXC 80-2020, once CCFL had completed its work on PAL, and noted that China, in collaboration with Australia and Ghana, would prepare a discussion paper and a project document for the revision of CXC 80-2020 for consideration at CCFH56, subject to the completion of work by CCFL on PAL.

New work proposal on the code of hygienic practice for manufacturing of cell-based foods

152. CCFH55 discussed a proposal for new work on a code of hygienic practice for the manufacturing of cell-based foods, introduced by Singapore in collaboration with China, the Republic of Korea, Saudi Arabia, and the United Kingdom.
153. Members in favour of the new work noted that it represented a unique opportunity for Codex to provide timely, science-based guidance for an emerging technology before significant regulatory divergence occurred. These Members also noted that the 2023 FAO/WHO report on cell-based foods already offered actionable guidance on mitigating hazards and that sufficient scientific information existed to develop a flexible, broad framework based on CXC 1-1969. These Members also emphasized that international guidance would facilitate safe trade and support jurisdictions currently developing regulatory frameworks and promote harmonization in that regard.
154. Members expressing concerns about approving the new work noted that the proposal was premature, citing a lack of agreed terminology and international food trade, insufficient data on food safety and consumer health risks, and that the industry was in its nascent stage in most countries. These Members highlighted that only a few countries had national regulatory experience or technical infrastructure to contribute to standard-setting. Some Members called for the establishment of a risk analysis framework for new food production systems rather than developing product-specific standards. Concerns were also raised about potential claims for these products.
155. The FAO Representative informed CCFH55 that FAO and WHO maintained several programs dedicated to monitoring emerging trends, diseases, and food production practices. Specifically, within the FAO Division of Agrifood Systems and Food Safety, a dedicated foresight group was tasked with looking at new trends and tracking potential emerging threats, including in the area of biotechnology. The Representative noted that they would continue these monitoring activities regardless of the CCFH decision on new work and offered to provide an update to CCFH next year, or to informal working groups as needed, regarding any new trends or concerns that arise to help the committee crystallize its future discussions.

Conclusion

156. CCFH55:
- noted the different views expressed and a lack of sufficient support to send this new work proposal for approval at this session;

- ii. noted some interest in continuing to collect data and learn from experiences with this topic before guidelines were developed;
- iii. welcomed ongoing updates from FAO and WHO on trends and/or concerns related to cell-based food to CCFH; and
- iv. agreed that the proposal would remain in the Forward Workplan and that it could be reconsidered at a future session of CCFH.

Revision of the Code of practice for the processing and handling of quick frozen foods (CXC 8-1976)

157. CCFH55 discussed a proposal for new work to revise CXC 8-1976 to allow poultry, pork, offal, and by-products to be frozen, stored, transported, and sold at a temperature equal to or below -15°C, instead of the current -18°C, provided effective cold chain control was ensured. There was general interest in this work and it was noted that during the PWG, participants discussed expanding the scope of this proposal to include a broader range of products (including other terrestrial animal meat, fish and fishery products and produce) and discussed whether CCFH should consider impacts on product quality alongside food safety.
158. Members supporting the proposal noted that -15°C was scientifically recognized as sufficient to inhibit the growth of foodborne pathogens and that allowing this flexibility could reduce energy consumption and facilitate trade without compromising safety. However, other Members raised concerns regarding the scope and the potential for temperature abuse if the baseline were raised, suggesting that JEMRA could evaluate the temperature threshold required to guarantee food safety (inhibiting metabolic activity), noting that -12°C and -15°C were suggested for evaluation. It was further noted that certain national jurisdictions already used -12°C as a safe holding temperature and it was suggested that scientific advice should evaluate the safety implications of both -12°C and -15°C.
159. Furthermore, it was noted that the issue of frozen temperature was relevant to a number of food hygiene texts and it would be useful to have a harmonized science-based approach to addressing this issue.
160. In response to a request for clarification on whether the quality related aspects were beyond the remit of the ToRs of CCFH, the Codex Secretariat noted that the task force that undertook the work on CXC 8-1976 had been dissolved. The Secretariat further clarified that there were no strict limitations on what CCFH could request in terms of scientific advice to support its decision-making. If safety and quality issues were interlinked, it might be difficult to separate them, and the Secretariat noted that the committee had the flexibility to move forward if the membership was agreeable to do so and engaged the necessary expertise in their delegations.

Conclusion

161. CCFH55 agreed to:

- i. request FAO and WHO to provide scientific advice on the holding frozen temperature threshold to guarantee food safety for a range of different food commodities as indicated in CXC 8-1976, also considering the related impact on quality and for products that had been both quick frozen or subject to normal freezing processes, noting that this might require a stepwise approach and that products of terrestrial and aquatic animal origin could be addressed as the first priority; and
- ii. request Chile, in collaboration with Australia and Brazil, to revise the proposal on the revision of the *Code of practice for the processing and handling of quick frozen foods* (CXC 8-1976) to broaden the scope in line with those commodities covered CXC 8-1976 and other relevant aspects and submit a revised proposal for consideration by CCFH56.

Revision of the Code of hygienic practice for powdered formulae for infants and young children (CXC 66-2008)

162. CCFH55 discussed the need for scientific advice to inform a potential revision of the *Code of hygienic practice for powdered formulae for infants and young children* (CXC 66-2008). Members noted that CXC 66-2008 was developed concurrently with several other hygiene texts that had since been updated, leaving the sections on cleaning and environmental monitoring in need of review. The importance of updating these sections to align with recently revised food hygiene texts, such as the guidelines for the control of *Listeria monocytogenes*, was also noted.
163. The discussion was further informed by the ongoing investigation into recent infant botulism outbreaks. While Members acknowledged that historical data had not always categorized *Clostridium botulinum* as a major risk in these products, the importance of investigating whether current gaps in CXC 66-2008 contributed to the risk was underlined. It was also noted that since CXC 66-2008 had been revised, there continued to be problems with pathogens such as *Cronobacter* spp. and that it was almost two decades since the committee had received scientific advice on this topic.
164. In this context, CCFH55 supported a comprehensive request for scientific advice from JEMRA.

165. Observers raised concerns regarding the global implications of contaminated infant formula, noting that these products linked to the ongoing infant botulism outbreak were distributed in over 20 countries, thereby extending the potential disease burden beyond the initial site of an outbreak, and highlighted the related challenges in accessing treatment modalities required for conditions like infant botulism. Furthermore, these Observers addressed the role of risk communication, pointing out the risks of misleading marketing and social media promotion regarding product safety, while noting that a future update to the text should include measures to protect breastfeeding.
166. The FAO Representative noted that a summary report from the recent expert meeting on clostridial diseases was currently available, with the full report expected by mid-2026, and indicated their willingness to provide further scientific advice in this area as needed.
167. CCFH55 noted that this scientific output would be important for interested parties to consider preparing a robust discussion paper and project document for consideration at the next session.

Conclusion

168. CCFH55 requested JEMRA to:

- i. conduct a risk assessment on spore-forming pathogens, including *Clostridium botulinum* and *Bacillus cereus*, in powdered infant formula;
- ii. update the existing risk assessment and scientific advice on environmental pathogens (e.g. *Cronobacter* and *Salmonella*); and
- iii. provide other relevant scientific advice that would inform recommendations on strengthened control measures across the production environment, covering all stages from primary production and packaging through to the reconstitution of the product, and including environmental monitoring programmes.

Other matters

169. In response to a Member's question regarding the need to update CCFH texts related to foodborne parasites, the Codex Secretariat explained that while expert meetings had occurred, the full reports might not be available until mid-2026. It was hence suggested that CCFH56 would have a clearer understanding of whether those outcomes would necessitate a technical revision of existing parasite-related texts.

Forward Workplan

170. CCFH55 noted that there had not been sufficient time to fully review the forward workplan and also noted the limitations on its work prioritization process with regard to assessment of proposed work in the area of new and emerging issues. It was noted that the forward workplan would be updated to reflect the decisions above and availability of scientific advice and attached to the report for consideration by CCFH56. The PWG Chair also indicated his willingness to review the workplan and the prioritization process based on the experience at this session and potentially present some recommendations for consideration by CCFH56.

Conclusion

171. CCFH55 agreed to:

- i. establish a PWG on CCFH Work Priorities, chaired by the United States of America, to be held in conjunction with CCFH56, working in English, French and Spanish;
- ii. request the Codex Secretariat to issue a Circular Letter (CL) for new work proposals with a deadline of 1 September 2026, for consideration at CCFH56; and
- iii. attach the forward workplan with updates from this session, as an ongoing reference for this process (Appendix VIII) and noted the willingness of the PWG Chair to review the forward workplan and work prioritization process.

DATE AND PLACE OF NEXT SESSION (Agenda Item 11)

172. CCFH55 was informed that CCFH56 would be held from 16 to 20 November 2026 in the United States of America with the final arrangements subject to confirmation by the host Government in consultation with the Codex Secretariat.

APPENDIX I

**LIST OF PARTICIPANTS
LISTE DES PARTICIPANTS
LISTA DE PARTICIPANTES**

CHAIRPERSON – PRÉSIDENTE - PRESIDENTA

Dr Evelyne Mbandi
Director of Microbiological & Chemical Hazards Staff (MCHS)
Office of Public Health Science
U.S. Department of Agriculture
Washington, D.C.

CHAIR'S ASSISTANT – ASSISTANTE DE LA PRÉSIDENTE – ASISTENTA DE LA PRESIDENTA

Ms Alexandra Ferraro
International Issues Analyst
U.S. Codex Office
U.S. Department of Agriculture
Washington, DC

**MEMBERS NATIONS AND MEMBER ORGANIZATIONS
ÉTATS MEMBRES ET ORGANISATIONS MEMBRES
ESTADOS MIEMBROS Y ORGANIZACIONES MIEMBROS**

ARGENTINA - ARGENTINE

Dr Maria Esther Carullo
Asesora - Coordinadora de CCFH Nacional
Servicio Nacional de Sanidad y Calidad
Agroalimentaria (SENASA)

AUSTRALIA - AUSTRALIE

Mr Ben Daughtry
A/g Section Manager
Microbiology and Food Safety
Food Standards Australia New Zealand

Dr Glen Edmunds
Director, Science and Strategy
Department of Agriculture Fisheries and
Forestry

Mr Mark Phythian
Senior Food Safety Risk Manager
Food Standards Australia New Zealand

Dr Mark Salter
Principal Microbiology and Laboratory Oversight
Department of Agriculture Fisheries and
Forestry

BELGIUM

Ms Katrien De Pauw
Policy Officer
DGAPF – nutrition policy and food security
FPS public health

BRAZIL - BRÉSIL - BRASIL

Ms Ligia Lindner Schreiner
Health Regulation Expert
Brazilian Health Regulatory Agency - Anvisa
Brasília

Ms Amanda Barros
Technical Manager
ABPA - Associação Brasileira de Proteína
Animal

Mrs Renata De Araujo Ferreira
Health Regulation Expert
Brazilian Health Regulatory Agency
Brasília

Ms Letícia Goulart Desordi
Federal Agricultural Officer
Ministry of Agriculture and Livestock – MAPA

Prof Mariza Landgraf
Associate Professor
University of São Paulo
São Paulo

Ms Viviane Mega De Andrade Zalfa
Health Regulation Expert
Brazilian Health Regulatory Agency - Anvisa

Ms Liza Pujolá Bevilaqua
Senior Regulatory & Scientific Affairs Manager
ABIA (Brazilian Food Industry Association)

Mr Rafael Ribeiro Goncalves Barrocas
Federal Inspector
Ministry of Agriculture and Livestock - MAPA
Brasília

Mr Eduardo Cesar Tondo
Professor of Food Microbiology
Institute of Food Science and Technology of
Federal University of Rio Grande do Sul -
ICTA/UFRGS

Mr Cesar Augusto Vandesteem Junior
Coordinator of Multilateral Affairs
Ministry of Agriculture and Livestock - MAPA
Brasília

CABO VERDE

Marlene Gomes
Técnico de Regulação Alimentar
Praia

CAMEROON - CAMEROUN - CAMERÚN

Mr Pouedogo Pouedogo
Attaché
Service du premier ministre
Yaoundé

CANADA - CANADÁ

Dr Martin Duplessis
Director
Health Canada
Ottawa

Dr Marie Breton
Chief, Micro Evaluation Division, Bureau of
Microbial Hazards
Health Canada
Ottawa

Mrs Kristin Hill
Policy and Program Leader
Canadian Food Inspection Agency
Ottawa

CHILE-CHILI

Andrea Schain Escaff
Profesional asesor del Departamento de
Nutrición y Alimentos
Ministry of Health
Santiago

CHINA - CHINE

Prof Yunchang Guo
Professor/Director of Risk Surveillance Division
II
China National Center for Food Safety Risk
Assessment
Beijing

Mr Xiao Chen
Associate Researcher
China National Center for Food Safety Risk
Assessment
Beijing

Ms Hao Ding
Associate Researcher
China National Centre for Food Safety Risk
Assessment
Beijing

Mrs Haihong Hao
Professor
Huazhong Agricultural University, college of
Veterinary Medicine
Hubei

Prof Weiwei Li
Associate professor/Deputy director of Risk
Surveillance Division II
China National Center for Food Safety Risk
Assessment
Beijing

Dr Jing Tian
Researcher
China National Center for Food Safety Risk
Assessment
Beijing

Dr Jun Wang
Researcher
China National Center for Food Safety Risk
Assessment
Beijing

COLOMBIA - COLOMBIE

Dr Claudia Patricia Forero Niño
Profesional especializada
Instituto Nacional de Vigilancia de
Medicamentos y Alimentos - Invima
Bogotá

COSTA RICA

Mrs Amanda Lasso Cruz
Asesor Codex
Ministerio de Economía Industria y Comercio
San José

Mrs Melina Flores Rodríguez
Asesor Codex
Ministerio de Economía Industria y Comercio
Tibás

CYPRUS - CHYPRE - CHIPRE

Mr Georgios Aristeidou
Agricultural Officer
Ministry of Agriculture, Rural Development and
Environment
Nicosia

Mr Antonios Mazeris
Senior Agricultural Officer
Ministry of Agriculture, Rural Development and
Environment
Nicosia

DENMARK - DANEMARK - DINAMARCA

Mrs Gudrun Sandø
Special Veterinary Adviser
Danish Veterinary and Food Administration
Glostrup

Mrs Birgitte Borck Høg
Special Adviser
Danish Veterinary and Food Administration
Glostrup

Mrs Outi Tyni
Political Administrator
Council of the European Union
Brussels

EL SALVADOR

Mr Emerson Geovany Quintanilla Monge
Coordinador
Superintendencia de Regulación Sanitaria
(SRS)
Santa Tecla

ESTONIA - ESTONIE

Ms Katrin Kemp
adviser
Ministry of Regional Affairs and Agriculture
Tallinn

**EUROPEAN UNION - UNION EUROPÉENNE -
UNIÓN EUROPEA**

Dr Kris De Smet
Team Leader Food Hygiene
European Commission
Brussels

Dr Judit Krommer
Policy Officer
European Commission
Brussels

FRANCE - FRANCIA

Ms Cécile Balon
Chargée d'études
Ministère de l'agriculture, de l'agroalimentaire et
de la souveraineté alimentaire
Paris

Ms Corinne Danan
Cheffe d'unité Salmonella et Listeria
ANSES
Paris

GAMBIA - GAMBIE

Mr Abdoulie Jallow
Principal Scientific Officer
Food Safety and Quality Authority
Serekunda

GERMANY - ALLEMAGNE - ALEMANIA

Dr Katja Alt
senior scientific advisor
Federal Ministry of Food and Agriculture
Berlin

Dr Matthias Fischer
Head of Unit Food Microbiology, Pathogen-Host-
Interactions
German Federal Institute for Risk Assessment
Berlin

GHANA

Ms Francisca Abena Asubonteng Anokye
Chief Regulatory Officer
Food and Drugs Authority
Accra

Mr Edward Worlanyo Archer
Chief Regulatory Officer
Food and Drugs Authority
Accra

Ms Lilian Kabukuor Manor
Scientific Officer
Ghana Standards Authority
Accra

Mrs Doreen Afi Gyau Koranteng
Codex Contact Manager
Accra

GUATEMALA

Mr Nelson Ruano
Director de Inocuidad
Punto de Contacto de Codex Alimentarius
Ciudad de Guatemala

GUYANA

Ms Tandeka Barton
Director (Ag)
Ministry of Health
Georgetown

HONDURAS

Ms Maria Eugenia Sevilla
Coordinator Technical Subcommittee
SENASA
Tegucigalpa

INDIA - INDE

Mr Adityakumar Premchand Jain
Deputy General Manager
National Dairy Development Board (NDDB)

Ms Aditi Sharma
Technical Officer
Food Safety and Standards Authority of India

**IRAN (ISLAMIC REPUBLIC OF) -
IRAN (RÉPUBLIQUE ISLAMIQUE D') -
IRÁN (REPÚBLICA ISLÁMICA DEL)**

Dr Asma Afshar
Member of CCFH in Iran
Iran

Mrs Samaneh Eghtedari Naeini
Expert Coordinator for Codex International Food
Standards
Iran National Standards Organization (INSO)
Tehran

Dr Zahra Ghafari
Secretary of CCFH in Iran
Iran

Dr Anahita Yazdanpak
Member of CCFH in Iran
Iran

IRELAND - IRLANDE - IRLANDA

Mr Denis Carroll
Senior Veterinary Inspector
Department of Agriculture, Food and the Marine
(DAFM)
Dublin

Dr Wayne Anderson
Director of Food Science and Standards
Food Safety Authority of Ireland
Dublin

Dr Lisa O'Connor
Chief Specialist, Biological Safety
Food Safety Authority of Ireland
Dublin

Dr Avril Hobson
Senior Superintending Veterinary Inspector
Department of Agriculture, Food and the Marine
Dublin

ITALY - ITALIE - ITALIA

Mr Giulio Cardini
Policy Officer
Ministry of Agriculture, Food Sovereignty and
Forests - Ministero dell'agricoltura, della
sovranità alimentare e delle foreste, MASAF
Rome

JAPAN - JAPON - JAPÓN

Dr Kazuko Fukushima
Director of Office of Import Food Safety
Ministry of Health, Labour and Welfare
Tokyo

Dr Saiki Imamura
Associate Director
Ministry of Agriculture, Forestry and Fisheries
Tokyo

Dr Michio Jinnai
Senior Research Scientist
National Institute of Health Sciences
Kanagawa

Ms Satoko Murakami
Deputy Director
Ministry of Health, Labour and Welfare
Tokyo

Mr Taizo Murakami
Technical Official
Ministry of Agriculture, Forestry and Fisheries
Tokyo

Dr Yohei Saburi
Section Chief
Ministry of Health, Labour and Welfare
Tokyo

Dr Kikuko Sakai
Section Chief
Consumer Affairs Agency
Tokyo

Ms Maako Sugiyama
Associate Director
Consumer Affairs Agency
Tokyo

Dr Mari Tohya
Senior Research Scientist
National Institute of Health Sciences
Kanagawa

KENYA

Dr Allan Azegele
Director of Veterinary Services
Ministry of Agriculture and Livestock
Development
Nairobi

Prof George Abong
Lecturer
University of Nairobi
Nairobi

Mr Vincent Chirchir
Assistant Director, Regulations and compliance
Agriculture and Food Authority

Ms Anne Gichuru
Director
Agriculture and Food Authority

Mr Mwanza James Nzomo
Senior Quality Assurance Officer
Agriculture and Food Authority
Nairobi

Ms Maryann Kindiki
Manager, National Codex Contact Point
Kenya Bureau of Standards
Nairobi

Ms Mildred Kosgei
Manager Trade and Standards
Kenya Dairy Board

Ms Naomi Mariach
Assistant Manager
Kenya Bureau of Standards
Nairobi

Mr Ferdinand Masinde
Principal Crops Officer
Agriculture and Food Authority
Nairobi

MEXICO - MEXIQUE - MÉXICO

Ms María Guadalupe Arizmendi Ramírez
Verificadora Dictaminadora Especializada
COFEPRIS

Ms Mariana Jiménez Lucas
Verificadora Dictaminadora Especializada
COFEPRIS

Ms Penélope Elaine Sorchini Castro
Verificadora Dictaminadora Especializada
COFEPRIS

MVZ. Gabriela Alejandra Jiménez Rodríguez
Subdirectora de Normas
Secretaría de Agricultura y Desarrollo Rural

MOROCCO - MAROC - MARRUECOS

Dr Oleya El Hariri
Chief of Fisheries and Aquaculture Products
Department
Food Safety Inspector
National Food Safety Office
Rabat

Prof Hanaa Abdelmoumen
Coordinatrice du Master des sciences et
Technologies Agroalimentaires (MSTA)
Faculté des sciences, Université Mohammed V
Rabat

Eng Mohcine Badr-Ezzammane
Ingénieur en chef à la Direction des Industries
de la Pêche, Rabat
Département de la pêche maritime (Direction
des Industries de la Pêche DIP)

Mrs Meryem Ibn Ghazala
Chef du Département Agréage Technique des
Unités
MOROCCO FOOD EX (EACCE)
Casablanca

NAMIBIA - NAMIBIE

Mr Gabriel Joseph
Deputy Director
Ministry of Health and Social Services

Ms Marjorie Van Wyk
Chief Health Programme
Ministry of Health and Social Services
Windhoek

NEPAL - NÉPAL

Dr Matina Joshi Vaidya
Director General
Department of Food Technology and Quality
Control, Ministry of Agriculture and Livestock
Development
Kathmandu

Dr Ashesh Raj Bk
Veterinary Officer
Department of Food Technology and Quality
Control
Kathmandu

Mr Mohan Krishna Maharjan
Senior Food Research Officer
Department of Food Technology and Quality
Control, Ministry of Agriculture and Livestock
Development
Kathmandu

Ms Shreya Pokhrel
Technical Assistant
Department of Food Technology and Quality
Control
Kathmandu

Mr Bhim Prasad Pulami
Senior Food Research Officer
Department of Food Technology and Quality
Control, Ministry of Agriculture and Livestock
Development
Kathmandu

Ms Pratima Shrestha
Senior Food Research Officer
Department of Food Technology and Quality
Control, Ministry of Agriculture and Livestock
Development
Kathmandu

**NETHERLANDS - PAYS-BAS -
PAÍSES BAJOS**

Mrs Moniek Ringenier
Senior Policy Officer
Ministry of Health, Welfare and Sport
The Hague

**NEW ZEALAND - NOUVELLE-ZÉLANDE -
NUEVA ZELANDIA**

Mr Roger Cook
Principal Adviser Strategic Science & Risk
Assessment
New Zealand Food Safety
Ministry for Primary Industries
Wellington

Ms Nicola Dermer
Manager Imported Food Standards
New Zealand Food Safety
Ministry for Primary Industries
Wellington

NIGERIA - NIGÉRIA

Dr Nureni Babatunde Opaleye
Fellow

Nigerian Institute for Food Science and
Technology
Lagos

NORWAY - NORVÈGE - NORUEGA

Ms Randi Edvardsen
Senior Advisor
Norwegian Food Safety Authority
Oslo

PARAGUAY

Mr Diego Fernando Toñáñez Gregor
Profesional Técnico
Dirección Nacional de Vigilancia Sanitaria -
DINAVISIA
Asunción

PERU - PÉROU - PERÚ

Ms Gloria Atala Castillo Vargas
Representante
INACAL
Lima

PHILIPPINES - FILIPINAS

Ms Kris Jenelyn De Las Peñas
Chairperson, Sub-Committee on Food Hygiene
(SCFH)
National Codex Organization

POLAND - POLOGNE - POLONIA

Mrs Aneta Klusek
Chief Specialist
Ministry of Agriculture and Rural Development
Warsaw

Mrs Magdalena Kowalska
Chief Expert
Agricultural Cooperation Department
Warsaw

Mrs Elzbieta Mackiw
Head of the Food Microbiology Unit
National Institute of Public Health NIH - National
Research Institute
Warsaw

**REPUBLIC OF KOREA -
RÉPUBLIQUE DE CORÉE -
REPÚBLICA DE COREA**

Ms Hansol Lee
Scientific Officer
Ministry of Food and Drug Safety

Ms Minjin Park
Researcher
Ministry of Food and Drug Safety

Mr Eunsoo Park
Researcher
National Agricultural Products Quality
Management Service - Experiment Research
Institute

Mr Yeoncheol Yu
Scientific Officer
Ministry of Food and Drug Safety
National Institute of Food and Drug Safety
Evaluation

**SAUDI ARABIA - ARABIE SAOUDITE -
ARABIA SAUDITA**

Ms Nada Ghazi Saeed
Senior specifications and regulations Expert
Saudi Food and Drug Authority
Riyadh

Mr Khalid Alzahrani
Head of the international communication for
standards
Saudi Food and Drug Authority
Riyadh

SINGAPORE - SINGAPOUR - SINGAPUR

Ms Jannie Wan
Director
Singapore Food Agency

Dr Jun Cheng Er
Branch Head
Singapore Food Agency
Singapore

Ms Yi Ling Tan
Senior Manager
Singapore Food Agency

Dr Adeline Yong
Scientist
Singapore Food Agency (SFA)

SPAIN - ESPAGNE - ESPAÑA

Mrs Marta Sanchidrián Pindado
Jefa de Servicio del Área de Gestión de Riesgos
Biológicos
Agencia Española de Seguridad Alimentaria y
Nutrición (AESAN)
Madrid

SWEDEN - SUÈDE - SUECIA

Ms Satu Salmela
Principal Regulatory Officer
Swedish Food Agency
Uppsala

SWITZERLAND - SUISSE - SUIZA

Mrs Franziska Weiss
Scientific Officer
Federal Food Safety and Veterinary Office
FSVO
Bern

THAILAND - THAÏLANDE - TAILANDIA

Ms Virachnee Lohachoompol
Standards Officer
Ministry of Agriculture and Cooperatives
Bangkok

Mr Udom Chanprapaipat
Senior Veterinarian,
Department of Livestock Development
Bangkok

Ms Umaporn Kamolmattayakul
Representatives of the Federation of Thai
Industries
The Thai Federation of Thai Industries
Bangkok

Ms Huai-hui Lee
Director
Thai Food Processors' Association
Bangkok

Ms Natthakarn Nammakuna
Standards Officer
National Bureau of Agricultural Commodity and
Food Standards
Bangkok

Dr Supaporn Wongsrichai
Veterinarian, Senior professional level
Department of Livestock Development, Ministry
of Agriculture and Cooperatives
Pathumthani

UGANDA - OUGANDA

Mrs Irene Mwesigwa
Principal Food Safety Officer
National Drug Authority
Kampala

Mr Bonaventura Kibaya
Standards Officer
Uganda National Bureau of Standards
Kampala

Mrs Susan Namaalwa
Manager, Research and Development
National Water and Sewerage Corporation
Kampala

Mr Edward Kizza
Standards Officer
Uganda National Bureau of Standards
Kampala

**UNITED KINGDOM - ROYAUME-UNI -
REINO UNIDO**

Ms Narriman Looch
Head of Food Hygiene and Foodborne Disease
Control
Food Standards Agency

Ms Dineka Fleming-Ovens
Food Policy Adviser
Food Standards Agency
London

Mr Chris McCann
Senior Food Policy Advisor
Food Standards Agency

**UNITED STATES OF AMERICA -
ÉTATS-UNIS D'AMÉRIQUE -
ESTADOS UNIDOS DE AMÉRICA**

Dr Benjamin Warren
Senior Science Advisor for Food Safety
U.S. Food and Drug Administration
College Park, MD

Dr William (Bill) Shaw
Acting Assistant Administrator
Office of Public Health Science
U.S. Department of Agriculture
Washington, DC

Ms Julie Chao
Deputy Codex Manager
U.S. Codex Office
U.S. Department of Agriculture
Washington, DC

Mr Anthony Goodman
Senior Policy Advisor
U.S. Department of Agriculture
Washington, DC

Dr Suzy Hammons
Senior Microbiologist
Office of Public Health Service
U.S. Department of Agriculture
Washington, DC

Ms Kristen Hendricks
International Issues Analyst
U.S. Codex Office
U.S. Department of Agriculture
Washington, DC

Mr Charles Risch
International Trade Specialist
Foreign Agricultural Service
U.S. Department of Agriculture

Dr Kristal Southern
Biological Scientific Information Specialist &
Liaison
U.S. Department of Agriculture
Washington, DC

Dr Eric Stevens
Vertical Sector Manager - Food
Hygiene
Camarillo, CA

Dr Aparna Tatavarthy
Microbiologist
Food and Drug Administration
College Park, MD
Dr William Zaragoza
Senior Microbiologist
U.S. Department of Agriculture
Eagan, Minnesota

URUGUAY

Dr Norman Bennett
Gerente de Inocuidad
Ministerio de Ganadería, Agricultura y Pesca
Montevideo

Mrs Ines Martinez
Investigador
Latitud
Montevideo

OBSERVERS - OBSERVATEURS - OBSERVADORES**INTERNATIONAL GOVERNMENTAL
ORGANIZATIONS –
ORGANISATIONS GOUVERNEMENTALES
INTERNATIONALES –
ORGANIZACIONES GUBERNAMENTALES
INTERNACIONALES****AFRICAN UNION (AU)**

Mr John Oppong-Otoo
Coordinator Economics, Trade and Marketing
AU-IBAR

**INTER-AMERICAN INSTITUTE FOR
COOPERATION ON AGRICULTURE (IICA)**

Mrs Alejandra Diaz
Especialista Internacional en Sanidad
Agropecuaria e Inocuidad de Alimentos
Inter-American Institute for Cooperation on
Agriculture

**NON-GOVERNMENTAL ORGANIZATIONS –
ORGANISATIONS NON
GOUVERNEMENTALES –
ORGANIZACIONES NO
GUBERNAMENTALES****EUROPEAN NETWORK OF CHILDBIRTH
ASSOCIATIONS (ENCA)**

Mrs Patti Rundall
ENCA
United Kingdom

Mrs Maryse Arendt
Lactation consultant
ENCA
Luxemburg

GOOD FOOD INSTITUTE (GFI)

Ms Mackenzie Battle
Senior Regulatory Attorney
Good Food Institute
Washington, DC

**HEALTH FOR ANIMALS
(HEALTHFORANIMALS)**

Dr Shaina Craige
Director, International Government Affairs
Elanco Animal Health
Washington, DC

INSTITUTE OF FOOD TECHNOLOGISTS (IFT)

Dr James Dickson
Professor
Iowa State University
Ames, Iowa

**INTERNATIONAL BABY FOOD ACTION
NETWORK (IBFAN)**

Ms Elisabeth Sterken
Chair IBFAN Codex Working Group
International Baby Food Action Network (IBFAN)

**INTERNATIONAL CO-OPERATIVE ALLIANCE
(ICA)**

Mr Kazuro Onitake
Senior Scientist
Tokyo, Japan

**INTERNATIONAL COMMISSION ON
MICROBIOLOGICAL SPECIFICATIONS FOR
FOODS (ICMSF)**

Dr Leon Gorris
Food Safety Expert
Nijmegen, The Netherlands

**INTERNATIONAL COUNCIL OF BEVERAGES
ASSOCIATIONS (ICBA)**

Ms Jacqueline Dillon
Senior Manager
PepsiCo, Inc.

Dr Trevor Phister
Principal Scientist
PepsiCo
Leicester

**INTERNATIONAL DAIRY FEDERATION
(IDF/FIL)**

Ms Aurelie Dubois
Science and Standards Programme Manager
International Dairy Federation

Mr Nicholas Gardner
Senior Vice President, Sustainability and
Multilateral Affairs
U.S. Dairy Export Council
Arlington, VA

**INTERNATIONAL FROZEN FOOD
ASSOCIATION (IFFA)**

Mr Sanjay Gummalla
Sr. VP Scientific Affairs
Culpeper, VA

Dr Lee-Ann Jaykus
Professor
North Carolina State University
Raleigh, NC

**INTERNATIONAL ORGANIZATION FOR
STANDARDIZATION (ISO)**

Mr Bertrand Lombard
Chairman of ISO/TC 34/SC 9 "Food products –
Microbiology"; Convenor of WG 2 "Statistics" of
ISO/TC 34/SC 9

**UNITED NATIONS ORGANIZATION
ORGANISATION DES NATIONS UNIES
ORGANIZACIÓN DE LAS NACIONES UNIDAS****PAN AMERICAN HEALTH ORGANIZATION
(PAHO)**

Mr André Luis De Sousa Dos Santos
Advisor, Food Safety and Surveillance
Pan American Center for Foot-and-Mouth
Disease and Veterinary Public Health
Brasília

**FAO PERSONNEL
PERSONNEL DE LA FAO
PERSONAL DE LA FAO**

Mr Jeffrey Lejeune
Food Safety and Quality Officer
Food and Agriculture Organization of the U.N.
Rome

Mr Kang Zhou
Food Safety Officer
Food Safety and Quality Unit, Agriculture and
Consumer Protection Department
Food and Agriculture Organization of the U.N.
Rome

**WHO PERSONNEL
PERSONNEL DE LA OMS
PERSONAL DE LA OMS**

Dr Juliana De Oliveira Mota
Scientist
World Health Organization
Geneva

Dr Akio Hasegawa
Technical Officer
World Health Organization
Geneva

CCFH SECRETARIAT

Ms Marie Maratos Bhat
International Issues Analyst
U.S. Codex Office
U.S. Department of Agriculture
Washington, DC

Mr Kenneth Lowery
Senior International Issues Analyst
U.S. Codex Office
U.S. Department of Agriculture
Washington, DC

Mr Vincent Camacho Jr
Program Analyst
U.S. Codex Office
U.S. Department of Agriculture
Washington DC

CODEX SECRETARIAT

Dr Sarah Cahill
Codex Secretary
Joint FAO/WHO Food Standards Programme
Food and Agriculture Organization of the U.N.
Rome

Mrs Verna Carolissen-Mackay
Food Standards Officer
Joint FAO/WHO Food Standards Programme
Food and Agriculture Organization of the U.N.
Rome

Mrs Lingping Zhang
Food Standards Officer
Joint FAO/WHO Food Standards Programme
Food and Agriculture Organization of the U.N.
Rome

Mrs Eunmi Cho
Food Standards Officer
Joint FAO/WHO Food Standards Programme
Food and Agriculture Organization of the U.N.
Rome

Mr Giuseppe Di Chiera
Standards development and communication
specialist
Joint FAO/WHO Food Standards Programme
Food and Agriculture Organization of the U.N.
Rome

Ms Ilaria Tarquinio
Programme Assistant
Joint FAO/WHO Food Standards Programme
Food and Agriculture Organization of the U.N.
Rome

APPENDIX II

**CONSEQUENTIAL AMENDMENTS TO THE CODE OF PRACTICE ON FOOD ALLERGEN
MANAGEMENT FOR FOOD BUSINESS OPERATORS (CXC 80-2020)**

(For adoption)

Hazard characterisation

The allergenic nature of some foods should be identified as a food safety hazard for susceptible individuals. Food allergies are caused by an adverse immune reaction (hypersensitivity) to certain food proteins. Allergies to food can be classified by their immune mechanism:

- immunoglobulin E (IgE)-mediated (immediate hypersensitivity),
- non-IgE mediated (cell-mediated, or delayed hypersensitivity), and
- mixed IgE and non-IgE mediated.

IgE-mediated symptoms typically develop within minutes to 1-2 hours of ingesting the food. Non-IgE-mediated and mixed IgE- and non-IgE-mediated food allergies present with their symptoms several hours after the ingestion of the food. Symptoms of IgE-mediated food allergy may include itching around the mouth, hives, swelling of lips and eyes, difficulties in breathing, drop in blood pressure, diarrhoea and, in its most severe form, anaphylaxis; and may result in death.

While many different foods can cause allergic reactions in susceptible individuals, the majority of food allergies on a global basis are caused by a variety of proteins in various eight foods/ food groups (and derived products) as described in Sections 4.2.1.4 and 4.2.1.5 of the *General standard for the labelling of pre-packaged foods* (CXS 1-1985). These are¹

- ~~cereals containing gluten (i.e. wheat, rye, barley, oats², spelt or their hybridized strains)~~
- ~~crustaceans;~~
- ~~eggs;~~
- ~~fish;~~
- ~~milk;~~
- ~~peanuts;~~
- ~~soybeans; and~~
- ~~tree nuts~~

~~The most common allergic reactions to tree nuts involve almonds, Brazil nuts, cashews, hazelnuts, macadamias, pecans, pistachios and walnuts. In addition, cereal grains such as wheat, barley and rye contain gluten, which can cause adverse reactions in persons with Coeliac disease³, as well as those with specific allergies to those cereals.~~

~~While the allergens listed above are the most common, other food allergens such as sesame seeds, buckwheat, celery, mustard, molluscs and lupin are recognised as important in many countries. The list of recognised food allergens varies among countries and there is the potential for additional major allergens to be identified in the future.~~ The controls outlined in this Code of Practice (Code) would be similar for any other allergens, and FBOs should apply these as appropriate to their own business requirements and applicable legislation. This includes being aware of the food allergens recognised as important in countries they are exporting their product to, managing those allergens and ensuring the necessary allergen labels are applied.

Poor allergen management can result in the presence of varying levels of undeclared and/or unintended allergens in food, which may pose a risk if consumed by an individual with an allergy to the food. The doses that provoke reactions vary among individuals and are dependent in part on the type of allergen. The risk of

¹ ~~The listed foods, with one exception (i.e. deletion of sulphites), are referred to in the *General Standard for the Labelling of Prepackaged Foods* (CXS 1-1985) as the foods and ingredients known to cause hypersensitivity and that must always be declared.~~

² ~~While oats do not contain gluten, they are commonly produced in the same location as gluten-containing cereals such as wheat, resulting in allergen cross-contact.~~

³ ~~Coeliac disease is a serious lifelong illness where the body's immune system attacks its own tissues when gluten is consumed. This causes damage to the lining of the gut and results in the inability of the body to properly absorb nutrients from food.~~

allergic reactions within a larger proportion of the population suffering from food allergies increases with increasing concentration of undeclared allergen.

Allergen cross-contact can result from a number of factors in processing, preparing and handling foods, some of which pose a greater potential for allergen cross-contact than others. The control measures implemented to prevent or minimise the likelihood of allergen cross-contact should be based on risk assessment conducted by food business operators.

It is important that FBOs are able to identify the allergenic nature of the foods, including ingredients, and processing aids they handle and take steps to manage any potential presence of undeclared allergens.

SECTION II – SCOPE, USE AND DEFINITIONS

2.1 Scope

This Code covers allergen management throughout the supply chain including at primary production, during manufacturing, and at retail and food service endpoints. It complements GHP in manufacturing and food preparation practices in food service.

This Code covers IgE-mediated, non IgE-mediated food allergies and other hypersensitivities (e.g. Coeliac disease) that can be triggered by small amounts of the offending food allergen (thus requiring attention to GHPs in addition to labelling). There are **various** ~~eight~~ foods/food groups (and derived products) that cause the majority of food allergies ~~on a global basis, these are cereals containing gluten; crustaceans; eggs; fish; milk; peanuts; soybeans; and tree nuts. (see CXS 1-1985)~~. However, since the complete list of recognised food allergens varies among countries, it is important to consider which allergens are applicable when exporting food.

This Code does not cover hypersensitivities with a non-immunological aetiology such as lactose intolerance and sulphite sensitivity. Food intolerance adverse reactions usually result from a non-immune mediated reaction to food, such as a lack of an enzyme to process foods effectively (e.g. the absence or deficit of lactase in those with lactose intolerance). While intolerances are not explicitly mentioned in the following text, some of the controls described here could be applied to protect those with food intolerances.

2.3 Definitions

Refer to definitions in the *General Principles of Food Hygiene* (CXC 1-1969) and other applicable Codes. In addition, for the purpose of this Code, the following expressions have the meaning stated:

Allergen means an otherwise harmless substance capable of triggering a response that starts in the immune system and results in an allergic reaction in certain individuals. In the case of foods, it is a protein which is found in food capable of triggering a response in individuals sensitised to it.

Allergenic Food means a food (including ingredients, food additives and processing aids) that can elicit immunoglobulin class E (IgE)-mediated or other specific immune-mediated reactions in susceptible individuals.

Allergen cross-contact occurs when an allergenic food, or ingredient, is unintentionally incorporated into another food that is not intended to contain that allergenic food.

Allergen profile means the food allergens present via intentional addition as well as those inadvertently present (or the absence of any allergens) in a food.

Food allergy means a reproducible adverse health effect arising from an IgE antibody or non-IgE antibody immune-mediated response following oral exposure to a food.

Food service means a food business or institution that produces, prepares and serves food for direct consumption.

Coeliac disease means a chronic immune-mediated intestinal disease in genetically predisposed individuals induced by exposure to dietary gluten proteins that come from wheat, rye, barley and triticale (a cross between wheat and rye).

APPENDIX III

ANNEX II OF THE GUIDELINES FOR THE SAFE USE AND REUSE OF WATER IN FOOD PRODUCTION AND PROCESSING (CXG 100-2023)**FISH AND FISHERY PRODUCTS****(For adoption at Step 5/8)****1. INTRODUCTION**

1. Fish and fishery products are generally regarded as safe, healthy, and nutritious foods. However, these products may be involved in infections and intoxications caused by viruses (e.g., norovirus and hepatitis A), bacteria (e.g., *Vibrio* spp. and *Salmonella* spp. and *Clostridium botulinum*), protozoans (e.g. *Giardia lamblia* and *Cryptosporidium parvum*), marine biotoxins (e.g., saxitoxin and ciguatoxin) and helminths (e.g., *Anisakis* spp.). The causes of such hazards are diverse, ranging from naturally occurring microorganisms and parasites to contamination of primary production environments and/or poor hygiene practices during processing, storage, distribution and handling prior to consumption. Depending on the pathogen, it can remain infectious in water for a considerable period of time and affect the suitability of a site to produce or harvest fish and fishery products¹.
2. Water is a key element in the production and processing of fish and fishery products. Water of potable quality might be the safest option; however, many primary producers and food processors/handlers have challenges accessing potable water. The use of potable water is often not a feasible, practical or responsible solution, and other types of water could be also fit for some purposes, provided they do not compromise the safety of the final product for the consumer. The increasing frequency of extreme weather events (e.g., drought, flooding) have exerted greater pressure on the availability and quality of water resources.
3. Increasingly, minimizing water consumption and exploring alternative water sources (e.g., water recovered from food or a food operation that could be reused after making it fit for purpose by suitable treatments or reconditioning, if necessary) are being considered.
4. Water can contact food directly or indirectly and is used in the maintenance of hygiene and sanitation throughout the food chain.
5. An overall management strategy should be developed to prevent the use of water that is, or could be, a source of microbiological contamination of fish and fishery products, taking into account risk factors and control measures applicable at each step. The strategy should be based on a water fit-for-purpose assessment, which encompasses the entire water supply from the catchment or source to its final use.
6. A more general use of 'water fit-for-purpose' is likely to be more feasible, effective and practicable, as proposed by FAO and WHO meeting report on Safety and Quality of Water Used in Food Production and Processing. Potable water is fit for purposes for use during all stages of processing of fishery products from a microbiological safety perspective without an in-depth water fit-for-purpose assessment. Clean water is also defined according to the *Code of Practice for Fish and Fishery Products* (CXC 52-2003) as water from any source where harmful microbiological contamination, substances and/or toxic plankton are not present in such quantities that may affect the safety of fish, shellfish and their products intended for human consumption. Consequently, clean water is considered safe for processing fishery products (e.g., clean sea water, deep groundwater) and can therefore be fit for purpose (FFP) for almost all uses of water without an in-depth water fit-for-purpose assessment. Water of other quality can become fit for purpose for specific usage following an in-depth water fit-for-purpose assessment and application of control measures as needed.

2. PURPOSE AND SCOPE

7. The purpose and scope of this Annex is to provide recommendations for the microbiologically safe sourcing, use and reuse of water in production and processing of fish and fishery products for human consumption by introducing the principle of 'fit for purpose' and a risk-based approach. This Annex also provides examples of decision trees for determining fit-for-purpose use and reuse of water for fish and fishery products focusing on fish or fishery products that could be eaten raw or undercooked.

3. USE

8. This Annex is complimentary to and should be used in conjunction with the General Section of these Guidelines and the following Codex Alimentarius guidance:

- *Code of Practice for Fish and Fishery Products* (CXC 52-2003);

¹ FAO and WHO. 2023. Safety and quality of water used in the production and processing of fish and fishery products: meeting report. Microbiological Risk Assessment Series, No. 41. Rome.

- *General Principles of Food Hygiene*: (CXC 1-1969);
- *Principles and Guidelines for the Conduct of Microbiological Risk Management (MRM)* (CXG 63-2007);
- *Principles and Guidelines for the Conduct of Microbiological Risk Assessment* (CXG 30-1999);
- *Standard for Live and Raw Bivalve Molluscs* (CXS 292-2008), and other relevant fish and fishery products standards;
- *Principles and Guidelines for the Establishment and Application of Microbiological Criteria Related to Foods* (CXG 21-1997);
- *Guidelines on the Application of General Principles of Food Hygiene to the Control of Foodborne Parasites* (CXG 88-2016), and
- *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012).

4. DEFINITIONS

9. Refer to the General Section of these *Guidelines for the Safe Use and Reuse of Water in Food Production*.
10. Refer to the *Code of Practice for Fish and Fishery Products* (CXC 52-2003) for the definitions of aquaculture, conditioning, depuration, extensive farming, fish, fish farming, glazing, growing areas, intensive farming and shellfish.

Brackish water: water occurring in a natural environment that has more salinity than freshwater but not as much as seawater. It may result from the dissolution of salt from mineral deposits, mixing of seawater with freshwater, as in estuaries, or artificial situations such as dikes or flooding of coastal marshland.

Closed aquaculture production system: any system of aquatic species production that creates a controlled interface between the farmed species and the natural environment. It includes rearing in raceways, tanks and ponds.

Open aquaculture production system: farming of any aquatic species in natural water such as oceans, bays, estuaries, coastal lagoons, lakes, or rivers.

Evisceration: The removal of viscera and other internal organs.

Fish and fishery products: Any species of fish, including crustaceans, molluscs (including bivalve molluscs, marine gastropods and cephalopods), echinoderms, tunicates, or part of them intended for human consumption.

Processing facilities: A facility (vessel or on land establishment) where harvested fish and fishery products may be depurated, processed, graded, and packed for further transportation and consumption.

Refrigerated seawater: clean seawater cooled by a suitable refrigeration system in fixed tanks chilled by mechanical refrigeration.

Reimmersion: Storing live bivalve molluscs in tanks, floats, or natural sites after harvesting from the original production area.

Undercooked fishery products: fishery products that are neither raw nor subjected to a cooking time and temperature sufficient to ensure the destruction of non-spore-forming pathogenic micro-organisms.

5. WATER SOURCE

11. Water used in the production and processing of fish and fishery products can be obtained from many sources, such as:
- drinking water from a public/municipal water supply system;
 - freshwater from surface sources;
 - freshwater from groundwater sources;
 - collected rainwater;
 - seawater and brackish water;
 - desalinated water;
 - reused water originating from agricultural activities (e.g., hydroponics);

- recycled/reused processing water within an establishment recovered from a processing step within the operation.

6. WATER USE

12. Water used in the production and processing of fish and fishery products should be subject to an in depth water fit-for-purpose assessment covering the whole water system from the source or catchment area, treatment and storage, distribution and up to the point of use (from “source to tap”), while, a simple identification of the water source linked to an analysis of its microbiological quality is sufficient for use of clean water and potable water. Water use should be part of an operation’s prerequisite programme and HACCP system, when applicable.
13. Water used as an ingredient and at the final stage for the preparation of filleted fishery products eaten raw, should be of potable quality. There are many other non-food applications in vessels and processing facilities where there is no intended or expected contact of the water with food – e.g., fire control systems.
14. Water use should be tailored to the particular conditions of the specific fish and fishery products processing operation to which it is applied. Consideration should be given to the potential reusable water sources of the operation, the different applications of the reused water, available recovery and treatment technologies, and the technical and operational capacity of the operator to monitor and maintain water quality.
15. Some common examples of where water is used in production or processing are:
 - for washing whole fish and rinsing the fish cavity after beheading, evisceration, skinning, and trimming;
 - for depuration or conditioning;
 - for reimmersion in the case of live bivalve molluscs;
 - as an ingredient;
 - to transport/convey fish and fishery products;
 - to wash, help preserve (chill/freeze) and cook fish and fishery products;
 - to clean and sanitize facilities, utensils, containers, and/or equipment;
 - to make ice;
 - for thawing of fish and fishery products;
 - for other processing purposes such as brining, glazing of frozen fish and fishery products to maintain quality during frozen storage;
 - for personal hygiene purposes; and
 - for non-food contact purposes.
16. Considering the General Section and the *Code of practice for fish and fishery products* (CXC 52-2003), and recognizing the specificities of the fishery products sector, as well as the diversity of water sources and uses across different countries, water can be differentiated into three categories based on the “fit for purpose” principle. The three categories can be used from a microbiological safety perspective as follows:
 - a) Potable water
 - Water fit-for-purpose for all uses;
 - Can be used as an ingredient in fish and fishery products and for washing at the final stage of the preparation of filleted fishery products eaten raw (e.g. ceviche, sashimi);
 - Standards of potability should align with the recommendations included in the latest edition of the Guidelines for drinking-water quality, issued by the World Health Organization;
 - Example: drinking water from a public/municipal water supply system; when sourced from a well, the potable quality of the water should be verified; wastewater, can seep into drinking water sources e.g. after flooding and these sources should be monitored when there is any suspicion that this may have occurred;
 - b) Clean water:
 - Water fit-for-purpose for all uses except as an ingredient and for washing at the final stage of the preparation of filleted fishery products eaten raw.

- Should come from any source where harmful microbiological contamination, substances and/or toxic plankton are not present in such quantities that may affect the safety of fish and fishery products intended for human consumption.
- Example: includes offshore sea water, and deep groundwater. The locations of the water sources should be assessed for appropriate proximity from higher risk factors (e.g., sea water is collected sufficiently offshore, wells that are sufficiently deep) and against any recent microbiological data relevant to the source.

c) Other sources of water

- Other sources of water can be used but only after an in-depth water fit-for-purpose assessment to specify what use it is suitable for and after implementing additional control measures to ensure food safety.
 - Example: surface groundwater, recycled/reused processing water within an establishment recovered from a processing step within the operation, or recirculated water, etc.
17. In any processing facility, contamination of the potable water system with non-potable water from other sources should be avoided. Non-potable water systems should be identified (for example, with labels or colour codes) and should not connect with or allow reflux into potable water systems. Contamination may occur for example, due to cross connections, dead legs, backflows or back siphonage in the water plumbing systems because of improper installations, or additions/modifications to the existing plumbing.
 18. Before the use in a processing facility, the source of the water coming into direct or indirect contact with material or product, should be identified and assessed; where necessary, testing and treatment should be applied to ensure that the water is fit-for-purpose for the processing step in which it will be used.
 19. Food Business Operators (FBOs) should consider the following in assessing and managing water:
 - Sanitary surveys/monitoring and an in-depth water fit-for-purpose assessment may be important to determine if water is fit for purpose and the likelihood of contamination in the production and processing systems.
 - Characterization of surface or groundwater safety in extraction points should be extended upstream, when possible, to include the whole water catchment area.
 - A water fit-for-purpose assessment should consider the specific waterborne hazards (e.g., marine microbiological contaminants) that may impact the safety and quality of the fish and fishery product. Depending on the fishing ground of origin, seasonal and climatic factors affecting source water quality in the immediate area should be included.

6.1 Water use for aquaculture production

20. In primary production, any source of water can be used provided that its suitability for the intended use has been assessed, that the water complies with predefined microbiological criteria and that the water quality is regularly monitored. The type and source of water used in aquaculture systems varies by species, geographical location, and water availability.
21. Seawater is primarily used in marine aquaculture, while inland aquaculture systems primarily use water from surface and groundwater sources, although other water sources as per Section 5 can be used in both of these production systems.

6.2 Water use onboard vessels

22. Many different types and sizes of fishing vessels are used throughout the world for catching, harvesting, and/or processing fish and fishery products. Water may be used on onboard vessels for preservation, washing, holding of live seafood, and further processing of fish and fishery products, as well as various non-food contact purposes.
23. Onboard preservation of fish and fishery products can involve chilling and/or freezing. Ice is most commonly used to chill fish and fishery products onboard vessels. Other means to chill fish and fishery products include chilled water, ice slurries and refrigerated seawater, including brine freezers. Ice may be brought on board from onshore sources and/or manufactured on board using brackish water or seawater.
24. Depending on a variety of factors (e.g., the geographical region, seasonality, proximity to marine dumping, proximity to congregation of marine life, industrial or sewage outflow (e.g., wastewater, storm water, sewer overflow), agricultural run-off and temperature), seawater can hold naturally occurring pathogenic microorganisms, such as *Vibrio* spp., that may require monitoring and control.

25. Seawater used on fishing vessels should be taken from offshore or coastal areas that are sufficiently distant from known pollution sources (e.g., sewage outflow) to ensure that the water is of suitable quality. Cross-contamination should be avoided between the point at which seawater is taken on board, and wastewater streams, bilge water and engine coolant outlets or other potential contaminants from the fishing vessel when stationary or moving.

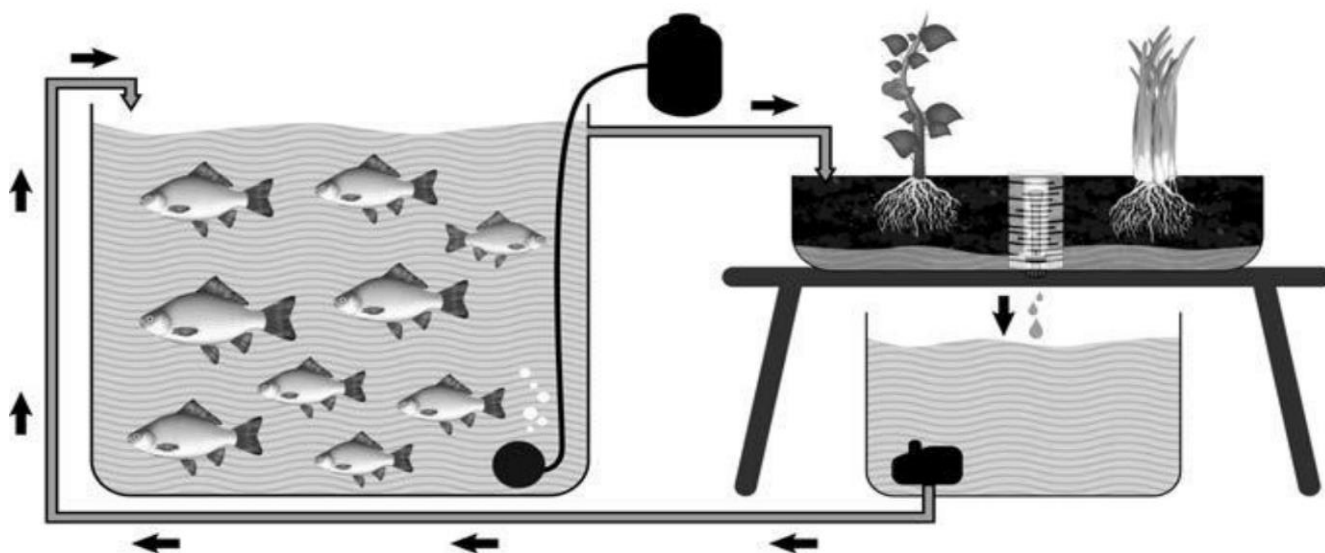
6.3 Water use at land-based processing facilities

26. Water is used for a variety of applications in land-based processing facilities for fish and fishery products. Recognizing the specificities of the fishery products sector, different sources of water may be used depending on the intended purpose as illustrated in Section 5. Where seawater is extracted from coastal sources for land-based processing plants, it cannot be guaranteed to be free from pathogens from the marine microbiota or from faecal contamination. It cannot be classified as a fit-for-purpose source for processing without an in-depth water fit-for-purpose assessment, the appropriate monitoring and application of control measures where necessary.
27. In any processing facility, contamination of fit-for-purpose water by non-fit-for-purpose water should be avoided.

7. WATER INTENDED FOR REUSE

28. Water recovered from food, certain agricultural activities (e.g., hydroponics), processing activities (such as cooling) or treated wastewater, are good examples of water that can be reused as long as its microbiological quality is fit-for-purpose for its planned use. Its use could be expanded for additional applications after treatment. Any water treatment processes should be effectively monitored, controlled and recorded.
29. Examples of aquaculture systems where water can be reused include integrated multi-trophic aquaculture systems, where multiple aquatic species from different trophic levels are farmed in an integrated fashion (e.g., finfish and seaweed) and aquaponic systems², which integrates aquaculture and hydroponics into a single recirculating production system (see Figure 1). The reuse of water within these (or other) aquaculture systems should be subject to a water fit-for-purpose assessment and appropriate water safety management practices.

Figure 1. Schematic of a simple aquaponic unit³



30. All reuse of water in the production and processing of fish and fishery products that could come in direct or indirect contact with food should be part of the prerequisite programme and HACCP system, when applicable.

² More information on Aquaponic System could be found in FAO and WHO. 2023. Safety and quality of water used in the production and processing of fish and fishery products: meeting report. Microbiological Risk Assessment Series, No. 41. Rome.

³ FAO. 2014. Small-scale aquaponic food production. Integrated fish and plant farming. FAO Fisheries and Aquaculture Technical Paper No. 589. Rome.

8. WATER USE OR REUSE FIT-FOR-PURPOSE ASSESSMENT

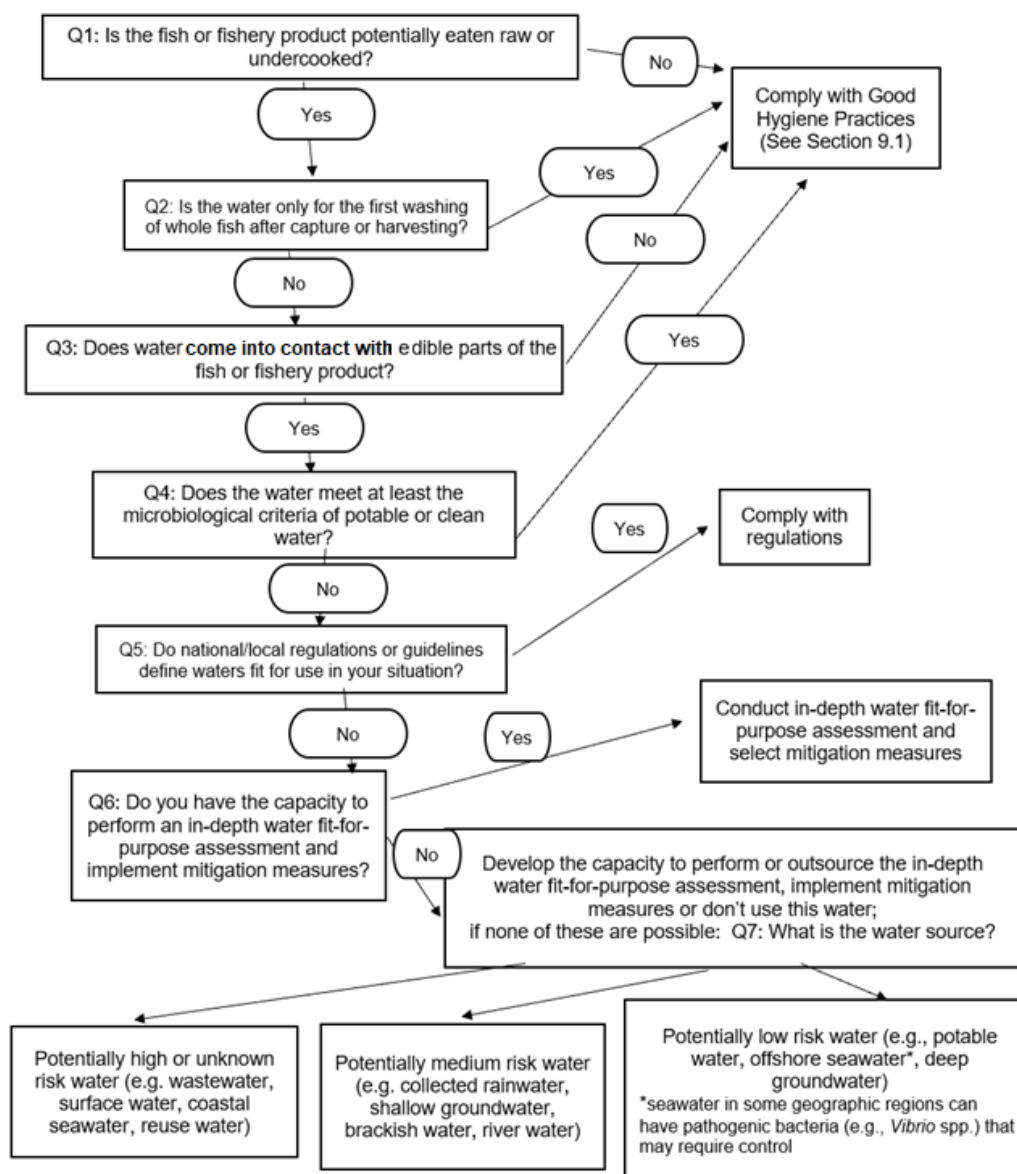
31. Refer to section 7 of the general section and Annex IV of these Guidelines in line with the recommendations in Annex IV.
32. It is important to note that the complexity of the water fit-for-purpose assessment required will depend on the situation and level of general understanding of the risk associated with a particular scenario. For example, if potable water, clean offshore seawater (known to be free of coastal or other contamination) or deep groundwater are used, these types of water are fit for purpose for almost all uses and do not require an in-depth assessment. For other water, an in-depth water fit-for-purpose assessment should include an evaluation of the specific operation, including the type and source of water used/reused to determine which indicator(s) are appropriate to be used to monitor the water source, including reconditioned water.
33. In addition to the factors described in Annex IV of these Guidelines, fit-for-purpose assessments of water to be used/reused in the production or processing of fish and fishery products should consider process- or product-specific factors such as:
 - whether the fish is dead or alive;
 - whether fish products are whole or processed; and
 - whether the fish or fishery product is likely to be eaten raw or undercooked.
34. General recommendations on the minimum microbiological quality for water to be fit for certain purposes include:
 - Water used in food contact applications for fish and fishery products that are potentially eaten raw or undercooked should be potable or clean water, or water demonstrated as fit for purpose through an in-depth risk assessment.
 - Water used as an ingredient in a fish and fishery product and for washing at the final stage of the preparation of filleted fishery products eaten raw, should be potable.
 - Any water used in direct contact with fish and fishery products during preservation or processing activities (e.g., for chilling, washing whole fish, or rinsing the fish cavity after beheading, evisceration, skinning, and trimming) should not further contaminate the product.
35. Evaluating risk of microbiological hazards in water in the fit-for-purpose assessment, should include information on local hazards of public health significance (e.g., epidemiological data). Waterborne microbiological hazards and their relative risk are listed in Table 1.
36. In an in-depth fit-for-purpose assessment, the first tasks in the decision processes are similar to the first steps and Principle 1 in the implementation of a HACCP system during food safety management. They include some or all of the following:
 - description of the fish or fishery product;
 - its intended use if known (e.g., eaten raw, cooked, ...);
 - understanding the product flow from production to consumption (e.g., harvesting, processing, transport, marketing, consumer handling);
 - identifying water use (e.g., washing, processing, ice, ingredient) and inputs (e.g., water source types, storage and delivery);
 - identifying potential water-related hazards⁴ at each stage; and
 - analysing the microbiological hazards and considering any measures in the product flow stages that may prevent, eliminate or reduce the water-related microbiological hazards introduced in the final product to acceptable levels.
37. When assessing the microbiological safety of surface or groundwater, it is important to extend the assessment upstream of extraction points, when possible. In addition, seasonal and climatic factors that may affect the microbiological quality of surface or groundwaters should also be considered.

⁴ Chemical and physical hazards are out of scope, but relevant to be considered.

8.1 Examples of Decision Trees

38. For practical guidance, a decision tree (DT) approach with underlying risk assessment (RA) is a useful decision support system (DSS) tool to identify whether the water is fit for purpose for use or reuse at a given step in the supply chain.
39. There is no single DT that applies/fits in all situations. The DTs below therefore should rather be considered as examples of an approach to evaluate a situation and draw attention to risk factors instead of as a tool fixed for all purposes. Competent authorities are encouraged to publish simplified national or regional decision trees to facilitate implementation by small-scale operators.
40. The DTs provide examples of how the quality of water used at each step in the process impacts final product safety, and hence whether the water available at that stage is fit for purpose or not.
41. Recommended good hygiene practices related to the appropriate use/reuse of water (see Section 9.1), historically identified using risk assessment principles, are considered sufficient to support decision making when fish and fishery products are intended to be cooked. In several cases, it may be impossible to guarantee during the production and processing stage that fish or fishery products won't be eaten raw or undercooked. When not possible to guarantee that the fish will be adequately cooked, the recommendations in these guidelines on the use of water for the production and processing of raw or possibly undercooked fish, should be applied. Figure 2 provides an example of a DT for examining the risk associated with the use of water, particularly when a water fit-for-purpose assessment is warranted. It also outlines potential risk characterizations for various water sources in a situation where the capacity to perform a water fit-for-purpose assessment or implement mitigation measures is lacking. Water sources considered as a potentially medium, high or unknown risk should not be used unless monitoring demonstrates compliance with the microbiological criteria of potable water, after treatment if required. Alternatively, a water fit-for-purpose assessment should be outsourced or the internal capacity to conduct such assessments and implement mitigation measures should be developed.

Figure 2. Example of a decision tree to determine whether or not a fit-for-purpose assessment of the water for fish and fishery products is warranted and potential risk characterizations where the capacity to perform a water fit-for-purpose assessment or implement mitigation measures is lacking.



42. Other DTs may assist in assessing if water is fit for purpose for fish and fishery products potentially eaten raw or undercooked. In such case, the water used should represent the lowest possible risk at each stage.

8.1.1 Example of DT to determine whether or not the water to be used in freshwater, marine or estuarine aquaculture production of fish and fishery products potentially to be eaten raw or undercooked, is fit for purpose.

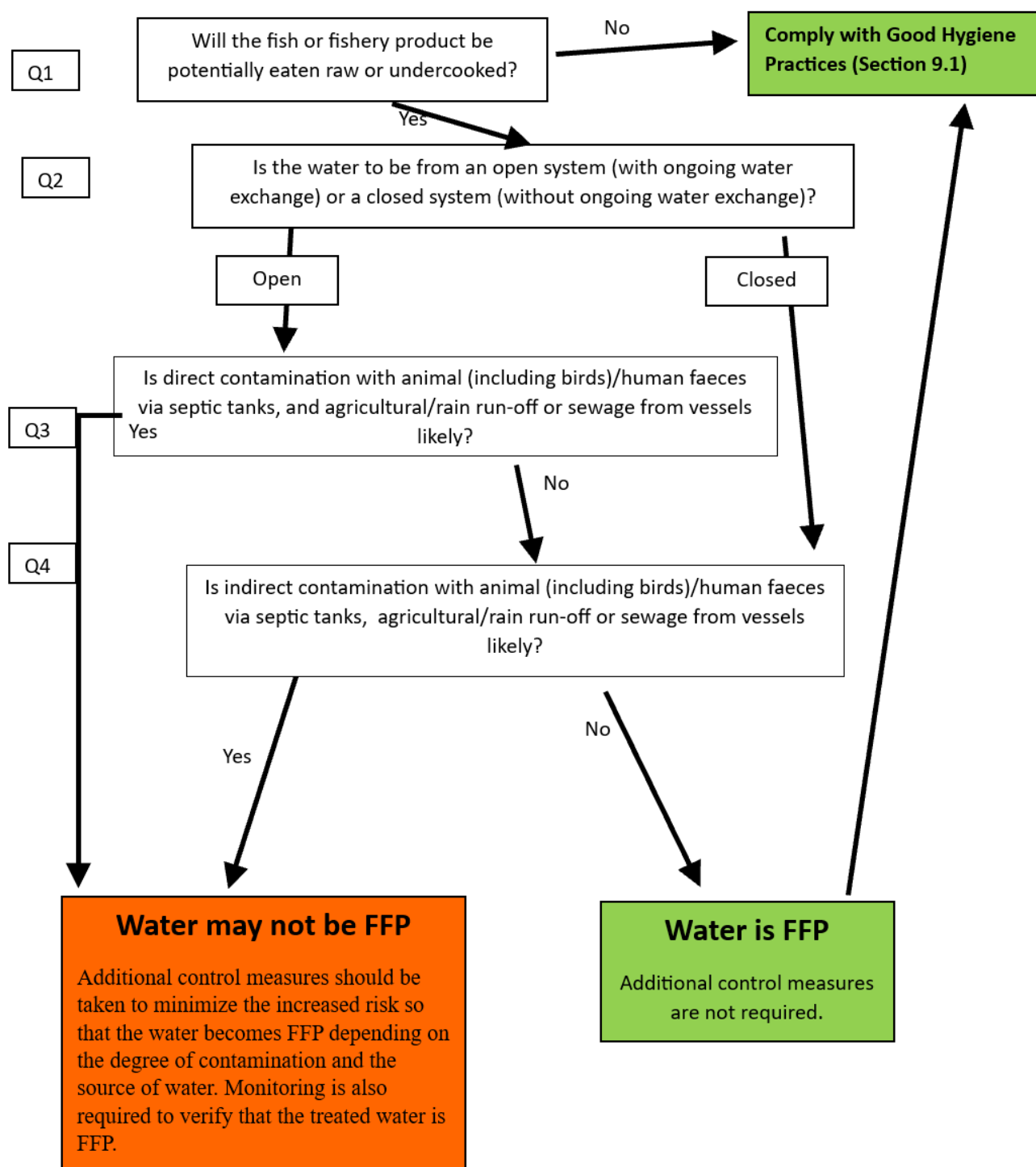
43. Figure 3 provides an example DT that can be useful in determining if water systems used for the aquaculture production of fish could have been subjected to conditions/events that increase the risk of microbiological hazards such that the application of control measures to the water are necessary. Since prevention of (faecal) contamination is a good hygiene practice for any fish production, this example DT could be applied both when the fish is to be consumed cooked or uncooked.
44. When one or several possible sources of contamination (sewage nearby, faeces or surface run-off water entering the system) have been identified by the DT, the possible presence of pathogens should be considered a risk unless regular monitoring demonstrates that it is fit for purpose by an in-depth risk assessment or control measures have been put in place and validated (the control measures can be water treatment or processing measures subsequently applied to the fish and fishery products). Any water treatment processes should be monitored, controlled and recorded. Detailed information on the possible control measures can be found

in the FAO/WHO documents⁵ or in relevant national guides. For example, specific guidance to control contamination of *Vibrio* spp. in the Guidelines on the application of *General Principles of Food Hygiene to the Control of Vibrio Species in Seafood* (CXG 73-2010) should be taken into account.

45. The risk presented by water changes with the season. For example, in periods with high rain fall in a short period, the risk of surface run-off water entering the growing waters or water supply may increase. Contamination by the faeces of mammals should be avoided (e.g. restricting access to growing waters or water supplies by fencing) while contamination by bird faeces should be minimized as much as possible (e.g. by removing perches as overhanging branches).

⁵ WHO Sanitation Safety Plan Manual, Second edition; WHO Water Safety Plan, step-by-step risk management for drinking-water suppliers, Second edition; WHO Safe Use of Wastewater, Excreta and Grey Water. Vol 3. Aquaculture.

Figure 3. Example of DT to determine whether or not the water used in freshwater, marine or estuarine aquaculture of fish and fishery products is fit for purpose.

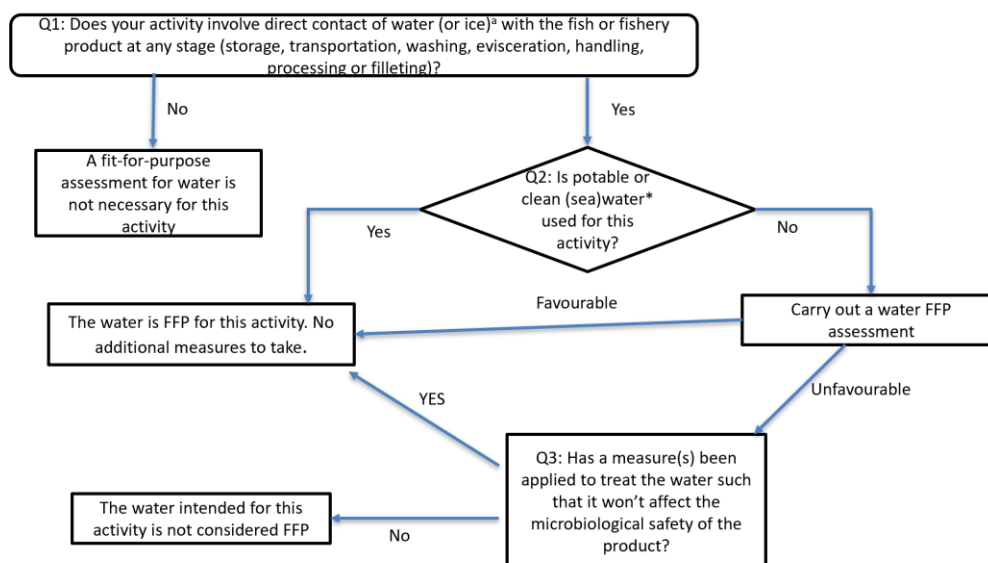


8.1.2 Example of DT to determine fit-for-purpose water used for post-harvest handling or processing of fish and fishery products, potentially eaten raw or undercooked.

46. In case of post-harvest handling and processing of fish and fishery products, the DT in Figure 4 can be used to determine if the water is fit for purpose or will require prior treatment (e.g., because of unacceptable levels of/ presence of pathogens) before use. Only potable or clean (sea)water would be fit for purpose for descaling, eviscerating and washing the fish cavity or use during filleting. The use of other waters would require an in-depth fit-for-purpose assessment and treatment of that water to minimize or eliminate faecal pathogens. This also applies to water used on contact surfaces (knives, cutting boards). For the (first) washing or transport (ice) of whole (non-eviscerated) fish, water can still be fit for purpose if of lower quality.

47. Consideration should be given to prevent the presence of naturally occurring marine pathogens (e.g., *Vibrio* spp.) where cross-contamination between fresh and seawater fish and fishery products may occur at this stage.

Figure 4. Example of DT to determine whether or not the water to be used for post-harvest handling and or processing of fish and fishery products, potentially eaten raw or undercooked, is fit for purpose

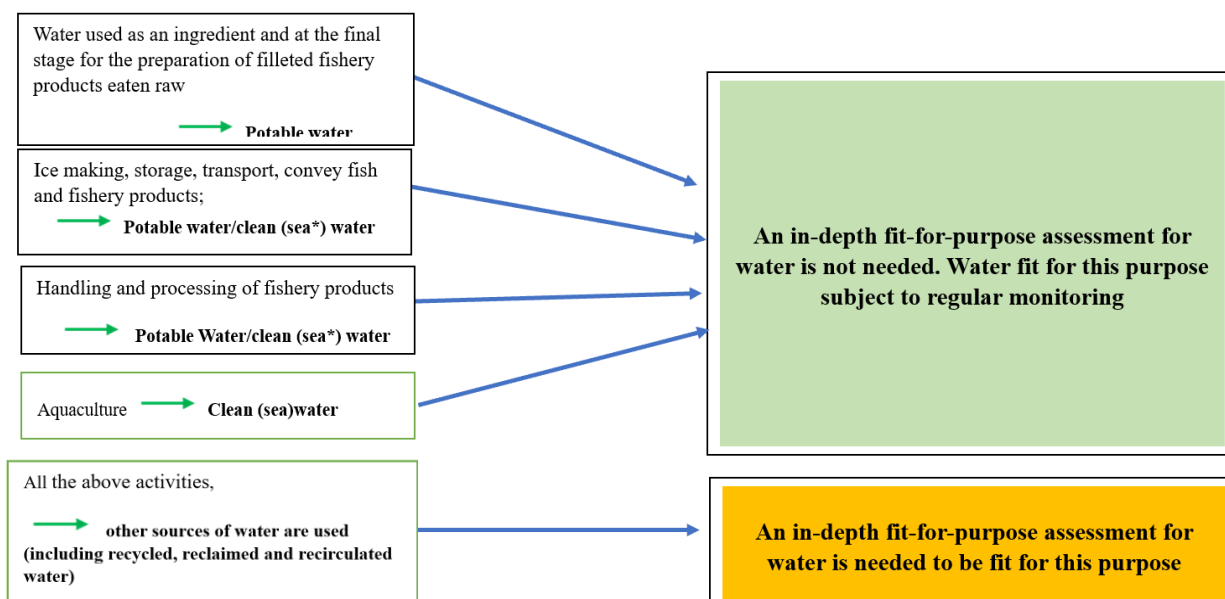


*: Seawater from high seas has lower risk while the possible use of seawater from near a coastline should be subject to an in-depth fit-for-purpose assessment.
 a: This also includes water used to clean all surfaces that come into direct contact with fish and fishery products.

8.1.3 Summary of examples of DTs

48. Figure 5 provides a summary of examples of water fit-for-purpose for use at certain steps with direct contact in fishery production and processing.

Figure 5. Summary of examples of water fit for purpose for use at certain steps with direct contact in fishery production and processing in case of fish and fishery products potentially eaten raw or undercooked



* While the possible use of seawater from near a coastline should be subject to an in-depth fit-for-purpose assessment.

9. WATER SAFETY MANAGEMENT

49. Refer to section 8 of the general section and Annex IV of this Guidelines.

9.1 Good hygiene practices

50. The good hygiene practices described in this Section should be applied as prerequisite programmes to ensure the safety of any fish and fishery product by the use and reuse of water in direct and indirect contact with the product. Categorization of quality of water used at various processing steps varies and includes potable water, clean (sea)water, and other water fit for purpose for its intended use.
51. When seawater is used on board fishing vessels, it is fit for purpose for any washing of whole fish, preservation and other processing activities when, for example the water is collected from offshore areas that are sufficiently distant from known pollution sources (e.g., sewage outflow, ship fleets and animal congregations). The point at which offshore seawater is taken on board should be located such that contamination from wastewater streams, bilge water and engine coolant outlets, or other objectionable substances from the fishing vessel is avoided.
52. Any water used in direct contact with fish and fishery products during preservation or processing activities (e.g., for chilling, washing whole fish, or rinsing the fish cavity after beheading, evisceration, skinning, and trimming) should not further contaminate the product. It is essential that water used on fish and fishery products that may be consumed raw or undercooked is free from microbiological hazards that could pose risks to human health.
53. Where an essential onboard treatment for water used in direct contact with fish or fishery products has failed or malfunctioned, fish and fishery products should be directed to further processing (e.g., cooking) to ensure food safety.
54. Storage and transportation of live fish:
- Water should not be contaminated with either human sewage or industrial pollution; holding tanks and transportation systems should be designed and operated in a hygienic way to prevent contamination of water and equipment.
 - Where seawater is used in holding or conditioning tanks, for species prone to toxic algae contamination, the seawater shall not contain toxic algae or toxic phytoplankton in a quantity that could contaminate the contained fish and fishery products.
55. On fishing vessels, adequate facilities should be provided for the handling and washing of fish and fishery products and should have an adequate supply of cold potable water or clean (sea)water. If not gutted, the catch should be immediately frozen or stored in tanks with refrigerated seawater, in clean seawater chilled with ice or in boxes containing ice. Refrigerated fish should be transported in ice water
56. Processing steps that use water can be the same on board or on land and for captured or cultured fish and fishery products and may include washing and evisceration, filleting, skinning, trimming and candling, glazing and mincing.
57. Processing of fresh, frozen and minced fish:
- Washing and evisceration: an adequate supply of clean (sea)water or potable water should be available for washing of:
 - whole fish, to remove foreign debris and reduce bacterial load prior to evisceration;
 - eviscerated fish, to remove blood and remaining viscera from the belly cavity;
 - surface of fish, to remove any loose scales;
 - evisceration equipment and utensils, to minimize build-up of slime, blood and offal.
 - Filleting, skinning, trimming and candling: An adequate supply of clean (sea)water or potable water should be available for washing of:
 - fish prior to filleting or cutting, especially fish that have been scaled;
 - fillets after filleting, skinning or trimming to remove any signs of blood, scales or viscera;
 - filleting equipment and utensils to minimize build-up of slime and blood and offal.
58. Ice should be produced using potable water or clean water and it should be protected from contamination.

59. For operations that require steam, an adequate supply at sufficient pressure should be maintained. Steam used in direct contact with fish, fishery products or food contact surfaces should not constitute a threat to the safety or suitability of the food.
60. Washing live bivalve molluscs: Washing should be carried out using pressurized seawater fit for purpose or saltwater made from potable water. If saltwater other than seawater is used, it should be prepared from potable water and of about 3 percent of food grade salt to minimize the uptake of moisture. The salinity of the saltwater should be monitored. Reimmersion should not cause additional contamination in live bivalve molluscs.
61. Washing shucked bivalve molluscs: Pre-chilling should include the immersion of the bivalve molluscs in clean refrigerated seawater or iced seawater.
62. Fresh, refrigerated and frozen products: Transportation of fish in an ice slurry, chilled seawater or refrigerated seawater (e.g., for pelagic fish) should be considered where appropriate. Chilled seawater or refrigerated seawater should be used under approved conditions.
63. Glazing: The application of a protective layer of ice formed at the surface of a frozen product by spraying it with, or dipping it into, clean (sea)water, potable water or potable water with approved additives, as appropriate.
64. Cleaning and disinfection of equipment and facilities: A good supply of clean (sea)water or potable water at adequate pressure should be available.

9.2 Implementation of a water safety management plan based on the fit-for-purpose assessment

65. Management procedures, such as a water safety plan, should be site specific. Their elaboration and implementation should consider particular characteristics of the site and the relevant hazards/hazardous events and the outcomes of the in-depth water fit-for-purpose assessment. The management procedures should include:
 - all uses of water;
 - measures to prevent contamination of water supplies;
 - measures to prevent cross-connections between a supply of water determined to be microbiologically fit for its intended use(s) and other supplies of water with lesser microbiological quality or safety;
 - any treatments, including the treatment parameters, necessary to control hazards such that the treated water is microbiologically fit for its intended use(s);
 - validation of disinfection steps of water treatments;
 - appropriate monitoring procedures and corrective actions.
66. A multi-barrier approach (e.g., protecting the water source from faecal contamination, treatment of water, and avoiding cross-contamination) is possible with regard to water safety management. The management procedures should include strict segregation measures for preventing cross-connections between supply waters of different qualities, and most importantly with wastewater systems.
67. When reusing water, the need for water treatments (e.g., biological, chemical, physical) should be considered to ensure that the water from the reuse system is fit for purpose, including conditions related to distribution, storage and intended use where relevant.
68. Revise and reinforce, as appropriate, operational monitoring, including periodic microbiological testing of water used in the production and processing of fish and fishery products to provide insight into the performance of the water safety management process. Such monitoring can enable identification of potential nonconformities and inform corrective actions, which may include additional microbiological testing of the process and/or the fish and fishery products.

9.3 Treatments for fit-for-purpose water

69. When the outcome of an in-depth water fit-for-purpose assessment or the risk characterization of a water source (see Figure 2) indicates that control of microbiological hazards is necessary for water to be fit for its intended use, treatment options should be determined on a case-by-case basis considering the hazards that may occur through contamination (e.g., faecal pollution) as well as any naturally occurring microorganisms (e.g., pathogenic *Vibrio* spp. and *Clostridium botulinum*).

70. Treatment technologies that render water fit for purpose by eliminating or inactivating microorganisms or reducing them to acceptable levels for use/reuse water include, but are not limited to, heating (e.g., pasteurization or boiling); use of a chemical disinfectant such as chlorine, chlorine dioxide⁶, ozone; and/or physical treatments such as membrane filtration and irradiation (e.g., UV light). Guidance on resistance to chlorination by different microbiological hazards is provided in Table 1.
71. Appropriate treatment parameters should be monitored and recorded to ensure the effectiveness of any treatment technology used to control microbiological hazards in water to be used/reused in the production or processing of fish and fishery products. The efficacy of such treatments should be periodically verified through appropriate microbiological testing of the treated water.
72. For more information on water treatment technologies refer to Annex IV of this guidance.
73. If disinfection is part of the water processing facility treatment or other water treatment, the effectiveness should be validated. In this case, attention should also be paid to possible residues of disinfectants used.

9.4 Monitoring the microbiological quality of water

74. Monitoring of water is a core element of any food safety management system. It is necessary for ensuring water safety and it is important to ensure that various type of water use in the production and processing of fish remain fit for purpose. The monitoring frequency must be risk-based and should be increased following unusual events (e.g. flooding, sewage incidents, harmful algal blooms) and tapered once trends stabilize and controls are verified.
75. The microbiological quality of any water used in the production and processing of fish and fishery products should be monitored at a frequency commensurate with the level of risk identified in the water fit-for-purpose assessment. Monitoring practices should cover the whole water system, from the source or catchment area, treatment and storage, distribution and up to the point of use (from “source to tap”). Historical data and information, including seasonal and climatic factors, should be considered when determining the frequency of monitoring. Additional monitoring should be carried out following weather events that may affect water being fit for purpose (e.g., flooding).
76. No single indicator microorganism (or group of microorganisms) is suitable for monitoring the safety of water from all potential water sources and in all applications in the production and processing of fish and fishery products. The limitations of various indicator microorganisms to appropriately identify microbiological safety of water in a specific application should be understood. There is rarely a direct correlation between indicator microorganisms (e.g. coliform bacteria), and enteric pathogens (e.g. protozoans or viruses) or naturally occurring pathogenic microorganisms (e.g. *Vibrio* spp.). In addition, pathogens may be present in the absence of indicator microorganisms. Notwithstanding these issues, testing for indicator microorganisms affords a better degree of health protection than testing for pathogens alone.
77. If the water is not potable nor clean, the in-depth water fit-for-purpose assessment of the type and source of water to be used/reused/reconditioned should include an evaluation of processes and procedures specific to the operation to determine which indicator(s) are appropriate for monitoring the microbiological safety of the water. In some circumstances, monitoring certain physico-chemical parameters may be useful in assessing the microbiological safety of water. Direct monitoring for pathogens may still be required, at an appropriate frequency, where suitable indicators for particular pathogens are not available.
78. Geographical region and temperature of seawater should be considered as they may impact the level of pathogenic bacteria, viruses, and parasites, and hence the utility of indicator organisms.
79. When monitoring water quality in a harvest region or area, contamination risks from surface or groundwater from the immediate area of the catchment, as well as further upstream in the catchment area should be assessed. In addition, seasonal and climatic factors across the whole water catchment area should be considered.
80. When establishing a new monitoring programme for the microbiological safety of water, it may be appropriate to begin with frequent sampling and testing to rapidly establish a baseline profile of water safety. This baseline can then inform the design of subsequent monitoring, which may involve reduced sampling frequency, as appropriate. The selection of an analytical method for water testing should meet the information and management needs of the monitoring program as determined by the fit-for-purpose assessment of the water system and its historical data. The selection may also consider the laboratory and human resources available, the speed of analyses required, and validation of the method for the specific type of water being analysed, among other factors.

⁶ Attention should be paid to the possible formation of toxic compounds when adding chemical disinfectants to seawater.

81. Monitoring procedures should include a description of corrective actions that will be taken when testing identifies a potential problem with the microbiological quality or safety of water used/reused in the production or processing of fish and fishery products. The corrective actions can include additional microbiological testing of water (collected from various processing steps from the water supply to point of use) and/or the fish and fishery products.

Table 1. Risk Ranking on the most significant waterborne microbiological hazards of relevance to fish and fishery products and their resistance to disinfection by chlorine⁷

Microbiological HAZARD	RISK RANKING	RESISTANCE TO CHLORINE
Bacteria		
<i>Aeromonas hydrophila</i>	++	Moderate
<i>Bacillus cereus</i>	++	High (spores)
<i>Campylobacter jejuni/C. coli</i>	+++	Low
<i>Clostridium botulinum</i>	+++	High (spores)
<i>Escherichia coli</i> , pathogenic	+++	Low
<i>Listeria monocytogenes</i>	+++	Moderate
<i>Pseudomonas aeruginosa</i>	+	Moderate
Non-tuberculosis mycobacteria	+	High
<i>Salmonella enterica</i> , all serovars	+++	Low
<i>Salmonella</i> , typhoid	+++	Low
<i>Shigella</i> spp.	+++	Low
<i>Vibrio cholerae</i>	+++	Low
<i>Vibrio parahaemolyticus</i>	+++	Low
<i>Vibrio vulnificus</i>	+++	Low
<i>Vibrio</i> , other species	+	Low
<i>Yersinia enterocolitica</i>	++	Low
Viruses		
Enteroviruses	+++	Moderate
Hepatitis A virus (HAV)	+++	Moderate
Hepatitis E virus (HEV)	+++	Moderate
Norovirus and Sapovirus	+++	Moderate
Rotavirus	+++	Moderate
Protozoans		
<i>Acanthamoeba</i> spp.	+	High
<i>Cryptosporidium parvum</i>	++	High
<i>Cyclospora cayetanensis</i>	++	High
<i>Entamoeba histolytica</i>	+++	High
<i>Giardia lamblia</i>	+++	High
<i>Toxoplasma gondii</i>	+++	High
Helminths		
<i>Anisakis</i> spp.	+++	N.R.
<i>Dracunculus medinensis</i>	+++	Moderate
<i>Schistosoma</i> spp.	+++	Moderate
<i>Diphyllbothrium latum</i>	++	N.R.

N.R. = Not relevant.

Note: The risk ranking in the table refers to the risk for consumers of fishery products and is based on the perceived frequency and consequence of disease: (+) low risk to consumers; (++) common cause of foodborne disease, but of variable importance for fishery products; and (+++) cause of disease by fishery products and of potentially high risk to consumers. The hazards listed are assumed to represent all regions globally and include those hazards relevant to all types of water, including fresh-, brackish- and seawater. The selection of hazards when evaluating risk should be based on local circumstances, particularly where the water is used.

⁷ Adapted from FAO and WHO. 2023. Safety and quality of water used in the production and processing of fish and fishery products: meeting report. Microbiological Risk Assessment Series, No. 41. Rome.

ANNEX IV OF THE *GUIDELINES FOR THE SAFE USE AND REUSE OF WATER IN FOOD PRODUCTION AND PROCESSING* (CXG 100-2023)

WATER FIT-FOR-PURPOSE ASSESSMENT, SAFETY MANAGEMENT, AND TECHNOLOGIES FOR RECOVERY AND TREATMENT OF WATER FOR REUSE

(For adoption at Step 5/8)

1. INTRODUCTION

1. The importance of a fit-for-purpose assessment on the use and reuse of water in view of appropriate water safety management has been illustrated in the General Section and the different sector specific annexes of these guidelines. This annex further provides recommendations for the fit-for-purpose assessment and water safety management that can be used across all sectors of food production and processing to ensure an efficient and microbiologically safe use and reuse of water.
2. The use of technologies for the treatment of water to make them fit for purpose and for the recovery of water for the purpose of reuse is becoming increasingly important along the food production and processing chain and, in case of reuse, to most effectively use often limited water resources.
3. The use of treated water and the reuse of reconditioned water should not jeopardize the safety of the food by direct or indirect contact.

2. PURPOSE AND SCOPE

4. This annex contains additional recommendations to the general section on:
 - the assessment that the water is microbiologically fit for purpose; and
 - the management of the water safety within a food hygiene system, based on fit-for-purpose assessment.
5. Also, this annex contains information or guidance on the technologies for the treatment of water as well as on the recovery and treatment of reuse water with recommendations for their safe application.
6. These recommendations apply across all sectors of food production and processing, albeit variably and as appropriate for each sector. They are intended for food business operators (FBOs) and competent authorities, as appropriate, to provide practical and applicable use and reuse of water by applying the principle of fit-for-purpose using a risk-based approach.

3. USE

7. This annex should be used in conjunction with the General Section of these guidelines, its sector specific annexes when applicable, and the following Codex Alimentarius guidance:
 - *General Principles of Food Hygiene* (CXC 1-1969),
 - *Principles and Guidelines for the Conduct of Microbiological Risk Management (MRM)* (CXG 63-2007),
 - *Principles and Guidelines for the Conduct of Microbiological Risk Assessment* (CXG 30-1999),
 - *Guidelines for the Validation of Food Safety Control Measures* (CXG 69 – 2008),
 - *Principles and Guidelines for the Establishment and Application of Microbiological Criteria Related to Foods* (CXG 21-1997),
 - *Guidelines on the Application of General Principles of Food Hygiene to the Control of Foodborne Parasites* (CXG 88-2016), and
 - *Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CXG 79-2012).

4. DEFINITIONS

Cleaning-in-place (CIP) systems: water-based cleaning and disinfecting systems used to clean and disinfect product flow pipes and equipment without disassembly.

Cleaning-out-of-place (COP) systems: mechanical-based, recirculating cleaning and disinfection systems used for partially or fully disassembled equipment and utensils to minimize or eliminate manual hand cleaning.

Indicator microorganisms: microorganisms used as an indicator of quality, process efficacy, or the hygienic status of food, water, or the environment, commonly used to suggest the occurrence of

conditions that potentially allow pathogen contamination or proliferation, a failure in process hygiene or in food processing. Examples of indicator microorganisms include mesophilic aerobic bacteria, coliforms, faecal coliforms, generic *E. coli* and Enterobacteriaceae.

Membrane bioreactor (MBR): A combination of a bioreactor and membrane filtration utilizing aerobic and anaerobic fermentation, ultra-filtration (UF) or micro-filtration (MF) delivering water ("permeate") from a potential reuse water source.

Membrane filtration: The use of polymeric or ceramic materials for a filtering system to remove debris, non-dissolved solids and microorganisms from water. Examples include micro, ultra, nano and reverse osmosis (RO) filtration.

Reverse osmosis water (RO water): water, including reuse water, generated by membrane filtration with membranes of 0.001-0.0001 μm (1.0-0.1 nm) pore size using high pressure to overcome osmotic resistance, forcing water through a membrane retaining materials (retentate) and recovering the water (permeate), removing most dissolved solids.

Reverse osmosis polisher water (ROP water) RO water that is further polished/purified by an additional RO process, or by filtration using other technologies that give improved (chemical and) microbiological quality.

Water reuse scenario: the combination of reusable water source and reuse water application, including specifics such as recovery, reconditioning, storage and distribution (logistics and technologies).

5. WATER FIT-FOR-PURPOSE ASSESSMENT

8. See Section 7 of the General Section of these guidelines.
9. A water fit-for purpose assessment should consist of the identification of known and/or potential microbiological hazards that have capacity to compromise water safety should be conducted at each step and throughout the recovery, reconditioning and application of reuse water. The factors that should be considered when applicable are:
 - the microbiological hazards present in the water sources which are introduced into or recycled in the water system,
 - hazards associated with other parts of the operation (e.g. factory environment, storage and distribution system) that could contaminate either the source or a reuse water supply;
 - the nutrients that may be present in a reuse water supply after recovery and reconditioning, which may support the growth of biofilms, spoilage organisms (thereby limiting shelf-life) or pathogens;
 - where the water is used, e.g. for food contact or non-food contact;
 - the impact of physical and chemical substances on the effectiveness of controls (e.g. turbidity or concentration of organic or inorganic matter that may affect treatment efficiency);
 - the history of the water source: whether reuse water that has been recycled or recirculated multiple times in a specific process operation could lead to biofilm formation or significant increase of spore levels;
 - any particular measure for the prevention or control of microbiological growth during storage;
 - the availability of a back-up fit-for-purpose water supply can be used in case the reuse water treatment system is not effective or not functioning properly;
 - assessment of the current cleaning and disinfection procedure's impact in view of the recovery, reconditioning and application of the reused water.
10. In some cases, there may not be a need for an in-depth fit-for-purpose assessment if the source is confirmed to be safe for its intended purpose and periodically monitored, if needed, e.g.,:
 - potable water is used;
 - water collected from deep wells, from bodies of surface water with a documented history of safety, or seawater known to be free of the risk of coastal contamination, is used;
 - the reuse water will strictly be used for non-food-contact applications;
 - the reuse water is free from microbiological hazards, for example, through the use of validated disinfection treatments before, during or after recovery and reconditioning, in so far as the

effectiveness of such treatments is monitored, with a frequency appropriate to the use or treatment of the water;

- competent authorities have established criteria for the water to be reused to meet various fit-for-purpose requirements and the water meets these requirements.

11. Table 1 provides an overview of fit-for-purpose considerations for different applications of reuse water and types of water available. For-food-contact applications, the reliable utilization of a reusable water supply, including recovery and any reconditioning, needs to be validated and verified within the overall food safety plan of the processing operation.

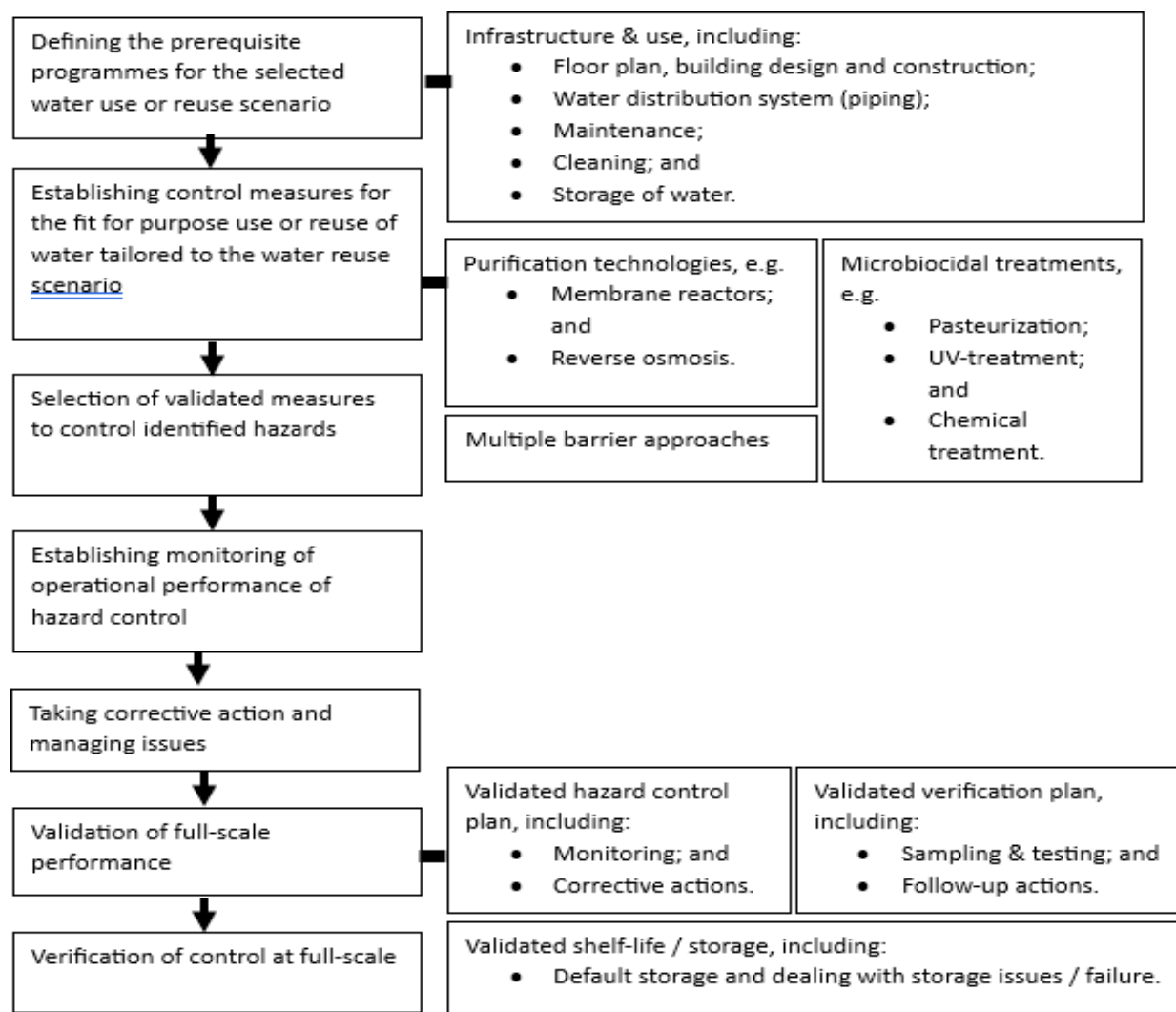
Table 1: Example of overview of fit-for-purpose considerations for different applications and types of reuse water

PURPOSES	RECIRCULATED WATER	RECLAIMED WATER	RECYCLED WATER
	e.g. Closed loop	e.g. Recovered from food (for example milk)	e.g. Recovered from a processing step
Food ingredient	Not fit for purpose unless appropriate treatment is applied and the microbiological criteria of potable water are complied with	Not fit for purpose unless appropriate treatment is applied and the microbiological criteria of potable water are complied with	Not fit for purpose unless appropriate treatment is applied and the microbiological criteria of potable water are complied with
Direct food contact	Not fit for purpose unless appropriate treatment is applied	Fit for purpose if no significant microbiological hazards present, either as recovered, or after reconditioning	Fit for purpose if no significant microbiological hazards present, either as recovered or after reconditioning
Indirect food contact	Fit for purpose as recovered if no significant hazards are present or food contact is avoided		
Non-food contact	Fit for purpose as sourced		

6. WATER SAFETY MANAGEMENT

12. See Section 8 of the General Section of these guidelines.
13. Based on the outcome of the fit-for-purpose assessment of the water and associated risks, the use and reuse of water should be managed by measures to be implemented within a food hygiene system and supplemented by monitoring, record keeping and verification activities to ensure that the system is operating as expected.
14. Figure 1 provides an example flowchart and an overview of the aspects that the FBO mainly in processing facilities should consider when establishing control measures for a safe water use and reuse in a scenario that is specific to its operation and is validated.

Figure 1: Example of flowchart/steps for implementing measures in a water use and reuse scenario in a processing facility



6.1 Prerequisite programmes (PRPs)

15. It is essential that proper PRPs are in place. All PRPs should be clearly written and implemented with procedures and specifications that will minimize hazard entry, spread and increase. Mainly for reuse scenarios in processing facilities, PRPs should, where applicable, include in general:

- Measures to exclude contamination with animal or human sewage;
- Measures that ensure the maintenance of good hygienic conditions, such as the ability to conduct CIP, COP and/or manual cleaning to remove/reduce potential microbiological hazards;
- Provisions to have a potable, clean water or other fit-for-purpose water supply available at the point(s) of water use to serve as back-up;
- Measures to be taken when switching to the back-up system in the event of an issue with the primary system and prior to recommencing production (e.g. full washdown flush of the facility and water holding tanks to avoid contamination from residual water that is not fit for purpose);
- Proper construction and maintenance to ensure the reliability of equipment in terms of operational performance and hazard control, e.g. specified requirements for RO processes, UV treatment systems and heat treatment/pasteurization processes, as well as calibration of monitoring equipment;
- Measures to prevent/reduce the spread and/or increase of microbiological hazards, for instance, by eliminating dead-ends (piping lengths of twice the diameter of the piping or greater from the fluid flow point to the end of the pipe or valve) or pockets in recovery collection system and the water

distribution system; and,

- Measures to reduce the likelihood of cross-contamination and inadvertent reuse of water for direct or indirect food-contact applications, which can introduce potential hazards, e.g. by using identifiable pipelines, regular maintenance and inspection of the entire water distribution to detect leaks, cross-connections, backflow, and other malfunctions; frequent monitoring of the collection, storage, treatment system (filtration, chemical and UV light) and end-use or application points.

16. Floor plan, design and construction of manufacturing plants:

- Systems for water distribution recovery and recirculation for both sourcing water as well as reused and recirculated water should be superimposed on the plant floor plan, drawn to scale with pipelines, valves, hoses, tanks and silo sizes. If possible, flow rates within the water system should be identified either on the plans or via a separate schedule.
- Facility design should ensure pipes, pipelines, tanks and taps used for food contact purpose cannot be interchanged with or contaminated by similar equipment used for non-food-contact water.
- Tanks, piping for the storage, treatments, and distribution system for water in the plants and facilities, should be designed for CIP, as appropriate, and should be able to withstand heat or cold exposure as well as wide range of corrosion and pH values outside expected values, or conditions, as needed.
- As needed and when not circulating or recirculating, the water system should self-drain as self-draining systems minimize biofilm formation and contamination risk during downtime.

17. Water distribution system (piping):

- All waterline discharge points and water taps should be secured against the backflow from potential contaminants caused by submerged inlets, for example, in case of loss of pressure.
- Where there are multiple water types, all water pipelines should be clearly marked with a word or code identifying the type of water (source, potable, clean, recycled, untreated reused, treated reused, etc.) as well as the direction of flow. Clear separation and identification between systems for the storage and distribution of water intended for food contact application and other water should be ensured. Different colours or marks should be used for water of different quality and intended use.
- Piping, buffer tanks and storage tanks should be installed such that no inadvertent mixing of water of lower quality can take place via backflows, improper valving and leaks in the pipes. If water of different qualities is mixed intentionally or unintentionally, the mixed water should always be categorized as that of the lower quality water used in the mixing.
- Pipes and tanks should be made from materials fit for food use and hygienically designed, manufactured and installed (i.e. smooth surface, proper welding, etc.).
- Tubes, pipes, tanks, etc., used for food products may also be used for handling reused water. If this multiple use of the same pipes and tanks is done, it is recommended they be clearly labelled to indicate this.
- Dead ends should be avoided to minimize piping locations where water may become stagnant (e.g. taps).
- All necessary measures should be taken to reduce or ideally eliminate condensation from forming on the outside of pipes and other equipment and to reduce fluctuations in the temperature of water inside the system. This may include taking measures like insulating pipes where temperatures inside the pipes or equipment vary from the temperatures on the outside of pipes or other equipment.
- Pipelines that are no longer used should be removed and sealed so as not to have dead ends.
- Operators should maintain documented oversight of the entire water pathway from source to point of use, including measures such as backflow prevention, color-coded distribution lines, and preventive maintenance controls.

18. Maintenance:

- FBOs should conduct regular inspection and maintenance of the entire water system and associated components to check for and repair any leaks or damages (e.g. leaky gaskets, valve seats, cross-connections, corrosion) that may lead to entry of microorganisms, formation of biofilms

and contaminate the water supply.

- Ensure the effectiveness of the membranes, if used, to avoid microbiological hazards bypassing the membranes. The performance of the membranes should be monitored and documented to identify when replacement should occur based on the recommendations by the manufacturer or the results of monitoring and verification if there is premature wear compared to the recommendations of the manufacturer, to ensure their effectiveness.
- Special attention should be given to check the integrity of gaskets and seals for pipelines and valves connected to piping.
- Maintenance incidents and problems related to the water system should trigger timely corrective actions.
- Implement a change control program to ensure like-for-like replacement of key water-system components and to enhance effective maintenance auditing during root cause analysis of system failures.
- A preventative maintenance schedule that includes all components of the water use and reuse system(s) should be developed and implemented, supported by a system of records (e.g. work orders).
- Records documenting the history of scheduled and unscheduled maintenance should be used to conduct trend analysis to identify and improve the preventative maintenance frequencies as well as identifying the need to replace equipment requiring increasing levels of maintenance.

19. Cleaning and sanitation:

- Facilities for the recovery, treatment, storage and distribution of water (including pipe ends where the water flow leads to the product) should be cleaned thoroughly with an appropriate biocide to remove/reduce possible microbiological hazards and done at a frequency that reduces the potential for the build-up of biofilm.
- All equipment making up the facility's water system should be emptied and cleaned regularly based on risk assessment that incorporates past history and the results of monitoring and verification programs. These, as well as specific knowledge about the potential problem areas and shortcomings of the facility's water system e.g. stagnant water in pipes/the distribution system, are important indicators in establishing the frequency of such emptying and cleaning.
- Equipment used for manufacturing foods and cleaned using CIP, COP or manual cleaning and sanitizing should conform to applicable standards and regulations, industry best practices and manufacturer's specifications. The specifics (e.g. time and temperature, pressure, flowrate and chemical concentrations) of a CIP, COP or manual cleaning and sanitizing regime should take into account the risk of contamination either upstream or downstream of the water treatment and meet fit-for-purpose requirements. These can include microbiological, chemical and physical characteristics, quality of reclaimed water, extent and type of fouling, and the characteristics of the surface(s) to be cleaned.
- If an automated CIP or COP system is out of operation for more than a prescribed period of time, the system should be evaluated and cleaned appropriately prior to use, as determined by risk assessment. If not assessed, a full and complete cleaning is recommended.
- All pipe and tank parts including gaskets and seals should be able to withstand cleaning and disinfection procedures in place, such as temperatures and chemicals without compromising their integrity. The time and temperatures should be fit for purpose, based on manufacturer's recommendations.

20. Storage of water:

- Water intended for food contact application can normally be stored without temperature control for a limited period (e.g. up to two days at 15-20 °C in temperate and subtropical conditions). However, the temperature and time will depend on external climatic factors and the level of nutrients in the water that can support microbiological growth. If storing water without temperature control, physical and chemical parameters such as turbidity, total solids, suspended solids, chemical oxygen demand (COD), biological oxygen demand (BOD), total organic carbon (TOC) and pH should be measured and determined to be within specified limits depending on the situation.
- Storage time of water can be extended if it is refrigerated (e.g. < 7 °C, measured where the water is warmest) or hot (e.g. minimum 70 °C, measured where the water is coldest). Storage of water at

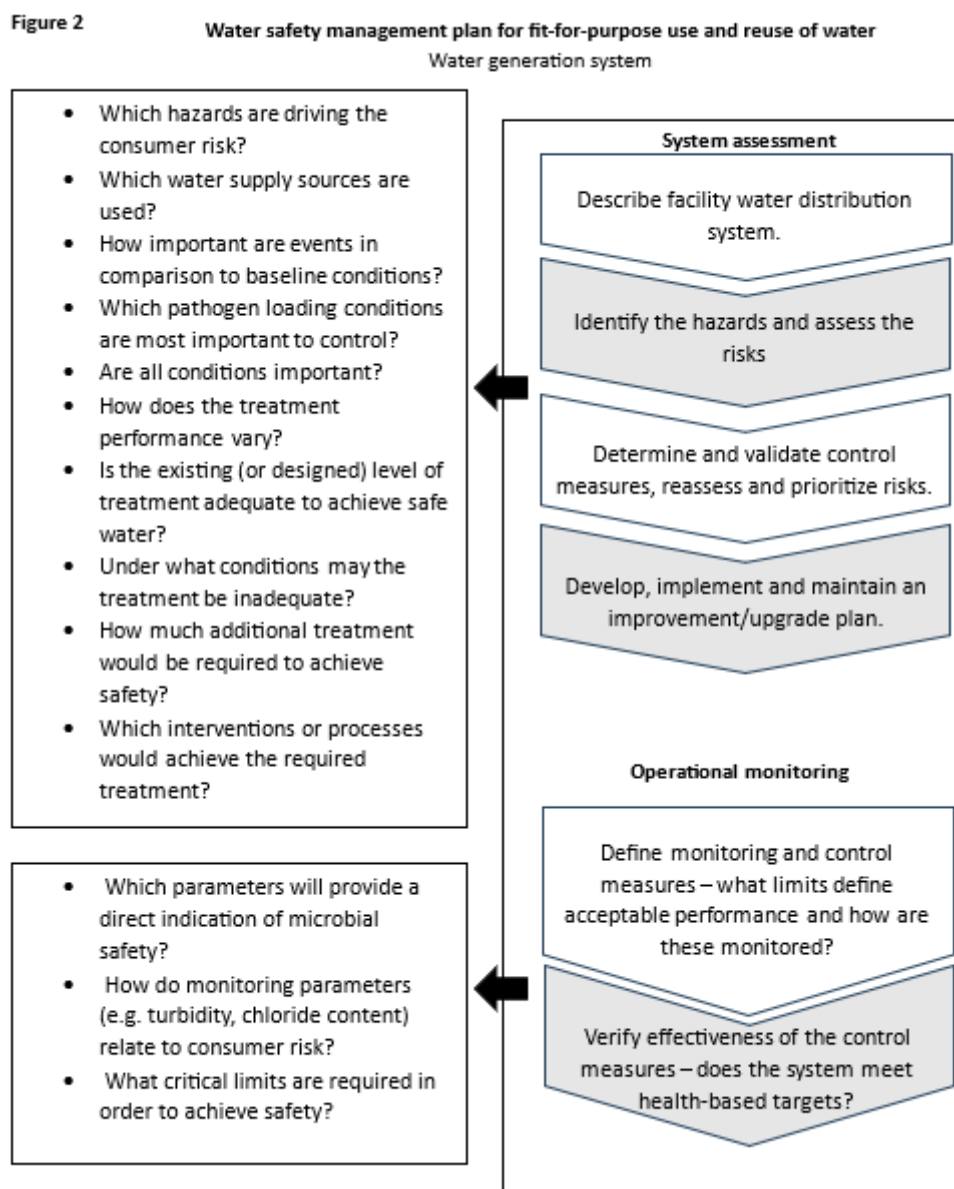
other temperatures can be acceptable based on a risk assessment which may require an ongoing microbiocidal treatment, e.g. by continuous recirculation through an UV treatment system, ozonation, chlorination or by a heat or chemical treatment with an established and monitored frequency.

- Stored water should be stirred to ensure the maintenance of consistent storage temperature, e.g. hot or cold, throughout the tank.
- The maximum storage time of any water should be established and validated based on monitoring and testing the water with regard to key criteria (such as total bacteria count, coliform, *Escherichia coli*, *Enterobacteriaceae* or *Pseudomonas* counts, turbidity, total solids, suspended solids, TOC, BOD, COD and pH, as well as organoleptic indicators (odour and appearance).
- Where appropriate, tanks used to store water should have a lid/be securely covered. Inlets, outlets and overflows should be screened or covered with suitable guards.

6.2 Development of a water safety management plan

21. A water safety management plan for the fit-for-purpose use or reuse of water should be developed based on a water fit-for-purpose assessment. It may comprise prerequisite programmes alone or a full HACCP based programme and be included in the food safety management plan as appropriate.
22. After consideration of the conditions and activities in the business, it may be determined that prerequisite programmes alone may be sufficient to manage the hazards. However, where significant hazards are identified that need to be controlled after the implementation of prerequisite programmes, it will be necessary to develop and implement a HACCP system.
23. A full HACCP-based water safety management plan for the fit-for-purpose use or reuse of water should be developed based on an in-depth water fit-for-purpose assessment utilizing a hazard analysis to ensure the safe use and reuse of water within plants. The control measures in the water safety management plan should consider the equipment, source water characteristics, possible one-off events affecting the source of reuse water, intended use of the source water, collection and storage of the used water and the available treatment technologies and any other relevant aspects.
24. A flow diagram should specify the key process steps where water is introduced into the processing system, the food and steps where used water is removed from the food processing line, collected and stored as the basis for the hazard analysis.
25. All water uses should be included in the water safety management plan. If the water is intended for food contact (direct and indirect), the results of the hazard analysis of all potential hazards should be included as input to the hazard analysis for the food products that will be impacted.
26. Figure 2 provides an example of input from an assessment to develop control measures for the fit-for-purpose use or reuse of water.

Figure 2: Examples of potential fit-for-purpose assessment questions that provide insights and inputs into the development of a water safety management plan for the safe use or reuse of water



27. The control measures described in the water safety management plan should be integrated into the food safety/ Hazard Analysis and Critical Control Point (HACCP) plan.
28. Possible operational management approaches for a food operation should consider the use of water and plans to implement a water reuse system. A water safety management plan is typically managed through control measures identified through a risk-based hazard analysis. A food processing system is typically managed using control measures also established through a risk-based hazard analysis to ensure the food hygiene system (i.e. Good Agricultural Practices, Good Manufacturing Practices, Good Hygiene Practices (GHPs), HACCP) is adequate. Both follow essentially similar development and implementation steps.
29. When water is required only for non-food contact purposes, control measures can be used to manage the water system independently of the food hygiene system in place, provided cross-contamination of hazards in the water with food materials or food contact surfaces is not possible and they do not pose a food safety risk through the food processing equipment or food product to consumers.
30. When water is used as an ingredient or will be in direct contact with food processing equipment surfaces, management of the source water may best be integrated within the full risk-based food hygiene system. In this case, the food hygiene system needs to include hazard control throughout the water system and needs to include procedures to monitor and verify the suitability of the water for its intended use (fit for purpose). This is applicable also to water not intended for food contact purposes when risk of its coming

in contact with food through cross-contamination is identified.

31. A risk/hazard matrix such as Table 1 of Annex III of the General Principles of Food Hygiene (CXC 1-1969) or the Table 2 below can be used as the basis for the risk-based hazard analysis. The purpose of this is to identify the potential hazards, their likelihood of occurrence and severity of associated adverse health effects (risk characteristics) for each processing steps, ingredients and intended water use to better enable the identification of appropriate control measures (i.e., standard operational procedures, PRPs or critical control points (CCPs)). Specific examples can be found in the case studies in MRA40 (examples referred to below).

Table 2: Example of risk-based hazard analysis worksheet

Processing Step, Ingredient or Water Source & Intended Use	Hazard	Risk matrix			Justification for Risk Matrix decisions	Control Measures.
		Likelihood/frequency of hazard occurrence	Severity if hazard occurs	Significance based on Likelihood and Severity		
Reuse water use for CIP processing equipment	• Microbiological • Chemical¹ residue • Physical¹ (metal, glass, wood, debris, etc.)	• Seldom • Occasionally • Frequent • Almost certain/always	Death Severe illness Minor illness Product Recall	Extreme Major Moderate Minor		UV-treatment, filtration, chemical treatment, limitation of reuse cycles, etc.

¹ Out of the scope of this guidance but to be included in the hazard analysis.

6.3 Selection of measures to control identified hazards

32. Based on the identification of the hazards to be controlled, appropriate control measures should be selected. The need for possible CCPs based on the HACCP principles should be considered for hazards not controlled by prerequisite programmes only, e.g. at the reconditioning of the water when the proper performance of the reconditioning control measure (such as temperature and time) is essential for acceptable hazard control.
33. When selecting appropriate control measures, the following factors, among others, should be taken into consideration:
- The quality and safety of the incoming source water;
 - In-plant treatment of incoming source water and target safety and quality criteria;
 - The “first” use of the incoming water;
 - The age, characteristics and maintenance history of the facility’s fit-for-purpose and reuse water systems;
 - The need for treatment and the quality of the fit-for-purpose water;
 - The microbiological profile of the water;
 - The presence of nutrients for microorganisms in the water;
 - The use of disinfectant chemicals (e.g. chlorine) in the water;
 - The risk and significance of the hazard such as:
 - Changes in the risk levels of relevant hazards at each step in the water supply system;
 - The magnitude and frequency of such changes up to the application of the water;
 - The impact of consumer exposure to the incoming or reused water;
 - The effectiveness of individual or combined controls (in multi-barrier approaches) in reducing or eliminating the targeted microorganisms (could include spores, vegetative cells, and different pathogens) in the water to be used or reused.
34. Control measures are typically applied where the risk of a hazard can be eliminated or reduced and could include implemented and effective GHPs, PRPs and CCPs within a HACCP system. For example,

purification or microbiocidal treatment at reconditioning might be appropriate control measures at CCP when essential for the control of hazards. When water is fit for purpose without reconditioning, it is likely that no CCPs are necessary to ensure the microbiological safety of the fit-for-purpose water. However, it may be necessary to assess and control hazards pertaining to storage (e.g. time and temperature factors during holding) when storage is required prior to use and there still may be a need to have controls in place to ensure that lower-risk hazards are controlled, minimized or eliminated.

35. To improve the microbiological quality of water, microbiocidal treatment such as heating, chlorination, ozonation, membrane filtration or UV treatment can be used.

6.4 Monitoring

36. The parameters of a water safety management plan that address the reconditioning processes such as TOC, COD, BOD, turbidity, pH or conductivity, based on the nature of the process should be monitored, with verification by microbiological or physicochemical testing at a determined frequency.
37. The frequency of monitoring should consider the water's fit for purpose use, required level of microbiological control for the water's intended use (e.g., is the reused water used for food contact application or not), and the identified level of risk to the product and the consumer in case of a deviation.
38. Monitoring data across subsequent batches of source and reused water should be plotted for trending purposes to help benchmark information for building confidence in the water safety management plan and control measures used to ensure the safety of the incoming or reused water. When the water safety management plan is consistently performing well, this trending of monitoring data can provide signals when operation or control measures may be heading towards a compromise or complete loss of safety (failure), or when a loss-of-control situation may develop. Trend analysis is a powerful operational management tool advocated to improve the effectiveness of control measures.

6.5 Corrective actions

39. In the event of a loss of control (i.e., in case of failure of the overall manufacturing system or the control measures during water supply, recovery or use, resulting in a potentially unsafe water), several actions described below should be considered to ensure that the affected and future water supply do not impact the safety of food products:
 - Immediately, and in parallel with the initiation of investigation into the water system failure and its effects, assess the risk of affected product that 'potentially unsafe' water came into contact with;
 - Gather as many observations, facts and findings as possible regarding the specific loss of control, e.g. who, what, when, where, how, how many, etc.;
 - Use the accumulated information to identify the problem in writing by conducting a root cause analysis to determine the fundamental cause(s) of the loss of control; identify changes that will restore control; establish corrective measures to prevent recurrence; and amend the control measures or other aspects of the water system or the food safety management system, as appropriate;
 - Isolate water that does not meet the required safety and quality performance criteria until root-cause has been identified and corrected. Consider reconditioning or discarding;
 - Re-evaluate the risk-based hazard analysis and make the necessary changes in the monitoring, verification, record-keeping and corrective actions, based on the outcome from the prior steps; invest in physical improvements to the water system (including treatment) to eliminate or reduce weak "links" where contamination has happened in the past or is suspected of happening in the future;
 - If the loss of water safety controls is associated with the incoming water supply, stop using this supply until the root cause of the loss of control can be determined and addressed in a permanent manner;
 - Switch the use of water to a lower-level fit-for-use criteria, i.e. from for food-contact application to non-food-contact application as appropriate;
 - Consider an increase in monitoring frequency until confidence in the control measure has been regained with the understanding that monitoring frequency alone is not likely to be able to demonstrate with a high level of confidence that the water supply safety and quality are under control again.

6.6 Validation

40. Validation of control measures used in the water system should be carried out in accordance with the *Guidelines for the validation of food safety control measures* (CXG 69-2008).
41. Specific validation strategies and documentation are highly dependent on the intended fit-for purpose use and plant-specific treatments and storage conditions. Consideration should be given to validating water storage time, i.e., how long the water may be stored prior to use or how many times can it be reused while still suitable for its fit-for-purpose application before a full sanitation of that operation is implemented. Validation will need to be re-done if any significant water conditions or treatments change.

6.7 Verification and testing

42. Verification of the water safety management plan should be carried out by:
 - Reviewing and evaluating monitoring data and corrective actions;
 - Conducting an internal audit on the water safety management system;
 - Conducting sampling and testing;
 - Calibrating monitoring instruments.
43. Routine testing of water for pathogens is not recommended, because the level of pathogens in water, if present, are likely to be low making detection by reasonable sampling plans improbable. It is more practical to test for suitable indicator microorganisms to verify that process controls are effective and to identify potential out-of-control situations. Suitable indicator microorganisms generally occur in water at levels that allow quantification. Notwithstanding, enhanced sampling and testing for pathogens may be warranted for validation of reconditioning processes or during an event where a loss of control may have resulted in water becoming contaminated with pathogens. Such water should not be used for food related activities and all equipment and utensils that were in contact with such water, re-cleaned and re-sanitized after the root cause of the pathogen presence has been identified and corrected.
44. Microbiological testing for indicator microorganisms such as total viable bacterial count, coliforms, Enterobacteriaceae and/or Pseudomonas counts in water, have proven to be useful and preventative in many circumstances. However, the microbiota relevant for verification of water often is plant or operation specific. It is, therefore, recommended to conduct an operation-specific study to determine which indicator organisms may be appropriate for use in evaluating water safety and quality.
45. The FBO should determine and document the acceptable microbiological limits in the water to be used as reference for verifying operational control. A maximum limit should be established for each relevant hazard or indicator organism applicable to the fit-for-purpose intent of water supply system for its intended purpose at each stage of the process.
46. Examples of microorganisms and their limits that can be considered for the monitoring of certain reuse water can be found in Section 6.3 of the FAO/WHO meeting report "Safety and quality of water use and reuse in the production and processing of dairy products" (MRA40)⁸. These are examples only and other criteria could be applicable.

7. TECHNOLOGIES

47. Several technologies have been developed to treat water at source or at recovery from production or processing for reuse. Reconditioning may use treatments or a combination of treatments such as membrane filtration, UV-treatment, or other microbiocidal treatments (e.g. chlorination or ozonation). Technologies are constantly evolving and improving and therefore this annex is not exhaustive. Other technologies, such as ultrasonication⁹ or bactofugation¹⁰ may also be an option. Such reconditioning treatment should be validated considering the source of reuse water and the final intended use of the water, to ensure fitness for purpose. Key parameters of the treatments should be monitored and verified to ensure efficacy. Biocides used for reconditioning treatments may be subject to approval by the competent authority. Information provided in Sections 7.1 – 7.3 are primarily for reuse water.

⁸ FAO and WHO. 2023. Safety and quality of water use and reuse in the production and processing of dairy products: meeting report. Microbiological Risk Assessment Series, No. 40. Rome.

⁹ The application of intense ultrasound waves into liquids

¹⁰ Process of removal of microorganisms from a liquid using centrifugal force

48. When applying one or several (multiple barrier approach) of these technologies, the following should be documented:
- determination of microbiological¹¹ characteristics of the water and possible microbiological hazards, taking into account, when applicable, pre- and post-treatment;
 - sources of water intended for reuse;
 - method of capture, storage and treatment of water intended for reuse;
 - acceptable end-use applications (fit-for-purpose) and microbiological criteria of the water intended for reuse;
 - validation, monitoring and verification of the water reuse systems; and
 - procedures to be followed if the water reuse system fails.

7.1 Recovery by sedimentation, coagulation, filtration, flotation and/or centrifugation⁵

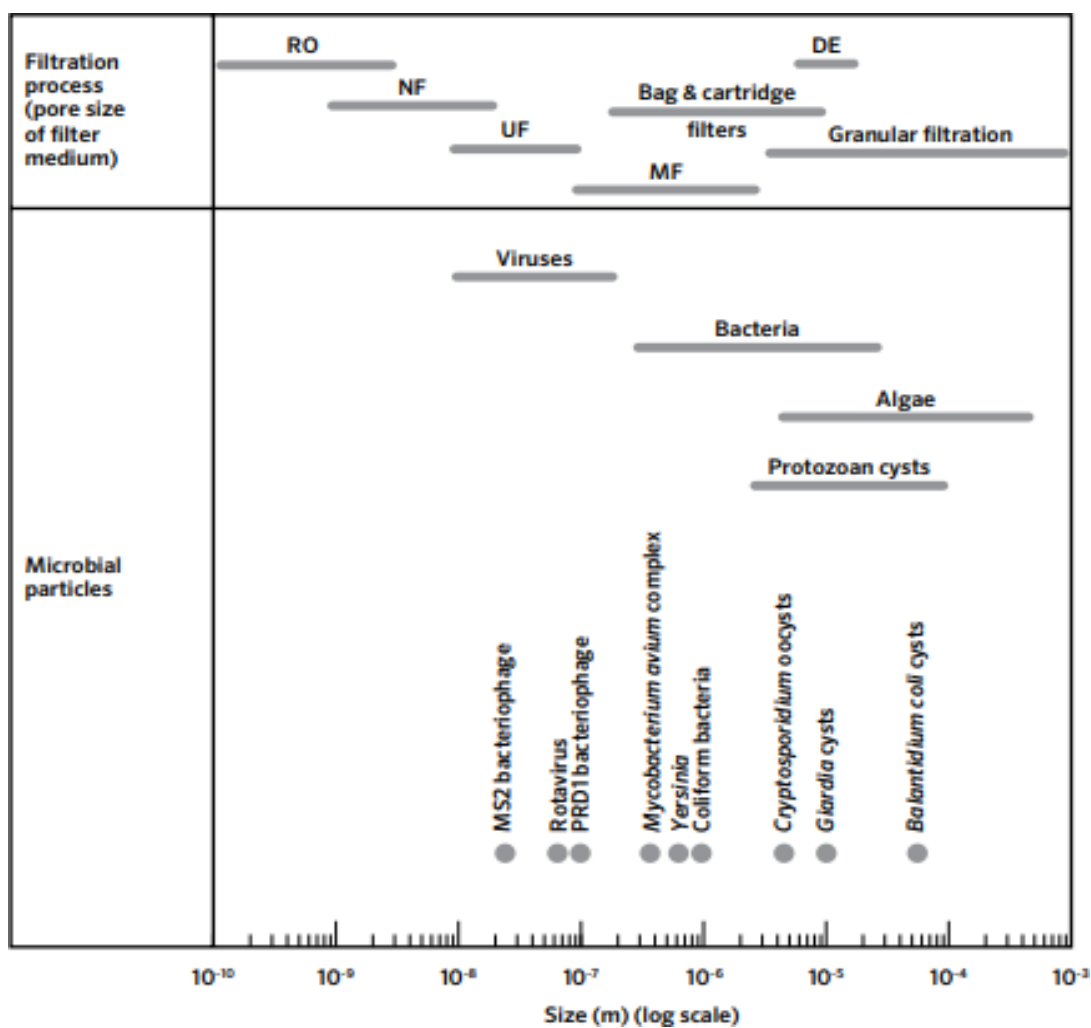
49. These technologies may be applied, alone or in combination, to effluents (e.g. of dairy manufacturing). Examples are sedimentation, coagulation-sedimentation, high-rate sand filtration, activated carbon filtration and dissolved air flotation to remove organic matters. They should be considered as preliminary treatments since they will not remove all contaminants, including pathogens if present. These technologies should be followed by treatment procedures for recovered water from any source to reduce or eliminate the presence of pathogens to meet fit-for-purpose requirements.

7.2 Purification technologies

50. Several membrane purification methods can be applied to water used or reused in food manufacturing plants such as reverse osmosis (RO), nanofiltration (NF), ultrafiltration (UF) and microfiltration (MF) in addition to other types of filtration systems. Their differences in performance for water purification are illustrated in Figure 3.

¹¹ Chemical and physical characteristics and hazards are out of the scope of this guidance but relevant to be considered

Figure 3: Average pore size for different filtration systems: RO, NF, UF, MF, bag & cartridge filters, diatomaceous earth (DE), granular filtration and the size of different particles of microorganisms



51. RO is a membrane filtration technology, widely used in food manufacturing plants. The main purpose of RO is to remove dissolved and undissolved materials from water, but secondarily it also reduces levels of bacteria and viruses. The integrity of the membrane should be monitored at a regular frequency as small leaks or microscopic holes in the membrane may negate the antimicrobial barrier. Depending on the filtration system and pore size used, certain dissolved components may be removed.
52. RO can be supplemented with other approaches/barriers for further purification referred to as “ROP”. This can consist of a secondary treatment, e.g. RO, deionization, use of activated carbon, etc. ROP water’s shelf life can be extended with the use of microbiocidal treatments (such as UV) and/or using chilled or hot temperature storage, when validated and verified.
53. Other membrane filtration technologies (MF, UF and NF) are typically used before RO to reduce fouling of the RO membrane (build-up of organic matter and undissolved materials) and to enhance maintenance of constant flux/flow through the RO membrane. These filtration technologies by themselves may not remove all microorganisms (including pathogens) that may be present in the water and further treatment may be required for fit-for-purpose water applications.
54. Membrane bioreactor (MBR) (aerobic or anaerobic digestion) can be used for the pretreatment of wastewater. The water from the MBR may be further reconditioned by RO or other treatments to reduce minerals, organic material, and bacterial “load” to achieve acceptable fit-for purpose water safety and quality criteria. Many portable aerobic or anaerobic digester technologies are available for bulk reconditioning of wastewaters.
55. Membrane systems should be operated as per manufacturer’s specifications to optimize membrane efficiency, control microbiological growth and avoid damage. All membranes require periodic cleaning and backflushing, and may also require periodic replacement, to prevent fouling or various mineral (e.g. calcium) deposits (scaling). The frequency of backflushing is dependent on the material make-up and construction of the membrane, as well as the feed material and pressure differences. Some membrane systems/configurations do not allow backflushing.

7.3 Microbiocidal treatments

56. Chlorine, chlorine dioxide, ozone, hydrogen peroxide and peracetic acid are examples of chemical products used for the microbiocidal treatment of water in food manufacturing plants. They should be used in accordance with the label instructions and may be subject to competent authorities’ requirements. The following considerations should be made:
 - Reuse water from food processing operations is known to contain microorganisms that can form biofilms on food contact surfaces which may or may not contain pathogenic bacteria, including pathogenic strains of *E. coli*. It is therefore important that reuse water has an appropriate disinfection treatment that meets the microbiological fit-for-purpose criteria at the point of use within the water distribution system that is furthest from the treatment.
 - The choice of disinfection treatment should also consider whether a residual disinfectant will persist throughout the maximum storage time of the reuse water, and, if not, then an additional treatment may be needed.
 - The optimal choice of disinfectant will vary based on the specifics of each food manufacturing facility, the food being processed, the intended fit-for-purpose use of the water, the method of recovering water for reuse, the characteristics of the source and reused water, such as the level of organic loading which can quickly deplete the efficacy of the disinfectant. Consideration should be given to evaluation on a trial basis in a laboratory or pilot setting, to determine organic loading and optimal concentrations of disinfectant(s). Resistance among microorganisms to disinfectants may develop but can be prevented by changing disinfectants periodically or combining with UV treatment.
 - Chlorine disinfection is generally a reliable, inexpensive and effective approach against a wide spectrum of pathogenic microorganisms. However, if ammonia or organics remain in reuse water and these are exposed to chlorine, in any form, they may produce chloramines, chlorates, perchlorates and trihalomethanes, which may result in chemical risks. When water containing bromide ions and residual chlorine is irradiated with ultraviolet light, the formation of bromate may be promoted. If UV treatment facilities are installed after chlorine injection, it may be necessary to pay attention to bromide ions in the water to be treated. Chloramine, while significantly less effective at inactivating pathogens, especially viruses, reacts slower compared to free chlorine, and has the advantage of being effective for a longer period.

- The FBO should be aware of the suitability and the effectiveness of the disinfectants chosen, including the risk of residual disinfectants, potential by-products, and compatibility with equipment and other relevant surfaces (e.g. potential for corrosion, pitting, etc.).
 - The use of disinfectant chemicals should be well-controlled with records providing full documentation of use; for example, the level (e.g. chlorine) should be used at recommended concentrations as per label instructions for the applicable use; the level should be monitored at a frequency to ensure effectiveness against microbiological contamination.
57. Heat treatment, such as pasteurization, sterilization or boiling, can be used to render reuse water microbiologically fit for purpose. It can be used in a multibarrier approach, e.g., after RO treatment to inactivate any remaining pathogens and microorganisms in order to render the water fit-for-purpose. Considerations to take into account are:
- Treatment parameters should be validated to eliminate the risk of pathogens and spoilage organisms;
 - The heat treatment temperature and flowrate or time spent at designated heating temperatures should be measured continuously and recorded automatically by a calibrated thermometer and timing device or similar automated and calibrated temperature recorders; proper holding time, being a critical component in a heat treatment process. This applies to both continuous-flow and batch-type pasteurizers.
 - For continuous flow pasteurization or sterilization systems using a holding tube, the holding time is determined according to the length of the holding cell/tube and the flow rate (max L/s) of the pump, which should be set so that at least the minimum desired holding time is achieved at all times;
 - A flow diversion valve should be in place so that, if the minimum required temperature is not achieved, it will redirect the reuse water flow for reconditioning back to the balance tank. The flow diversion valve should be tested at a frequency recommended by the manufacturer to ensure it is functioning properly;
 - When using thin-walled plate heat exchangers for continuous pasteurization systems, continuous monitoring for under or over pressure on the heat-treated side is strongly recommended to ensure any potential leakage of water or other fluid moving from the unheated side to the heated side of the thin-walled plates via worn or misaligned gaskets or micro-fractures in the thin-walled plate(s). This is an important failsafe measure.
58. UV treatment of reuse water can be used to reduce some populations of bacteria, viruses, moulds, yeast and protozoa, if the effective UV wavelength and dose are applied. Continuous monitoring (including alerts), regular maintenance, cleaning and correct calibration of the treatment parameters are essential to maintain the microbiocidal effect. Further treatments may be required downstream. Critical factors to consider are:
- The optimum UV light wavelength for anti-microbial effect is 254 nanometers, recognizing the optimum wavelength for anti-microbial effect needs to be validated depending on the pathogen. The dose (mJ/cm^2) is determined by required log reduction of a target organism. A dose of $40 \text{ mJ}/\text{cm}^2$ or equivalent is typical for control of most bacteria.
 - Transmission of UV light, i.e. the level of turbidity or color in the water; even if there is a slight turbidity/cloudiness or color in the water, the use of UV light may be ineffective as a microbiocidal treatment;
 - Preventative maintenance of the UV treatment system, such as measuring the existing UV wavelength and overall performance of the UV lamp, including its age, and wear of protective sleeves that may prevent light from reaching some pathogens;
 - The fastest operational flow past the UV light source; the flow should be turbulent in most cases; note that flow that is too high or too low can cause uneven dose distribution of the UV light and leave some water without adequate disinfection;
 - Geometric configuration of the disinfection chamber; longer exposure time and reducing the distance between the UV light source and the point in the chamber farthest away from the UV light source provides more confidence in the effectiveness of the UV photon/microbe interaction and inactivation.

59. UV treatment systems must be set up to be adequately cleaned without significant infrastructure disassembly (i.e. cleaned, using a validated CIP approach), with cleaning and its frequency done in accordance with the manufacturer's recommendations, often enough to ensure that the system always delivers the specified UV dose. If CIP is used, it should have the capability of removing fat, protein and mineral coatings (e.g. calcium) from the UV light-emitting equipment.

APPENDIX IV

**AMENDMENTS TO THE GUIDELINES FOR THE SAFE USE AND REUSE OF WATER IN FOOD
PRODUCTION AND PROCESSING (CXG 100-2023)**

(For adoption)

1. INTRODUCTION

...

Associated annexes provide product-specific guidelines for the sourcing, collection, storage, treatment, handling, distribution, use and reuse of water in both direct and indirect contact with food throughout the food chain. The annexes also provide examples such as decision tree tools (DTTs) that can help to determine if water is fit-for-purpose.

More detailed recommendations on the water-fit-for-purpose assessment can be found in Section 5 of Annex IV. More detailed recommendations on the water safety management can be found in Section 6 of Annex IV. Information and guidance on the use of technologies that can contribute to this management can be found in Section 7 of Annex IV.

Annex I

FRESH PRODUCE

7. WATER FIT-FOR-PURPOSE ASSESSMENT

Refer to Section 7 of the General Section and Section 5 of Annex IV of these guidelines.

The development of a risk-based strategy for water sourcing, use and reuse should take into account:

- identification of water-related microbiological hazards and source of those hazards, relevant for the area of production;
- sources of water available;
- the description of the water supply system (e.g. delivery and storage system);
- uses of water considered such as irrigation, washing (fresh produce, containers and surfaces), storage on ice, etc.;
- type of irrigation, in particular, if the water is in direct contact with the produce;
- type of crop (e.g. leafy greens versus fruit trees);
- physiological characteristics of the fresh produce (such as the peel and whether the produce would be subject to infiltration of water in the produce);
- water treatment and water disinfection techniques available such as heating, microfiltration and treatment with chlorine, chlorine dioxide, chloramine, ozone, UV-C. **Refer to Section 7 of Annex IV.**
- application after use of water (e.g. irrigation cessation, washing, peeling);
- consumers' habits such as eating raw, cooking, fermenting, etc.; and
- labelling with instructions for the intended use of the food.

8. RISK MITIGATION/RISK MANAGEMENT STRATEGIES

Refer to Section 8 of the General Section and Section 6 of Annex IV of these guidelines.

8.1 Indicator organism for monitoring hazards in water used in fresh produce production

Indicator organisms should be used as indicators of faecal contamination rather than presence or concentration level of any specific pathogen. The major indicator organisms are *E. coli* and enterococci.

Such faecal indicators can be used as process indicators or to validate the efficacy of water treatments if they respond to treatment processes in a similar manner to pathogens of concern.

It should be taken into account that, in general, faecal indicators reasonably predict the probable presence of faecal pathogens in water, but they cannot precisely predict the concentrations present, with the possible exception of heavily polluted waters. The correlation becomes erratic and biologically improbable as dilution occurs.

Bacteriophages are better indicators of enteric viruses than bacterial faecal indicators, although they cannot be absolutely relied upon as indicators for enteric viruses. A combination of two or more bacteriophages can be considered. Bacteriophages can be used as good process indicators to determine the efficacy of water treatments against enteric viruses.

Protozoa and helminths cysts/eggs survive more easily than bacteria and viruses and there is no suitable indicator of their presence/absence in irrigation water. Specific tests should be performed if the presence of these parasites is suspected.

Annex III

MILK AND MILK PRODUCTS

7. TECHNOLOGIES FOR RECOVERY AND TREATMENT OF WATER

7.1 General recommendations

Membrane filtration, and other technologies of hygienic design, may be applied to reclaimed, recycled or recirculated water (other than potable water) in order to make the water fit-for-purpose. Refer to **Section 7 of Annex IV.**ⁱ

8. WATER FIT-FOR-PURPOSE ASSESSMENT

Refer to Section 7 of the general section and **Section 5 of Annex IV**ⁱⁱ of these guidelines.

9. WATER SAFETY MANAGEMENT

Refer to Section 8 of the general section and **Section 6 of Annex IV**ⁱⁱⁱ of these guidelines.

ⁱ~~Under development.~~

ⁱⁱ~~Under development.~~

ⁱⁱⁱ~~Under development.~~

APPENDIX V

**AMENDMENTS TO CXG 85-2014, CXG 86-2015¹, AND CXG 88-2016
FOR ALIGNMENT WITH CXC 1-1969****(For adoption)****Part A: Amendments to the *Guidelines for the control of Taenia saginata in meat of domestic cattle* (CXG 85-2014)****1. INTRODUCTION**

Bovine cysticercosis refers to the infection of the striated muscle of cattle with the metacestode (e.g. cysticerci) of *Taenia saginata*, traditionally referred to as “*Cysticercus bovis*”. Humans acquire the infection (taeniasis or beef tapeworm infection) solely from consumption of raw or undercooked beef containing live cysticerci. Taeniasis in human populations varies worldwide with a high prevalence in some countries. Very few countries are free from *T. saginata*. Bovine cysticercosis is not a condition notifiable to the OIE and is regulated in some countries.

The public health significance of *T. saginata* is limited due to the mostly benign clinical symptoms (or asymptomatic forms illustrated in the global ranking of foodborne parasites using a multicriteria ranking tool for scoring parasites based on public health criteria only during the FAO/WHO expert meeting on Foodborne Parasites – Multicriteria based ranking for risk management². However, the economic importance is high for several reasons:

- Resources involved in routine meat inspection
- Downgrading and condemnation of affected carcasses (or routine treatment to inactivate cysticerci such as freezing or cooking)
- Intensified livestock controls at farm level when affected herds are identified.

As governments review their meat hygiene systems, non-risk based control measures for meat and meat products in trade can be disproportionate to the level of risk reduction achieved.

Where the parasite is common in domestic cattle, mitigation of risks to consumers is hampered by the low sensitivity of routine post mortem meat inspection.

These Guidelines incorporate elements of a risk management framework (RMF) approach as developed by the Codex Committee on Food Hygiene for managing microbiological hazards (*Principles and guidelines for the conduct of microbiological risk management* (CXG 63-2007)) i.e.:

- Preliminary risk management activities
- Identification and selection of risk management options
- Implementation of control measures
- Monitoring and review.

2. OBJECTIVES

The primary objective of these Guidelines is to provide guidance to governments and industry on risk-based measures for the control of *T. saginata* in meat of domestic cattle.

These Guidelines also provide a consistent and transparent technical basis for reviewing national or regional control measures based on epidemiological information and risk analysis. These Guidelines should be taken into

¹ Including those amendments agreed under agenda item 2, to update references to WOA and align with the revised WOA definition of compartment.

² FAO and WHO. 2014. *Multicriteria-based ranking for risk management of food-borne parasites*. Microbiological Risk Assessment Series No. 23. See Annex 5, Figure A5.2.

account in the judgement of equivalence by importing countries where such measures differ from their own, thereby facilitating international trade³.

3. SCOPE

These Guidelines, used in conjunction with *FAO/WHO/OIE Guidelines for the Surveillance, Prevention and Control of Taeniasis/Cysticercosis*⁴ ("FAO/WHO/OIE Guidelines Taeniasis") address the control of cysticercosis in the meat of domestic cattle that may cause human taeniasis. They are based on the *Code of hygienic practice for meat* (CXC 58-2005) that provides generic advice on a risk-based approach to meat hygiene.

These Guidelines, used in conjunction with the *FAO/WHO/OIE Guidelines Taeniasis*, apply to all steps in a "primary production-to-consumption" food chain continuum.

4. USE

These Guidelines provide specific guidance for control of cysticercosis in meat according to a risk-based approach to selection of post-harvest control measures as risk management options. The Guidelines are supplementary to and should be used in conjunction with the *General principles of food hygiene* (CXC 1-1969), the *Code of hygienic practice for meat* (CXC 58-2005) and the *FAO/WHO/OIE Guidelines on Taeniasis*.

The diagnostic techniques referred to in the Guidelines are those of the *OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animal*.

Provision of flexibility in application of the Guidelines is an important attribute. They are primarily intended for use by government risk managers and industry in the design and implementation of food control systems. The Guidelines could also be used when judging the equivalence of different control measures for beef meat in different countries.

5. GENERAL PRINCIPLES

Together with the *General principles of food hygiene* (CXC 1-1969), overarching principles for good hygienic practice for meat are presented in the *Code of hygienic practice for meat* (CXC 58-2005) in Section 4: "General principles of meat hygiene". Three principles that have particularly been taken into account in these Guidelines are:

- i. The principles of food safety risk analysis should be incorporated in the design and implementation of meat hygiene programmes wherever possible and appropriate.
- ii. As appropriate to the circumstances, the results of monitoring of slaughter populations and surveillance of human populations should be considered when reviewing or modifying meat hygiene requirements
- iii. Competent authorities should recognise the equivalence of alternative hygiene measures where appropriate, and promulgate meat hygiene measures that achieve required outcomes in terms of safety and suitability and facilitate fair practices in the trading of meat.

6. DEFINITIONS

Domestic cattle mean all domesticated cattle species, including *Bos taurus* and *B. indicus*, banteng (*Bos javanicus*), gayal (*Bos frontalis*), and yaks (*Bos grunniens*), and additionally all *Bubalus* and *Bison* species.

Herd means a number of animals of one kind kept together under human control.

GOOD HYGIENE PRACTICES

³ *Guidelines on the judgement of equivalence of sanitary measures associated with food inspection and certification systems* (CXG 53-2003)

⁴ Murrel, K.D. (ed.) 2005. *FAO/WHO/OIE Guidelines for the surveillance, prevention and control of taeniasis/cysticercosis*. Paris, OIE and FAO. [Cited 6 March 2026]. <https://openknowledge.fao.org/server/api/core/bitstreams/3e3980c4-0795-4a40-b47f-30a897a928b3/content>

7. INTRODUCTION AND CONTROL OF FOOD HAZARDS

Refer to Section 7 of the *General principles of food hygiene* (CXC 1-1969), together with the following:

7.1 Identification of a food safety issue

Preliminary risk management activities appropriate to these Guidelines include:

- Development of a national or regional level risk profile taking into account the generic Codex risk profile; and
- Evaluation of the epidemiological evidence supporting a risk-based approach relative to the national or regional situation or trade in meat.

7.2 Risk Profile

Risk profiles provide a collation of scientific information that guides risk managers and industry in taking further actions as part of applying a RMF approach to a food safety issue. Both risk profiles and risk assessment can assist in the design of food control systems that are tailor-made to individual food production and processing systems. A generic risk profile is available on the repository of risk profiles on the FAO and WHO⁵ websites.

Epidemiological evidence to support decisions on appropriate control measures to be applied can be gathered from a range of sources. For example, both industry and governments may have historical records on test results from slaughter populations and farm investigations. Human health surveillance and treatment data, where available, are useful in assessing any residual risks that may exist in different regions or countries.

8. PRIMARY PRODUCTION

Refer to Section 8 of the *General principles of food hygiene* (CXC 1-1969), together with the following:

These Guidelines should be applied in conjunction with the FAO/WHO/OIE Guidelines on Taeniasis, regarding selection and application of control measures. These control measures cover all steps of the "primary production-to-consumption" food chain continuum.

The competent authority may apply movement control requirements to herds where they judge from monitoring information that this is an appropriate risk-based measure.

9. ESTABLISHMENT – DESIGN OF FACILITIES AND EQUIPMENT

Refer to Section 9 of the *General principles of food hygiene* (CXC 1-1969).

10. TRAINING AND COMPETENCE

Refer to Section 10 of the *General principles of food hygiene* (CXC 1-1969), together with the following:

All persons involved in cattle production should receive basic public health awareness training on the life cycle of the parasite and how humans may pose a risk as a source of infection to the cattle.

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

Refer to Section 11 of the *General principles of food hygiene* (CXC 1-1969).

12. PERSONAL HYGIENE

Refer to Section 12 of the *General principles of food hygiene* (CXC 1-1969).

13. CONTROL OF OPERATION

⁵ FAO and WHO. 2014. *Multicriteria-based ranking for risk management of food-borne parasites*. Microbiological Risk Assessment Series No. 23.

Refer to Section 13 of the *General principles of food hygiene* (CXC 1-1969), together with the following:

13.1 Description of products and processes

13.1.4 Monitoring and corrective action

A robust system for monitoring of data obtained at slaughterhouse level by both organoleptic post-mortem inspection and histopathology, where practicable, should be in place. This system should provide for evaluation of the performance of the selected control measures relative to the level of consumer protection that is sought and may include:

- Collection and evaluation of slaughterhouse information as well as related laboratory reports (e.g. histopathology);
- Trace back to the farm when suspect cysts are found in the slaughterhouse and application of on- farm controls and more intensive slaughterhouse inspection if required by the competent authority;
- Notification of results of intensified inspection to the competent authority;
- Involving public health authorities.

13.6 Post mortem inspection

Routine post-slaughter control measures for *T. saginata* are essentially limited to meat inspection. Where necessary and practicable, a sample of suspect cysts should be confirmed by histopathology (identification of cysts that are viable) according to validated techniques acceptable to the national competent authority.

Any laboratory-based test should have known performance characteristics, i.e. sensitivity and specificity if a risk-based approach to ensuring food safety is to be applied. The sensitivity of routine post mortem meat inspection for *T. saginata* is very low, particularly in lightly infected animals, and this means a significant proportion of individual carcasses containing *T. saginata* cysts will pass undetected. Only a proportion of undetected cysts will be viable and this proportion depends on the extent and cycle of infection in the herd of origin.

The range and intensity of post mortem inspection procedures varies from country to country.

13.6.1 Alternative inspection procedures

When a suspect carcass or part is identified during routine inspection procedures, additional inspection of the suspect carcass and its parts and cohorts can increase the sensitivity of inspection for identifying infected parts and/or further infected carcasses. The range and intensity of alternative post mortem inspection procedures varies from country to country.

13.6.2 Treatment of meat

Temperature treatment (heating and freezing) at regimes that ensure lethality for *T. saginata* is an available routine preventative control measure⁶. Heat treatment is also used for meat from suspect or confirmed

T. saginata carcasses and carcasses from the same herd. Such treatments should be validated according to national guidelines.

Salting and irradiation are further treatments that may be available provided the treatment has been validated and has been approved by the competent authority to ensure the lethality of *T. saginata*. Guidance on irradiation is given in the *General standard for irradiated foods* (CXS 106-1983) and the *Code of practice for radiation processing of food* (CXC 19-1979).

⁶ Temperatures of -10 °C for no less than 10 days or heating to a core temperature of 60 °C have been recommended in Motarjemi, Y., Kaferstein, F., Moy, G., Miyagishima, K., Miyagawa, S. and Reilly, A.(eds.) 1995. *Food technologies and public health*. Geneva, WHO. [Cited 6 March 2026]. <https://www.who.int/publications/i/item/WHO-FNU-FOS-95.12>

13.6.3 Traceability for slaughtered cattle

Traceability of cattle between slaughterhouse and place of production should be in place so that information on carcasses positive for *T. saginata* can be utilised for application of control measures at farm level (and elsewhere) when deemed appropriate by the competent authority. This may include notification of “suspect” cohorts of animals sent to the slaughterhouse for application of intensified post mortem inspection procedures.

13.7 Selection of risk-based control measures

13.7.1 Risk-based approach

Slaughter populations may be regarded as being of low prevalence if the following conditions are met:

- Slaughterhouse information demonstrating the absence of, or a low prevalence of, suspect cysts in the meat of the slaughtered population over time; or
- If available, public health data demonstrating that human infection attributable to the domestic slaughter population is absent or very rare;
- Other epidemiological data as relevant.

In such circumstances, risk modelling can be used to demonstrate that derogation from some routine post mortem inspection procedures and/or reduction in the intensity of some routine post mortem inspection procedures (palpation and/or incision) would have negligible impact on the level of consumer protection afforded by traditional and highly intensive procedures. Where this situation occurs, the competent authority should apply risk-based post mortem inspection derogations as appropriate.

Examples of levels of consumer protection provided by different levels of post mortem inspection for slaughter populations were modelled for low and high prevalence populations by FAO and WHO⁵.

Intensified post mortem procedures applied to an individual carcass when a suspect cyst is detected, and further post mortem inspection procedures applied to a related group of carcasses should also be considered according to the characteristics of infection in the slaughter population and the likelihood of reduction of risks to the consumer.

Episodes of cysticercosis can occur regardless of the available information on past history. Incursions can occur, and occasionally do, from sources out of the country, including via contaminated feed and infected people.

14. PRODUCT INFORMATION AND CONSUMERS AWARENESS

Refer to Section 14 of the *General principles of food hygiene* (CXC 1-1969), together with the following:

Best practice in the control of *T. saginata* in the meat of domestic cattle should be communicated to all stakeholders in cattle production.

The competent authority should make appropriate information (e.g. monitoring, investigation information) publicly available where possible when there is a public health risk and conduct public education campaigns as appropriate.

15. TRANSPORTATION

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

Refer to Section 16 of the *General principles of food hygiene* (CXC 1-1969).

17. PRINCIPLES OF THE HACCP SYSTEM

Refer to Section 17 of the *General principles of food hygiene* (CXC 1-1969).

18. GENERAL GUIDELINES FOR THE APPLICATION OF THE HACCP SYSTEM

Refer to Section 18 of the *General principles of food hygiene* (CXC 1-1969).

19. APPLICATION

Refer to Section 19 of the *General principles of food hygiene* (CXC 1-1969).

Part B: Amendments to the *Guidelines for the control of Trichinella spp. in meat of Suidae* (CXG 86-2015)

(including those agreed under agenda item 2, to update references to WOAHP and align with the revised WOAHP definition of compartment)

1. INTRODUCTION

Trichinellosis is a parasitic disease of major public health and economic importance in some countries. Human infection occurs from the consumption of raw or undercooked meat of many species (e.g. domestic pig, horse, game) containing infective *Trichinella* spp. larvae. Meat from animals of the family Suidae (further referred to as "Suidae") is considered to be the most important means of transmission of *Trichinella* spp. to humans. The infection status of domestic pig populations is informed by knowledge of management practices and data from monitoring programs for live (serological survey) or slaughtered pigs. Human health data can also be used to support the determination of risk of exposure to *Trichinella* spp.

Post-slaughter control measures to protect consumers from exposure to *Trichinella* spp. in the meat of Suidae should be risk-based.

These Guidelines incorporate elements of the "risk management framework" (RMF) approach as developed by the Codex Committee on Food Hygiene for managing microbiological hazards (*Principles and guidelines for the conduct of microbiological risk management* (CXG 63-2007)) such as:

- Preliminary risk management activities;
- Identification and selection of risk management options;
- Implementation of control measures;
- Monitoring and review.

2. OBJECTIVES

The primary objective of these Guidelines is to provide guidance to governments and industry on risk-based control measures to prevent exposure of humans to *Trichinella* spp. in meat of Suidae.

The Guidelines provide a consistent and transparent technical basis for reviewing and implementing control measures based on epidemiological information and risk analysis. The risk-based control measures that are selected vary between countries and production systems. Measures applied at the national level should be taken into account in the judgement of equivalence⁷ by importing countries, thereby facilitating international trade.

3. SCOPE

These Guidelines address only the control of *Trichinella* spp. in meat from Suidae as this is considered the most important source of infection of humans. The control of *Trichinella* spp. in meat from other species (e.g. horses, bears, walrus, etc.) should however be taken into account where considered relevant to the control of *Trichinella* spp. in meat from Suidae.

These Guidelines apply to the control of all species and genotypes of *Trichinella* that may infect Suidae and cause foodborne disease. The Guidelines are based on the "Working Principles for Risk Analysis for Application in the Framework of the Codex Alimentarius"⁸ and the *Code of hygienic practice for meat* (CXC 58-2005) that provides generic advice on a risk-based approach to meat hygiene.

⁷ *Guidelines on the judgement of equivalence of sanitary measures associated with food inspection and certification systems* (CXG 53-2003)

⁸ FAO and WHO. 2025. *Codex Alimentarius Commission Procedural Manual – Thirty-first edition*. Rome. <https://doi.org/10.4060/cd7978en>, see Section 4.1.

These Guidelines used in conjunction with the WOAHP recommendations (chapter on *Infection with Trichinella* spp. of the WOAHP *Terrestrial Animal Health Code*), apply to all steps from primary production to consumption.

4. USE

These Guidelines, used in conjunction with the WOAHP recommendations (chapter on *Infection with Trichinella* spp. of the WOAHP *Terrestrial Animal Health Code*), provide specific guidance for control of *Trichinella* in meat of Suidae with potential control measures being considered at each step, or group of steps, in the food chain. The Guidelines are supplementary to and should be used in conjunction with the *General principles of food hygiene* (CXC 1-1969), the *Code of hygienic practice for meat* (CXC 58-2005), the *Code of practice for the processing and handling of quick frozen foods* (CXC 8-1976), the FAO/WHO/OIE *Guidelines for the Surveillance, Management, Prevention and Control of Trichinellosis*⁹ and the *Recommendations on Methods for the Control of Trichinella in Domestic and Wild Animals Intended for Human Consumption* prepared by the International Commission on Trichinellosis (ICT) Standards for Control Guidelines Committee¹⁰.

The diagnostic techniques referred to in these Guidelines are those of the WOAHP *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals* (chapter on Trichinellosis (*infection with Trichinella* spp)).

Flexibility in application is an essential element of these Guidelines. They are primarily intended for use by government risk managers and industry in the design and implementation of food control systems. These Guidelines could also be used when judging the equivalence¹¹ of different food safety measures for meat of Suidae in different countries for international trade purposes.

These Guidelines provide a framework for decisions regarding post-slaughter control measures to protect humans from consumption of meat of Suidae which may be infected with *Trichinella* spp. Pre-harvest preventative measures, prerequisite criteria and conditions for recognition of compartments of domestic pigs as negligible risk are described in the chapter on *Infection with Trichinella* spp. of the WOAHP *Terrestrial Animal Health Code*.

5. GENERAL PRINCIPLES

Together with the *General principles of food hygiene* (CXC 1-1969), overarching principles for good hygienic practice for meat are presented in the *Code of hygienic practice for meat* (CXC 58-2005) section 4: *General Principles of Meat Hygiene*. Three principles that have particularly been taken into account in these Guidelines are:

- i. The principles of food safety risk analysis should be incorporated wherever possible and appropriate in the design and implementation of meat hygiene programmes.
- ii. As appropriate to the circumstances, the results of monitoring and surveillance of animal and human populations should be considered with subsequent review and/or modification of meat hygiene requirements whenever necessary.
- iii. Competent authorities should recognize the equivalence of alternative hygiene control measures where appropriate, and promulgate meat hygiene measures that achieve required outcomes in terms of safety and suitability and facilitate fair practices in the trading of meat.

6. DEFINITIONS

⁹ Dupouy-Camet, J. and Murrell, K.D. (eds.) 2007. *FAO/WHO/OIE Guidelines for the surveillance, management, prevention and control of trichinellosis*. Paris, FAO, WHO and OIE. http://www.trichinellosis.org/uploads/FAO-WHO-OIE_Guidelines.pdf

¹⁰ Gamble, H.R., Bessonov, A.S., Cuperlovic, K., Gajadhar, A.A., van Knapen, F., Noeckler, K., Schenone, H. and Zhu, X. (eds.) 2000. International Commission on Trichinellosis: recommendations on methods for the control of *Trichinella* in domestic and wild animals intended for human consumption. *Vet Parasitol.* 2000 Dec 1;93(3-4):393-408. [https://doi.org/10.1016/S0304-4017\(00\)00354-X](https://doi.org/10.1016/S0304-4017(00)00354-X)

¹¹ *Guidelines on the judgement of equivalence of sanitary measures associated with food inspection and certification systems* (CXG 53-2003)

For the purpose of this document, the following definitions apply:

Compartment¹² means an animal subpopulation contained in one or more establishments, separated from other susceptible populations by a common biosecurity management system, with a specific animal health status with respect to one or more infections or infestations for which the necessary surveillance, biosecurity and control measures have been applied for the purposes of international trade or disease prevention and control in a country or zone.

Cross breeds means the progeny of domestic pigs with non-domesticated animals of the family Suidae.

Domestic pigs means domesticated animals of the family Suidae living in a managed production system.

Feral pigs means an animal of a domesticated species of the family Suidae that now lives without direct human supervision or control.

Finishing pigs means domestic pigs kept solely for meat production.

Reservoir wildlife means feral animals, captive wild animals and wild animals that are known to be the most important potential direct or indirect sources of infection for *Trichinella* spp. to domestic pigs in a region or country.

GOOD HYGIENE PRACTICES

7. INTRODUCTION AND CONTROL OF FOOD HAZARDS

Refer to Section 7 of the *General principles of food hygiene* (CXC 1-1969), together with the following:

7.1 Availability and selection of risk-based control measures.

7.1.1 Availability of control measures at herd level

Measures to prevent *Trichinella* infection in domestic pig herds and to establish a compartment of negligible risk are described in the chapter on *Infection with Trichinella* spp. of the WOA *Terrestrial Animal Health Code*.

7.1.2 Availability of post-slaughter control measures

Post-slaughter control measures for *Trichinella* spp. include: laboratory testing and follow-up actions, freezing and heat treatment. Irradiation of meat of Suidae is also an option to destroy *Trichinella* spp. in meat prior to consumption. Control measures should be validated and then be approved by the competent authority, as appropriate. Non-weaned pigs slaughtered below the age of 5 weeks may be derogated from post-slaughter control measures¹³ when there is relevant information that can be verified by the competent authority.

Inactivation of *Trichinella* spp. by curing should follow the recommendations of ICT¹⁴.

7.1.2.1 Laboratory testing and follow-up actions

When laboratory tests are performed on individual carcasses, those selected analytical methods should be in accordance with the diagnostic techniques recommended in the chapter on Trichinellosis (infection with *Trichinella* spp. of the WOA *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals* (digestion assays) and the ICT *Recommendations for Quality Assurance in Digestion Testing Programmes for Trichinella*¹⁵ or ISO/CEN standards.

¹² Definition in the Glossary of the WOA *Terrestrial Animal Health Code*.

¹³ AESAN. 2012. Report of the Scientific Committee of the Spanish Agency for Food Safety and Nutrition (AESAN) in regard to the risk of trichinosis through suckling pig meat consumption. *Revista del Comité Científico de la AESAN*, no. 15. [Cited 6 March 2026].

https://www.aesan.gob.es/AECOSAN/docs/documentos/seguridad_alimentaria/evaluacion_riesgos/informes_cc_ingles/TRICHINELLA_SUCKLING_PIG.pdf

¹⁴ Validated methods for curing are currently under development by ICT

¹⁵ Gajadhar, A.A., Noeckler K., Boireau, P., Rossi, P., Scandrett, B. and Gamble, H.R. (eds.) 2019. International Commission on Trichinellosis: Recommendations for quality assurance in digestion testing programs for *Trichinella*. *Food Waterborne Parasitol*, 2019 Jun 5;16:e00059. <https://doi.org/10.1016/j.fawpar.2019.e00059>

Any analytical method that is selected should have known performance characteristics, i.e. sensitivity and specificity, if a risk-based approach to ensuring food safety is to be applied.

If a *Trichinella*-positive carcass is identified during post-slaughter testing, the competent authority should be notified. The competent authority can then decide which follow-up actions are necessary including possible disposal of the carcass.

7.1.2.2 Freezing

Freezing of meat should utilise cooling regime parameters that ensure lethality for all *Trichinella* spp. Present in different portions of meat or whole carcasses. Use of this method for inactivation of *Trichinella* spp. That are not cold tolerant should be in accordance with validated parameters such as those described in the “*Recommendations on Methods for the Control of Trichinella in Domestic and Wild Animals Intended for Human Consumption*” prepared by the ICT Standards for Control Guidelines. Freezing should not be used as a control measure in regions where *Trichinella* species and genotypes that are known to be cold tolerant such as *Trichinella* T6, *T. britovi*, and *T. nativa*, are endemic.

7.1.2.3 Heat treatment or irradiation

Inactivation of *Trichinella* spp. by these methods should be performed in accordance with validated methods such as those described in the “*Recommendations on Methods for the Control of Trichinella in Domestic and Wild Animals Intended for Human Consumption*” prepared by the ICT Standards for Control Guidelines Committee. Guidance on irradiation is given in the *General standard for irradiated foods* (CXS 106-1983) and the *Code of practice for radiation processing of food* (CXC 19-1979).

7.1.3 Selection of risk-based control measures

With the establishment of the negligible risk compartment as described in the chapter on *Infection with Trichinella* spp. of the WOA *Terrestrial Animal Health Code*, including consideration of the level of public health protection provided, the competent authority may provide derogation from specific post-slaughter controls or change the level of application of specific post-slaughter controls.¹⁶

7.2 Preliminary risk management activities

Consumers are exposed to the risk of *Trichinella* spp. infection when they consume meat containing infectious larvae. Risk management activities should incorporate a “primary production-to-consumption” approach in order to identify all steps in the food-chain where control measures are required.

Preliminary risk management activities appropriate to these Guidelines include:

- Development of a national, regional, or compartment risk profile noting that a generic risk profile which takes into account the *FAO/WHO/OIE Guidelines for the Surveillance, Management, Prevention and Control of Trichinellosis* has been published.
- Evaluation of the epidemiological evidence supporting a negligible risk claim for domestic pigs consumed domestically or abroad.

7.3 Implementation of risk-based measures

Implementation of selected control measures is dependent on official recognition by the competent authority of the *Trichinella* status of the compartment.

¹⁶ Illustrations of the levels of public health protection that can be achieved when establishing a compartment with negligible risk are provided in FAO and WHO. 2014. Report of the forty-sixth session of the Codex Committee on Food Hygiene. Rome. https://www.fao.org/fao-who-codexalimentarius/sh-proxy/en/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FMeetings%252FCX-712-46%252FREP15_FHe.pdf

8. PRIMARY PRODUCTION

Refer to Section 8 of the *General principles of food hygiene* (CXC 1-1969), together with the following:

8.5 Non-domesticated suidae, feral pigs and cross-breeds

All meat derived from non-domesticated Suidae, including wild boars, feral pigs and cross-breeds intended for human consumption should come from animals:

- a) tested in accordance with the diagnostic techniques recommended in the chapter on [Trichinellosis](#) (infection with *Trichinella* spp.) of the WOA *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals* (digestion assays); or
- b) be processed to ensure the inactivation of *Trichinella* spp. in accordance with one of the methods in the relevant section in the chapter on "[Trichinellosis](#) (Infection with *Trichinella* spp.) of the WOA *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals*, validated and approved for post-slaughter control in these animals.

Positive carcasses should be disposed of according to recommendations of the competent authority.

9. Establishment – design of facilities and equipment

Refer to Section 9 of the *General principles of food hygiene* (CXC 1-1969).

10. Training and competence

Refer to Section 10 of the *General principles of food hygiene* (CXC 1-1969).

11. Establishment maintenance, cleaning and disinfection, and pest control

Refer to Section 11 of the *General principles of food hygiene* (CXC 1-1969).

12. PERSONAL HYGIENE

Refer to Section 12 of the *General principles of food hygiene* (CXC 1-1969).

13. CONTROL OF OPERATION

Refer to Section 13 of the *General principles of food hygiene* (CXC 1-1969), together with the following:

13.1 Description of products and processes

13.1.1 Monitoring and corrective action

After establishing a negligible risk compartment according to the chapter on Infection with *Trichinella* spp. of the WOA *Terrestrial Animal Health Code*, ongoing assurance of public health protection should be based on avoiding *Trichinella* spp. contaminated meat from going into commerce. Public health protection can be assured by:

- a) a review of evidence, in particular from audits of herds, demonstrating compliance with the conditions as described in the relevant article of the chapter on infection with *Trichinella* spp. of the WOA *Terrestrial Animal Health Code*; or
- b) a risk based slaughter surveillance programme that takes into account information from historical testing results and is supplemented by regular review of information from audits of herds within the compartment; or
- c) a slaughter surveillance programme incorporating current testing data demonstrating that prevalence of infection does not exceed 1 infected carcass per 1,000,000 pigs slaughtered with at least 95% confidence.

In addition to the above, epidemiological investigation of human trichinellosis cases to confirm that the source of the contaminated meat was not from a negligible risk compartment in accordance with the chapter on Infection with *Trichinella* spp. of the WOA *Terrestrial Animal Health Code* should be conducted to the extent possible.

Where applicable and available, slaughter and any other relevant data from outdoor pigs and wild animals can provide additional information on the conditions surrounding the negligible risk compartment and the potential for infection of animals within the compartment.

14. PRODUCT INFORMATION AND CONSUMER AWARENESS

Refer to Section 14 of the *General principles of food hygiene* (CXC 1-1969), together with the following:

14.5 RISK COMMUNICATION

Best practice in the control of *Trichinella* spp. in the meat of Suidae should be communicated to all stakeholders in domestic pig production. Similarly, all stakeholders should be aware of the benefits of obtaining *Trichinella* negligible risk compartment status.

Hunters should be informed on the risk of consumption of meat from reservoir wildlife, stressing the importance of testing even if for personal consumption or the need to properly cook any meat from wild game (e.g. a core temperature of at least 71°C as recommended by ICT). Hunters should be also informed of the risk of promulgating and maintaining the sylvatic life cycle associated with the common habit of leaving animal carcasses in the field after skinning, or removing and discarding the entrails, thereby providing the opportunity for transmission to new hosts.

Communication procedures on the occurrence of *Trichinella* infections should be established between the veterinary authority and the public health authority. The competent authority should ideally publish annual laboratory results in a form that demonstrates the epidemiological status of herds, compartments, regions or the whole country. Results of epidemiological investigations of any food-borne outbreaks should also be communicated.

Since each country has specific consumption habits, communication programs pertaining to trichinellosis are most effective when established by individual governments.

Retailers and consumers, including people who visit regions or countries where *Trichinella* is endemic, should be made aware that meat should be fully cooked e.g. a core temperature of at least 71°C as recommended by ICT in order to avoid becoming sick from consuming meat contaminated with parasites.

15. TRANSPORTATION

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

Refer to Section 16 of the *General principles of food hygiene* (CXC 1-1969).

17. PRINCIPLES OF THE HACCP SYSTEM

Refer to Section 17 of the *General principles of food hygiene* (CXC 1-1969).

18. GENERAL GUIDELINES FOR THE APPLICATION OF THE HACCP SYSTEM

Refer to Section 18 of the *General principles of food hygiene* (CXC 1-1969).

19. APPLICATION

Refer to Section 19 of the *General principles of food hygiene* (CXC 1-1969).

Part C: Amendments to the Revised Draft Aligned Guidelines on the application of general principles of food hygiene to the control of foodborne parasites (CXG 88-2016)

1. INTRODUCTION

Foodborne parasites are a major public health burden worldwide¹⁷, particularly in areas with poor sanitary facilities and in populations that traditionally consume raw and undercooked food dishes. Infections may have prolonged, severe, and sometimes fatal outcomes, and result in considerable hardship in terms of food safety, security, quality of life, and negative impacts on livelihood.

The joint Food and Agriculture Organization of the United Nations (FAO)/ World Health Organization (WHO) report on Multicriteria-Based Ranking for Risk Management of Foodborne Parasites¹⁸ lists 24 parasite species, genera or families that ranked highest in global public health concern. The top 8 highly ranked parasites are *Taenia solium*, *Echinococcus granulosus*, *Echinococcus multilocularis*, *Toxoplasma gondii*, *Cryptosporidium* spp., *Entamoeba histolytica*, *Trichinella* spp, and Opisthorchiidae. The ranking was based on 7 criteria of which 5 were public health related. The ranking was based on worldwide impacts and regionally other foodborne parasites may be more important. The ranking indicates that the foodborne parasites of greatest concern from a global public health perspective are not limited to a single parasite group or a food vehicle, but span a number of different parasites groups, and food vehicles.

Knowledge of parasite life cycles, transmission routes and environmental requirements is needed to understand which control measures may be effective. Foodborne parasites are transmitted to humans by ingestion of fresh or processed foods that are contaminated as a consequence of the parasite's life cycle (e.g. meat that contains *Trichinella* larvae or *Toxoplasma* tissue cysts) or that are contaminated with soil or water carrying infective stages of parasites (e.g. cysts, oocysts, eggs). In the first case, human infection can occur through the consumption of an infective stage in raw, undercooked or poorly processed meat and offal from domesticated animals, game, fish, crustaceans, cephalopods and molluscan shellfish. In the second case, human infection can occur from ingestion of infective stages in water and on foods such as fresh fruit and vegetables resulting from animal or human faecal contamination (e.g. oocysts of *Cryptosporidium* spp. in fresh vegetables).

Control of foodborne parasites can be achieved through the prevention of infection of farmed food animals (e.g. livestock, poultry, fish) with infective stages, the prevention of contamination of fresh and processed foods with infective stages, and/or the inactivation of parasites in or on foods during processing. Control during primary production is important for many parasite/food combinations, while control measures during post-harvest are necessary for other parasite/food combinations. During a parasite hazard analysis, producers should consider how the product will be further processed, prepared and consumed in order to determine appropriate parasite control measures. Education and awareness-raising are important components of consumer protection from foodborne parasitic diseases and, in many cases, may be the only feasible option available.

The first step of foodborne parasite risk management should be identifying any potential parasite hazard(s) applicable to the food being produced¹⁹. The details of the epidemiology (both human and animal disease) and the life cycle of each parasite are essential in the identification, prevention and control of the risks associated with that parasite. Epidemiological data collection in food and environmental parasite surveys can be effective in identifying hazards and collecting information to be used for risk management strategy decisions. Surveillance for parasitic diseases in humans is complicated by the often prolonged incubation periods, sub-clinical nature, unrecognized chronic sequelae and lack of easily available diagnostic procedures.

¹⁷ WHO. 2015. *WHO estimates of the global burden of foodborne diseases: Foodborne diseases burden epidemiology reference group 2007-2015*. Geneva. <https://www.who.int/publications/i/item/9789241565165>

¹⁸ FAO and WHO. 2014. *Multicriteria-based ranking for risk management of food-borne parasites*. Microbiological Risk Assessment Series, No. 23.

¹⁹ *Principles and guidelines for the conduct of microbiological risk management (MRM)* (CXG 63-2007)

The occurrence and distribution of parasitic species in the raw commodities used for food can be affected by climate changes, land use, and other environmental factors. The spread of foodborne parasitic diseases is also affected by human behaviour (for instance, environmental contamination by human faeces due to the lack of latrines and human-to-human contact that spread parasite eggs and cysts), demographics, and global trade. For example, globalization of food trade offers new opportunities for parasite dissemination into new area.

2. OBJECTIVES

The primary purpose of these guidelines is to provide guidance on preventing, reducing, inactivating, or otherwise controlling foodborne parasite hazards that present a public health risk. The guidelines provide science-based advice to governments and the food industry with the aim of protecting the health of consumers against foodborne parasites and ensuring fair practices in food trade. The guidelines also provide information that will be of value to consumers and other interested parties.

3. SCOPE

These guidelines for the control of foodborne parasites are applicable to all foods especially those foods identified in the FAO/WHO report, from primary production through consumption. They should complement guidelines in place for any other pathogens (e.g. bacteria and viruses).

Control measures should be applied to parasite hazards in proportion to the public health risk. Countries in which specific parasites are endemic should take special measures to reduce the identified risk.

Section 3 is subdivided into four food categories: i) Meat and meat products, ii) Milk and milk products, iii) Fish and fishery products, iv) Fresh fruits and vegetables. The Scope of these categories is the same as provided in the following codes:

- Meat and Meat products: [Code of hygienic practice for meat \(CXC 58-2005\)](#), especially raw or undercooked meat.
- Milk and Milk products: [Code of hygienic practice for milk and milk products \(CXC 57-2004\)](#), especially, unpasteurized milk and milk products.
- Fish and Fishery products: [Code of practice for fish and fishery products \(CXC 52-2003\)](#), especially, raw or undercooked fish and fishery products.
- Fresh Fruits and Vegetables: [Code of hygienic practice for fresh fruits and vegetables \(CXC 53- 2003\)](#), especially fruits and vegetables consumed raw or undercooked.

The remaining sections contain guidelines applicable to the food chain after primary production (i.e. processing, food service, home preparation, and consumption), but are not subdivided into food categories.

4. USE

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 such as:

- [Code of hygienic practice for meat \(CXC 58-2005\)](#),
- [Code of hygienic practice for milk and milk products \(CXC 57-2004\)](#),
- [Code of practice for fish and fishery products \(CXC 52-2003\)](#),
- [Code of hygienic practice for fresh fruits and vegetables \(CXC 53- 2003\)](#).

The World Organization for Animal Health (WOAH) develops standards for the prevention, detection and control of some foodborne parasites at the primary production stage. Therefore, these guidelines should also be used in conjunction with relevant Articles of the WOAH Codes and Manuals and the WOAH/FAO guide to Good Farming Practices for Animal Production Food Safety.

4.1 Roles of competent Authorities, food business operators and consumers

Flexibility in application of the Guidelines is important. They are primarily intended for use by government risk managers and industry in the design and implementation of food control systems.

5. GENERAL PRINCIPLES

Refer to Section 5 of the *General principles of food hygiene* (CXC 1-1969).

6. DEFINITIONS

For the purpose of these Guidelines, the following definitions apply:

Definitions of the General principles of food hygiene (CXC 1-1969) in addition to the definitions relevant to these guidelines:

The definitions of **fish**, **aquaculture** and **fish farm** in the *Code of practice for fish and fishery products* (CXC 52-2003), and of **feed** in the *Code of practice on good animal feeding* (CXC 54-2004), apply.

Cyst – A transmission stage of a parasite that can cause infection when consumed. Environmental cysts are resistant to outside conditions and can be transferred with soil, dust, and water to food. Tissue cysts are located within animal tissues.

Foodborne Parasite – Any parasite that can be transmitted to humans by ingesting food.

Host – An organism which harbours the parasite.

Larvae – Immature form of helminths, before the development of the mature stage. Larvae can be infective or not.

Oocyst – The environmental, developmental stage of coccidian parasites, produced through sexual reproduction in the definitive host. Oocysts can be infective or not when produced or shed.

GOOD HYGIENE PRACTICES

7. INTRODUCTION AND CONTROL OF FOOD HAZARDS

Refer to Section 7 of *General principles of food hygiene* (CXC 1-1969).

8. PRIMARY PRODUCTION

Refer to Section 8 of *General principles of food hygiene* (CXC 1-1969), together with the following:

It is necessary to conduct a hazard analysis to identify the foodborne parasite hazards that could be present in the feed and food production environment and that may contaminate foods during primary production. Control of parasites during primary production is particularly important when subsequent control steps during processing may not be adequate to eliminate the hazard or reduce it to an acceptable level.

Sources of parasitic contamination of food and food producing animals at the primary production site include feed, water, soil, workers, untreated manure, sludge or fertilizers contaminated by faeces of human and/or domestic and wild animals, or proximity to other activities which could result in run-off or flooding with contaminated water. Therefore, attention to water quality throughout the food-chain, from primary production through processing to consumption is very important. In addition to the above, food-producing animals feeding on other live and dead animals (e.g. mammals, fish, birds, invertebrates), are important sources of parasitic infections.

Farm workers in endemic areas may be infected with parasites without feeling ill or showing any symptoms. In order to minimize the probability for contamination of the production environment with parasitic stages from human faeces, on-farm sanitary facilities should be installed and used, e.g. functional latrines in the field that do not leak contaminants into the primary production area, and an adequate means of hygienically washing (e.g. scrubbing under running water) and drying hands. Waste from sanitary facilities should be hygienically disposed of in such a way as to eliminate contact of potentially infectious faeces with animals or pasture land.

8.5 Meat and Meat Products

Important meat-transmitted foodborne parasites include, but are not limited to, *Taenia solium* (pigs), *Toxoplasma gondii* (pigs, cattle, chickens, sheep, goats, horses, game), *Trichinella spiralis* (pigs, horses, game) and other *Trichinella* spp. (pigs, horses and game), *Taenia saginata* (cattle), *Sarcocystis* spp. (pigs, cattle) and *Spirometra* spp. (fish, reptiles, and amphibians). Certain foodborne parasites present in domestic animals may be transmitted to food of plant origin via faecal contamination (e.g. *Echinococcus* spp., *Cryptosporidium* spp., *Fasciola* spp. and *Giardia duodenalis*.) These parasites are not associated with human illness from consumption of meat, however they should be controlled in animal production in order to interrupt their life cycle. For information on specific food vehicles for these parasites, see Table 2 in FAO/WHO report on *Multicriteria-Based Ranking for Risk Management of Food-Borne Parasites*¹⁸.

8.5.1 Environmental control

Refer to Section 8.1 of the [General principles of food hygiene \(CXC 1-1969\)](#) and Section 5.5 of the [Code of hygienic practice for meat \(CXC 58-2005\)](#) and the relevant chapters of the WOAHP *Terrestrial Animal Health Code*²⁰ In addition:

Faeces of domestic and wild animals (e.g. *Toxoplasma* oocysts in felids), as well as human faeces (e.g. *Taenia* eggs), may contain parasites that are infective to domestic food-producing animals. Some parasites may also be transmitted to domestic animals or other animal hosts when these animals eat infected tissues from other animals. Where parasites will not be controlled at a later processing stage, the feasibility of controlling environmental introduction of foodborne parasites during primary production with available methods should be determined before primary production begins. The risk associated with the introduction of organic material (e.g. faecal and other material that may contain oocysts or eggs) from non-food-producing animals into the production environment should also be assessed.

Game meat may contain parasites that infect humans directly or via the infection of livestock. The environment of wild animals and open range domesticated animals cannot be controlled, therefore, mitigation measures should be in place to minimize the risk at a later stage in the food chain.

8.5.2 Hygienic production

For information related to the control of parasites related to animal feed, refer to the [Code of practice on good animal feeding \(CXC 54-2004\)](#), Section 4, Section 5 and Section 6.5 of the [Code of hygienic practice for meat \(CXC 58-2005\)](#), and the relevant chapters of the WOAHP *Terrestrial Animal Health Code*, and the WHO/FAO/OIE *Guidelines for the surveillance, prevention and control of taeniosis/cysticercosis*²¹, and FAO/WHO/OIE *Guidelines for the surveillance, management, prevention and control of trichinellosis*²².

Where indicated by a hazard analysis, control measures and/or hygienic practices should be implemented that prevent foodborne parasites from contaminating foods or infecting food animals during primary production, or that reduce contamination to an acceptable level.

Fully enclosed animal housing systems, or other systems that prevent intrusions of potentially contaminated small animals or unauthorized people, combined with other good production practices, can be effective in controlling foodborne parasite hazards in meat, since such systems have been demonstrated to be effective for a number of parasites (e.g. *Trichinella* spp., *Toxoplasma*).

²⁰ WOAHP. 2025. Terrestrial Animal Health Code. In: *Codes and Manuals*. [Cited 5 March 2026]. <http://www.oie.int/en/international-standard-setting/terrestrial-code/access-online/>

²¹ Murrell, K.D. (ed.) 2005. *WHO/FAO/OIE Guidelines for the surveillance, prevention and control of taeniosis/cysticercosis*. Paris, OIE, WHO, FAO. [Cited 5 March 2026]. <https://openknowledge.fao.org/server/api/core/bitstreams/3e3980c4-0795-4a40-b47f-30a897a928b3/content>

²² Dupouy-Camet, J. and Murrell, K.D. (eds.) 2007. *FAO/WHO/OIE Guidelines for the surveillance, management, prevention and control of trichinellosis*. Paris, FAO, WHO, OIE. http://www.trichinellosis.org/uploads/FAO-WHO-OIE_Guidelines.pdf

Feed should be effectively protected against rodents (e.g. *Trichinella* spp. control), cats (e.g. *Toxoplasma gondii* control) and other animals. All dead animals should be immediately removed from feed storage and food-producing animal production areas and disposed of in a safe manner.

Primary producers should supply water that is not a significant source of transmission of foodborne parasites to food-producing animals and to the extent possible block access of food producing animals to surface water and untreated water collection systems to minimize the potential for infection with parasites.

In order to assess whether foodborne parasite controls at primary production are properly implemented and effective, control measures should be documented and verified. Animal surveillance may be a useful tool for assessing control measure needs/shortcomings; however, because of the practical limitations of sampling and testing methodology, testing cannot assure the absence of a parasite hazard.

8.5.3 Cleaning, maintenance and personnel hygiene

Refer to Section 8.4 of the *General principles of food hygiene* (CXC 1-1969) and the relevant chapters of the *WOAH Terrestrial Animal Health Code* for recommendations on cleaning, disinfection and personal hygiene.

8.5.4 Monitoring and surveillance at primary production

Refer to the relevant chapters of the *WOAH Terrestrial Animal Health Code*. Surveillance and monitoring of foodborne parasites in food animals and in species that are potential sources of parasites could be effective in developing risk management strategies. Monitoring and surveillance can be useful as tools to verify the effectiveness of parasite controls, and should begin at primary production.

Assurance that a parasite hazard is adequately controlled can be attained through demonstration of properly implemented controls and hygienic practices, which may be supported by a series of negative test results over a sufficient time period through a risk-based surveillance programme.

It is important to exchange information between the owner of the herds and the slaughterhouse or processing plant e.g.:

- When the status of the herd in relation to parasite infection (e.g. history of parasitic infection) is known, it should be communicated to the slaughterhouse to facilitate a more targeted monitoring of parasites in the slaughterhouse.
- The status of the meat, following a post-mortem inspection in the slaughterhouse, should be provided to the owner of herds, to facilitate a more targeted control at primary production.

8.6 Milk and milk products

Consumption of unpasteurized milk has been associated with outbreaks of cryptosporidiosis and toxoplasmosis. Contamination of unpasteurized milk with *Cryptosporidium* spp. may result from unsanitary milking conditions, such as when the udders are not properly cleaned. Outbreaks of toxoplasmosis have been associated with the consumption of unpasteurized goat and camel milk. Infective stages of *Toxoplasma* in recently infected animals may be excreted in the milk and might result in milk-borne infection. For information on specific food vehicles for these parasites, see Table 2 in FAO/WHO report on *Multicriteria-Based Ranking for Risk Management of Food-Borne Parasites*¹⁸.

8.6.1 Environmental control

Refer to Section 3.1 of the [Code of hygienic practice for milk and milk products \(CXC 57-2004\)](#).

Cats should be excluded, to the extent possible, from barns and food production, handling and storage areas used for dairy herds (e.g. cows, goats, sheep and camels).

8.6.2 Hygienic production

Refer to the [Code of practice on good animal feeding \(CXC 54-2004\)](#) and Section 3.2 of the *Code of hygienic practice for milk and milk products* (CXC 57-2004).

8.6.3 Handling, storage and transport

Refer to Section 3.3 of the *Code of hygienic practice for milk and milk products* (CXC 57-2004).

8.6.4 Cleaning, maintenance and personnel hygiene

Refer to Section 6 of the *Code of hygienic practice for milk and milk products* (CXC 57-2004).

8.7 Fish and fishery products

Important fish-transmitted foodborne parasites include Opisthorchiidae in freshwater fish, *Paragonimus* spp. in freshwater crustaceans, Anisakidae in marine fish, crustaceans and cephalopods, Heterophyidae in freshwater/brackish water fish, and Diphyllbothriidae in freshwater and marine fish. For information on specific food vehicles for these parasites, see Table 2 in *Multicriteria-Based Ranking for Risk Management of Food-Borne Parasites*, Report of a Joint FAO/WHO Expert Meeting, 2012¹⁸.

8.7.1 Environmental control

Refer to Sections 6.1.1 and 6.1.2 of the [Code of practice for fish and fishery products \(CXC 52-2003\)](#).

Wild fish, and aquacultured fish without controlled rearing conditions, may contain parasites that infect people. The environment of wild fish cannot be controlled, requiring measures to be taken at a later stage of the food chain, e.g. processing, for fish that will be consumed raw or undercooked.

The source of water used for aquaculture fish farming can be a risk factor for parasitic infections. The larval stages of certain trematodes, which may be present in fish farm water, can penetrate fish skin and infect fish tissues. Aquaculture primary producers should use clean water and seek appropriate guidance on water quality, and should prevent influx of contaminated water (including waste water). The hygienic suitability of the water, under both normal and rain-storm conditions, should be assessed.

Where feasible, material derived from on-board evisceration of fish showing signs of infection by parasites communicable to humans should not be disposed of at sea unless it has undergone a treatment that kills the parasites, in order not to maintain the parasite life cycle.

Some aquaculture methods may reduce a parasite hazard to an acceptable level, for example, ocean pen-reared salmon that are raised on commercial pelleted feed have not been observed to contain any anisakid worms compared to wild salmon. Closed systems with controlled feed and environment conditions can effectively eliminate parasites that normally occur in wild fish.

8.7.2 Hygienic production

Refer to Section 3 and Section 6 of the [Code of practice for fish and fishery products \(CXC 52-2003\)](#), and the [Code of practice on good animal feeding \(CXC 54-2004\)](#) and the relevant Chapters of the *WOAH Aquatic Animal Health Code*²³ the *FAO Technical Paper on Assessment and Management of Fish Safety and Quality-Current Practices and Emerging Issues*²⁴.

To prevent potential transmissions of parasites, fingerlings should only be purchased from producers who implement reliable source management systems and Good Aquaculture Practice (GAqP). Fingerlings collected from the wild may contain foodborne parasites that remain a hazard in adult fish.

²³ WOAH. 2025. Aquatic Code. In: *Codes and Manuals*. [Cited 5 March 2026]. <https://www.woah.org/en/what-we-do/standards/codes-and-manuals/>

²⁴ Ryder, J., Karunasagar, I. & Ababouch, L., (eds.) 2014. *Assessment and management of seafood safety and quality: current practices and emerging issues*. FAO Fisheries and Aquaculture Technical Paper, No. 574. Rome, FAO. <https://openknowledge.fao.org/handle/20.500.14283/i3215e>

Animals and people infected with foodborne parasites may excrete parasite eggs that enter water and develop into larval stages that subsequently infect farmed fish. In order to minimize the opportunity for contamination of the production environment with parasitic stages from human faeces, on-farm sanitary facilities should be installed, e.g. functional latrines, and an adequate means of hygienically washing and drying hands.

Animals, including dogs and cats, are hosts for freshwater trematode fishborne parasites and should be excluded from land-based fish ponds to the extent possible. Good practices include not feeding raw meat/offal of fish to dogs and cats, preventing fish-eating mammals from accessing fish ponds and controlling the population of semi-domesticated or stray/feral dogs and cats in close vicinity of fish farms. Workers infected with or being treated for fish-borne trematodes (liver and intestinal flukes) should be excluded from the farm environment during treatment.

Attention should also be given to animals that serve as intermediate hosts²⁵ in the life cycle of fishborne parasites. For example, in the case of aquaculture, the exclusion of snails, as intermediate hosts for fishborne trematodes, from fish farm areas, may help interrupt trematode life cycles in fish ponds. For wild fish, intermediate hosts cannot be controlled, and fish migrate from different areas with varying risks for exposure to parasites.

Using raw fish as feed for aquaculture is likely to introduce a risk of parasitic infection, therefore it should be avoided as much as possible. Raw fish used for feed may be previously frozen in order to inactivate parasites. It is particularly important to inactivate parasites in feed where the fish will not be subsequently frozen, and may be consumed raw or undercooked.

Toilets should not directly empty into land-based fish ponds. Fishponds should be protected from contamination from human and animal faeces, pollution with sewage and other wastes. Untreated human and animal excreta should not be used as fertilizer or as fish food.

Where needed, control measures at primary production should be assessed in order to determine if they are properly implemented and effective. Fish surveillance may be a useful tool for assessing control measure needs/shortcomings; however, because of the practical limitations of sampling and testing methodology, testing cannot assure the absence of a parasite hazard.

8.7.3 Handling, storage and transport

Eviscerating fish without any undue delay during harvest is helpful to prevent migration of Anisakidae larvae from the viscera into the flesh after harvest.

Refer to Sections 6.3.5 and 6.3.6 of the [Code of practice for fish and fishery products \(CXC 52-2003\)](#), and the relevant Chapters of the *WOAH Aquatic Animal Health Code* for considerations for transport.

8.7.4 Cleaning, maintenance and personnel hygiene

Refer to Sections 3.4 and 3.5 of the [Code of practice for fish and fishery products \(CXC 52-2003\)](#) and the relevant Chapters of the *WOAH Aquatic Animal Health Code*.

8.7.5 Monitoring and surveillance at primary production

Examining fish for live fishborne parasites may be a useful tool to assess the effectiveness of fishborne parasite preventive control measures. Data from monitoring and surveillance can be useful to develop and review risk management strategies.

Assurance that a parasite hazard is adequately controlled may be attained through demonstration of properly implemented controls and hygienic practices, which may be supported by a series of negative test results over a sufficient time period through a risk-based surveillance programme.

8.8 Fresh fruits and vegetables

²⁵ A host which harbours the larval developmental stages of the parasite prior to maturity.

Important fruit- and vegetable-transmitted foodborne parasites include, but are not limited to, *Taenia solium*, *Echinococcus granulosus*, *Echinococcus multilocularis*, *Toxoplasma gondii*, *Entamoeba histolytica*, *Cryptosporidium* spp., *Ascaris* spp., *Giardia duodenalis*, *Fasciola* spp., *Cyclospora cayetanensis*, *Trichuris trichiura*, *Balantidium coli*, and *Toxocara* spp. For information on specific food vehicles for these parasites see Table 2 in FAO/WHO report on *Multicriteria-Based Ranking for Risk Management of Food-Borne Parasites*¹⁸.

Certain fruits and vegetables are consumed raw without a cooking or freezing step or disinfection to kill parasites. In this case, controls that reduce the parasite hazard to an acceptable level during primary production are especially important.

8.8.1 Environmental control

Refer to Section 3.1 of the [Code of hygienic practice for fresh fruits and vegetables \(CXC 53-2003\)](#).

Areas for cultivation of fresh fruits and vegetables need to be assessed in terms of their susceptibility to direct or indirect faecal contamination from wild animals, domestic animals and/or humans, whether from run-off, flooding, irrigation water, or natural fertilizers. Prior to selecting the site for cultivation it should be determined if adequate control measures can be implemented to manage any identified risks.

8.8.2 Hygienic production

Refer to the [Code of hygienic practice for fresh fruits and vegetables \(CXC 53-2003\)](#) and the *WHO/WOAH Manual on Echinococcus in Human and Animals*²⁶.

The use of biological soil amendments of animal origin, particularly on fresh produce, should be managed to minimize the potential for contamination with parasites (e.g. adequately treating manure). Parasite eggs and oocysts can survive for years in the environment, and can be highly resistant to environmental changes; for example *Ascaris* eggs can remain viable in anaerobically digested sewage sludge.

In case the presence of infected snail intermediate host (Lymnaeidae) is identified, aquatic plants, such as watercress, grown in the area should not be harvested for raw consumption in order to prevent infection with *Fasciola hepatica* and *F. gigantica*.

Flooding may cause contamination of crops with water containing the parasite eggs, cysts and oocysts from animal or human faeces. After such events, produce should be evaluated for risk of contamination and where there is a risk, proper disposal of the affected produce is needed.

8.8.3 Cleaning, maintenance and personnel hygiene at primary production

Refer to Sections 3.2.3 and 3.4 of the [Code of hygienic practice for fresh fruits and vegetables \(CXC 53-2003\)](#).

9. ESTABLISHMENT – DESIGN OF FACILITIES AND EQUIPMENT

Refer to Section 9 of *General principles of food hygiene* (CXC 1-1969), together with the following:

9.1 Location and structure

9.1.2 Design and layout of food establishment

The post-harvest processing establishment should be designed to exclude animals that may excrete faeces that contain parasite stages. The layout should minimize the introduction of soil that may contain faeces from animals and parasite stages from the outside environment (e.g. changing boots/clothes at the entrance of the establishment).

10. TRAINING AND COMPETENCE

Refer to Section 10 of *General principles of food hygiene* (CXC 1-1969), together with the following:

²⁶ Eckert, J., Gemmell, M.A., Meslin, F.-X. and Pawłowski, Z.S. (eds.) 2001. *Manual on echinococcosis in humans and animals A public health problem of global concern*. Paris, OIE and WHO. <https://www.who.int/publications/i/item/929044522X>

10.1 Awareness and responsibilities

Workers engaged in primary production, processing, preparation, retail or food service should be trained and/or instructed in the control of foodborne parasites (e.g. from good animal husbandry practices to hygiene and sanitation measures) to a level appropriate to the operations they are to perform. Particular attention should be paid to abattoir workers who may be performing post-mortem inspection procedures and food handlers of ready-to-eat foods.

10.2 Training programmes

Training programmes should contain information on the following, as appropriate to those being trained:

- The potential for food to be a vehicle of transmission of foodborne parasites if contaminated.
- The potential sources and routes of transmission of foodborne parasites.
- The potential for persistence of parasites in/on contaminated foods and food production settings.
- The need to comply with good animal husbandry practices and the importance of compliance with such practices, including:
 - the role of domestic and wild animals in the transmission of certain parasites;
 - the importance of on-farm sanitation and hygiene in interrupting the life cycle of parasites and minimizing the opportunity for faecal-oral transmission; and
 - the importance of animal feed management to avoid domestic and wild life parasite contamination.
- 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. It is advisable to educate each new employee in the proper practices that are to be followed for hand-washing.
- The importance of adequate food processing and preparation to eliminate potential parasite risks.
- Task-specific practices to reduce or eliminate the risks of parasites in foods.

10.3 Instruction and supervision

Training and instructions should be given to all new personnel on the transmission and management of foodborne parasites.

Inspectors or other relevant authorities, who inspect fields, post-harvest processing plants, and food service facilities, should also be trained.

10.4 Refresher training

Periodic retraining of existing personnel should be given as refresher and to maintain competence level of all personnel.

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

Refer to Section 11 of *General principles of food hygiene* (CXC 1-1969), together with the following:

11.2 Pest control systems

11.2.1 General

Insects, such as flies and cockroaches, and animals such as rodents and birds can transport parasite stages from faeces to food and should be controlled.

12. PERSONAL HYGIENE

Refer to Section 12 of the *General principles of food hygiene* (CXC 1-1969), together with the following:

Proper personal hygiene such as hand-washing practices should be used to prevent faecal-oral transmission of parasites. For example, workers infected with the tapeworm *T. solium* with improper hand-washing practices can spread eggs that result in the severe disease neurocysticercosis.

13. CONTROL OF OPERATION/CONTROL OF FOOD HAZARDS

Refer to Section 13 of *General principles of food hygiene* (CXC 1-1969), together with the following:

Control measures are used to address specific foodborne parasite hazards, e.g. as part of a Hazard Analysis and Critical Control Point (HACCP)-based system. Contamination of foods during processing with parasites transmitted by the faecal-oral route is typically controlled by a stringent application of hygiene control systems, which could be referred to as, e.g. Good Hygienic Practices (GHPs) and sanitation standard operation procedures (SSOPs). These prerequisite programs, together with validated interventions for specific parasites provide a framework for the control of foodborne parasites.

During the parasite hazard analysis, food business operators should consider how the product will be further processed, prepared and consumed in order to determine appropriate parasite controls. Where the hazard analysis indicates the presence of a significant foodborne parasite hazard, slaughter and post-harvest processing operations should have control measures in place that prevent or eliminate the hazard or reduce it to an acceptable level.

The hazard analysis may determine that a foodborne parasite hazard is adequately controlled at primary production, or by the previous processor. In this case, methods may be used to verify that previous control measures are adequate, such as inspecting the implementation of control measures at the primary producer or previous processor, and for some products, testing incoming product for the presence of parasites.

Various processes have been shown to control parasites in selected food items, but the conditions needed to inactivate parasites are subject to substantial variability depending on the parasites, the food matrix and the location of parasites in the food matrix. Specific processing steps and processing combinations should be subject to rigorous validation to ensure consumer protection. For additional information on validation, refer to the [Guidelines for the validation of food safety control measures \(CXG 69-2008\)](#). Control measures may include: freezing, heat treatment, salting, drying, high pressure processing, filtration, sedimentation, UV light, ozone and irradiation. Specific processing steps and processing combinations (hurdle concept) to control parasites should be used in accordance with guidance from competent authorities, where available.

13.2 Key aspects of hygiene control systems

13.2.1 Time and temperature control

Time and temperature control treatments (freezing and heating) that will result in the reduction/elimination of viable parasites are the most commonly used preventative control measures. Such treatments should be done in accordance with validated parameters, as described in relevant and reliable guidelines and other scientific literature.

13.2.2 Specific process steps

13.2.2.1 Freezing

Many parasites in food are susceptible to freezing. However, specific time/temperature combinations are required to inactivate parasites by freezing, and these are also dependent on the food type and portion size. Some parasites (e.g. *Trichinella nativa* and *T. britovi* larvae or eggs of *Echinococcus multilocularis*) are resistant to freezing.

For control of parasites in fish and fishery products intended for raw consumption by freezing, refer to Annex 1 of the [Code of practice for fish and fishery products \(CXC 52-2003\)](#). For control of parasites in cold smoked fish, smoke-flavoured fish, and smoke-dried fish refer to Annex 1 of the [Standard for smoked fish, smoke-flavoured fish and smoke-dried fish \(CXS 311-2013\)](#).

13.2.2.2 Heat treatment

Parasites can be inactivated by adequate heat treatment of foods and water. Other validated treatments may be used.

13.2.2.3 Salting, curing, marinating, pickling, smoking

Processing methods such as salting, curing, marinating, pickling, smoking, and addition of food additives that may be effective for the control of certain other foodborne pathogens are generally not sufficient for the control of foodborne parasites. Combinations of several treatments (hurdle concept) can be effective to control parasites. When a combination of treatments is used, it should be subject to rigorous validation to ensure consumer protection.

13.2.2.4 Irradiation

Irradiation is a possible measure for parasite control. Refer to the [General standard for irradiated foods \(CXS 106-1983\)](#).

13.2.2.5 Washing

Fruits and vegetables should be washed with water in accordance with the Section 5.2.2.1 of the [Code of hygienic practice for fresh fruits and vegetables \(CXC 53-2003\)](#) to reduce parasites. However, it should be noted that most parasite eggs or oocysts are sticky and difficult to remove from fruits and vegetables, particularly those with crevices or folds on the surface.

13.2.2.6 Packaging

It should be noted that vacuum packaging does not alter the infectivity of parasites in food.

13.4 Documentation and records

Documentation related to validation, monitoring and verification activities regarding the control measures used for parasites should be kept.

Monitoring and review of foodborne parasite safety control systems is an essential component of application of a risk management framework (RMF). It contributes to verification of process control and demonstrating progress towards achievement of public health goals.

Information on the level of control of parasites at appropriate points in the food chain can be used for several purposes e.g. to validate and/or verify outcomes of food control measures, to monitor compliance with public health goals, and to help prioritise regulatory efforts to reduce foodborne parasite illnesses.

14. PRODUCT INFORMATION AND CONSUMER AWARENESS

Refer to Section 14 of the *General principles of food hygiene* (CXC 1-1969), together with the following:

14.2 Product information

Labels may be used to help differentiate between products that are intended for raw consumption and products that are intended to be cooked by the consumer. However, even with the beneficial use of labels instructing consumers to cook the product, a parasite hazard should be reduced to an acceptable level before marketing products that are likely to be consumed raw or undercooked.

14.4 Consumer education

In order to increase consumer awareness of foodborne parasite hazards, education, is an important component of risk management, and in some cases may be the only practical option available. Consumers should recognize the risks associated with consumption of raw, undercooked, and lightly processed (e.g. marinated, smoked) meat and fish, as well as the consumption of certain fruits and vegetables that may not be rendered safe simply by washing alone. Consumer advice should be provided on how to prepare foods (e.g. cooking times and temperatures) and on the importance of good hygiene (e.g. hand-washing) in order to avoid infection with foodborne parasites. Consumers should always make sure to separate raw foods from cooked food, and ready to

eat fruit and vegetables to prevent cross-contamination while handling and preparing meals. The WHO *Five Keys to Safer Food* could assist in this process.²⁷

Education is particularly important for consumers in endemic areas, and in high risk groups, such as those who are pregnant or immunocompromised (e.g. *Toxoplasma gondii* in pregnant women and immunocompromised groups; *Cryptosporidium* spp. in children, immunocompromised groups and older adults.) For such consumers, advice on the preparation and consumption of high-risk foods such as fresh produce, adequate cooking of meat and fish prior to consumption and the importance of hygiene, e.g. hand- washing, is critical. When people are diagnosed with an *Anisakis* spp. nematodes allergy, they should be advised to avoid eating marine fish.

15. TRANSPORTATION

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

Refer to Section 16 of the *General principles of food hygiene* (CXC 1-1969).

17. PRINCIPLES OF THE HACCP SYSTEM

Refer to Section 17 of the *General principles of food hygiene* (CXC 1-1969).

18. GENERAL GUIDELINES FOR THE APPLICATION OF THE HACCP SYSTEM

Refer to Section 18 of the *General principles of food hygiene* (CXC 1-1969).

19. APPLICATION

Refer to Section 19 of the *General principles of food hygiene* (CXC 1-1969).

²⁷ WHO. 2006. *Five Keys to Safer Food Manual*. France. <http://www.who.int/foodsafety/publications/5keysmanual/en/>

APPENDIX VI

REVISED GUIDELINES FOR THE CONTROL OF CAMPYLOBACTER AND SALMONELLA IN CHICKEN MEAT (CXG 78-2011)

(For adoption at Step 5/8)

1. INTRODUCTION

Campylobacteriosis and salmonellosis are among the most frequently reported foodborne diseases worldwide. While numerous potential vehicles of transmission exist, raw chicken meat has been identified as one of the most important food vehicles for the transmission of these organisms. The risk in different countries varies according to control measures and practices implemented along the chain from primary production to final preparation of the meat for consumption and is impacted by geographical and climatic factors. The burden of the diseases and the cost of control measures are highly significant in many countries and contamination with *Campylobacter* and *Salmonella*¹ has the potential to severely disrupt trade between countries.

Campylobacter spp. are a Gram-negative, non-spore forming obligate microaerophile belonging to the family *Campylobacteraceae*. Organisms of the genus have optimal growth at a pH between 6.5 and 7.5, and at temperatures between 37°C and 42°C. *Campylobacter* spp. lack the necessary cold shock proteins to thrive at temperatures below 30 °C, however, some species can grow slowly and persist in moist environments at temperatures as low as 25 °C. *Campylobacter* spp. cannot grow when water activity (a_w) is less than 0.987. Domestic and wild poultry are a major reservoir of *Campylobacter* with a high prevalence of *C. jejuni* and *C. coli* found in broiler chickens used in commercial production. While *C. jejuni* is the leading cause of campylobacteriosis worldwide, other species, such as *C. coli*, commonly cause human illness.

Salmonella spp. are Gram-negative, non-spore forming, rod-shaped facultative anaerobic bacteria belonging to the *Enterobacteriaceae* family. The genus *Salmonella* is divided into two species: *S. enterica* (comprising six subspecies) and *S. bongori*. *Salmonella* spp. can grow between 5.2°C and 46.2°C, with the optimal temperature being between 35°C and 43°C (ICMSF 1996). *Salmonella* spp. will grow over a broad pH range between 3.8 and 9.5, with an optimal pH range for growth between 7 and 7.5 (ICMSF 1996). The optimum a_w for *Salmonella* is 0.99 and the lower limit for growth being 0.94. *Salmonella* spp. can survive for months or even years in foods with a low a_w . Over 99% of human *Salmonella* spp. infections are caused by *S. enterica* subsp. *enterica*. While all serovars can cause disease, pathogen virulence and public health impact can be focused through the lens of serovars and virulence genes, to better focus surveillance efforts on screening for pathogens of public health concern in the global food supply.

Both *Campylobacter* spp. and *Salmonella* spp. can survive diverse environmental conditions and can persist in chicken production systems. It should also be emphasized that these microorganisms can exist in viable but non-culturable (VBNC) states, which makes their control and detection difficult by traditional methods. VBNC states induced by some control measures may limit their apparent effectiveness.

These guidelines build on general food hygiene provisions already established in the Codex system and develop potential control measures specific for *Campylobacter* and *Salmonella* of public health relevance in raw chicken meat. In this context, the guidelines give effect to the Codex Alimentarius Commission (CAC) commitment to developing standards that are based on sound science and risk assessment². Potential control measures for application at single or multiple steps are presented in the following categories:

- Good hygienic practices (GHPs). Fundamental measures and conditions applied at any step within the food chain to provide safe and suitable food. They are usually prescriptive and may differ between countries.
- Hazard-based. They are developed from scientific knowledge of the likely level of control of *Campylobacter* or *Salmonella* at a step (or series of steps) in a food chain, have a quantitative basis in the prevalence and/or concentration, and can be validated as to their efficacy in hazard control at the

¹ Human pathogens of public health relevance only. For the purposes of this document, all references to *Salmonella* and thermotolerant *Campylobacter* relate only to human pathogens.

² Objective 2 “Promoting widest application of scientific principles and risk analysis” of the [Codex Strategic Plan 2020-2025](#) and the first Statement of Principle relating to the Role of Food Safety Risk Assessment “Health and safety aspects of Codex decisions and recommendations should be based on a risk assessment, as appropriate to the circumstances” Codex Procedural Manual Safety Risk Assessment “Health and safety aspects of Codex decisions and recommendations should be based on a risk assessment, as appropriate to the circumstances” [Codex Procedural Manual](#).

given step. Any reduction in hazard prevalence and/or concentration has the potential to provide human health benefits depending on the type of food, stage in the food chain, intended use and preparation of the food, and consumer habits.²

Examples of hazard-based control measures have been subjected to a rigorous scientific evaluation and review in the development of these guidelines. Such examples are illustrative only and their use and adoption may vary amongst member countries. Their inclusion in these guidelines highlights the value of a quantitative approach to hazard reduction throughout the food chain and, where the decision support tool for risk-based control measures (Section 10) is applied, the likely level of public health protection that may result from implementing these control measures at the national level.

These guidelines are presented in a flow diagram format to enhance practical application of a primary production to consumption approach to food safety. This format:

- Demonstrates differences and commonalities in control measures for *Campylobacter* and *Salmonella*
- Illustrates relationships between control measures applied at different steps in the food chain
- Facilitates development of Hazard Analysis Critical Control Point (HACCP) plans at individual premises and national levels
- Assists in judging the equivalence³ and appropriateness of control measures for raw chicken meat applied in different countries

These guidelines provide flexibility for use at the national (and individual primary production and processing) level.

2. OBJECTIVES

The primary objective of these guidelines is to provide information to competent authorities and food business operators on the control of *Campylobacter* and *Salmonella* in raw chicken meat to reduce foodborne disease from this source whilst ensuring fair practices in international food trade. The Guidelines provide a scientifically sound international tool for robust application of GHP and hazard-based approaches to control *Campylobacter* and *Salmonella* in raw chicken meat according to national risk management decisions.

It is not the intention of these guidelines to set quantitative limits for *Campylobacter* and *Salmonella* in raw chicken meat for international trade. Rather, the Guidelines follow the example of the overarching Codex *Code of Hygienic Practice for Meat* (CXC 58-2005) and provide an enabling framework that countries can use to establish control measures appropriate to their national situation. As a result, control measures may vary between production systems and countries.

3. SCOPE

These guidelines apply to the control of all *Campylobacter* and *Salmonella* that may contaminate raw chicken meat (*Gallus gallus*) and cause foodborne disease. The primary focus is raw chicken meat in the form of broiler carcasses and parts (e.g., raw chicken legs, breasts, and wings). These guidelines do not include recommendations for further preparations (i.e., raw chicken meat which has had foodstuffs, seasonings or additives added to it). These guidelines can be applied to other classes of chickens, e.g., end-of-lays, as appropriate. While significant consumer exposure may occur from consumption of further processed products such as ground/minced meat, and raw chicken meat preparations (raw chicken meat which has had foodstuffs, seasonings or additives added to it) and offal, these guidelines do not include any specific recommendations for these products as cooking is the primary control measure after processing.

While the biosecurity provisions in this document have been developed primarily for chickens raised in controlled-environment housing systems, they also have applicability to other housing systems such as free-range. Where appropriate, free-range specific guidelines are noted.

4. USE

These guidelines describe specific guidance for control of *Campylobacter* and *Salmonella* in raw chicken meat according to a “primary production to consumption” food chain approach. Potential control measures are considered at each step, or group of steps, in the process flow.

³ [Codex Guidelines on the Judgement of Equivalence of Sanitary Measures Associated with Food Inspection and Certification Systems \(CXG 53-2003\)](#).

These guidelines are supplementary to and should be used in conjunction with the [Code of Practice – General Principles of Food Hygiene \(CXC 1 – 1969\)](#), the [Code of Hygienic Practice for Meat \(CXC 58-2005\)](#), the [Code of Practice for the Processing and Handling of Quick Frozen Foods \(CXC 8-1976\)](#), the [WOAH Terrestrial Animal Health Code](#), and the [Code of Practice on Good Animal Feeding \(CXC 54-2004\)](#).

General and overarching provisions are referenced as appropriate, and their content is not duplicated in these guidelines.

The guidelines systematically present GHP-based control measures and examples of hazard-based control measures. GHPs are pre-requisites to selecting hazard-based control measures. Examples of hazard-based control measures are limited to those that have been scientifically evaluated as being effective under conditions of commercial use. Where no quantifiable outcome is mentioned for a specific control measure, it should be noted that the effect may be different between *Salmonella* and *Campylobacter*. Countries should also note that these hazard-based control measures are indicative only and the references provided should be reviewed to assist application. The quantifiable outcomes reported for control measures are specific to the conditions of particular studies and would need to be validated under local commercial conditions to provide a meaningful estimate of hazard reduction⁵. Competent authorities and Food Business Operators (FBO) can choose hazard-based control measures to inform decisions on critical control points when applying HACCP principles to a particular food process.

Several hazard-based control measures as presented in these guidelines are based on the use of chemical decontaminants to reduce the prevalence and/or concentration of *Campylobacter* and/or *Salmonella* in broiler carcasses. Where chemical decontaminants are considered necessary, the processor should conduct studies to determine the most effective processing step for their use. The use of these control measures, including chemical decontaminants where relevant, in the food chain, is subject to approval by the competent authority⁴, where appropriate. The use of chemical decontaminants does not replace good hygienic practices in slaughterhouses and processing facilities and biosecurity measures at the farms of origin. Also, these guidelines do not preclude any other choice of a hazard-based control measure that is not included in the examples.

Provision of flexibility in the application of these guidelines is an important attribute. They are primarily intended for use by competent authorities and food business operators in the design and implementation of food safety control systems.

The Guidelines can be useful when judging the equivalence and assessing the appropriateness of different food safety measures for raw chicken meat in different countries.

5. GENERAL PRINCIPLES

Together with the General Principles of Food Hygiene (CXC 1-1969), overarching principles for good hygienic practice for meat are presented in the Code of Hygienic Practice for Meat (CXC 58-2005) section 4: General Principles of Meat Hygiene. Two principles that have particular relevance to these guidelines are:

- The principles of food safety risk analysis should be incorporated wherever possible and appropriate in the control of *Campylobacter* and *Salmonella* in raw chicken meat from primary production to consumption.
- Wherever possible and practical, Competent Authorities should formulate risk management metrics⁵ to objectively express the level of control of *Campylobacter* and *Salmonella* in raw chicken meat that is required to meet public health goals.

6. DEFINITIONS

For the purpose of this document, definitions of the *General Principles of Food Hygiene* (CXC 1-1969), the *Code of Hygienic Practice for Meat* (CXC 58-2005), and the following definitions apply:

Biosecurity: Set of management and physical measures designed to reduce the risk of introduction, establishment and spread of animal diseases, infections or infestations to, from and within an animal population.

Broiler: Birds of the species *Gallus gallus* selectively bred and reared for their meat rather than eggs.

⁴ Competent authority as defined in CXC-1 1969, "The government authority or official body authorized by the government that is responsible for the setting of regulatory food safety requirements and/or for the organization of official controls including enforcement.

⁵ [Principles and Guidelines for the Conduct of Microbiological Risk Management \(MRM\) CXG 63-2007](#)

Chicken: Birds of the species *Gallus gallus*.

Competitive exclusion⁶: Administration of defined⁷ or undefined bacterial formulations to poultry to prevent gut colonization by enteropathogens, including *Campylobacter* and *Salmonella*.

Controlled-environment flock: Flocks raised in enclosed housing or barns without access to the outside environment.

Crate: Container used to transport live chickens.

Flock⁸: A number of animals of one kind kept together under human control or a congregation of gregarious wild animals. A flock is usually regarded as an epidemiological unit.

Free-range flock: Flocks raised in housing with access to the outside environment.

Horizontal transmission: Transmission of infectious disease or pathogens between birds of the same generation sharing the same living space.

Module: Structure containing crates / cages that facilitates loading and unloading.

Partial depopulation: Incomplete harvest, thinning, or “catching” of chickens from a growing flock that, for the purposes of this document, will be transported to slaughter.

Potable water: Water fit for human consumption.

Total depopulation: Full harvest or “catching” of chickens from a growing flock that, for the purposes of this document, will be transported to slaughter.

Vertical transmission: Transmission of infectious disease or pathogens from a parent bird to an offspring through the egg.

Water fit-for-purpose⁸: 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.

7. RISK MANAGEMENT AND RISK PROFILES

These guidelines apply a risk management framework (RMF) approach as advocated in the Codex *Principles and Guidelines for the Conduct of Microbiological Risk Management (MRM)* (CXG 63-2007). Preliminary microbiological risk management activities and identification and selection of risk management options are represented by the guidance developed for control measures at each step in the food chain. Following sections on “Implementation” and “Monitoring” complete the application of all the components of the RMF.

Risk profiles are an important part of preliminary risk management activities when applying an RMF to a food safety issue. They provide scientific information to risk managers and industry in the design of food safety control systems that are tailor-made to individual food production and processing systems.

The contents of these guidelines are predicated on two extensive risk profiles on *Salmonella* and *Campylobacter* in broiler chicken:

- Measures for the control of non-typhoidal *Salmonella* spp. poultry meat: Meeting report (2023)⁹
- Measures for the control of *Campylobacter* spp. in chicken meat: Meeting report (2024)¹⁰

8. INTRODUCTION AND CONTROL OF FOOD HAZARDS

Refer to the [General Principles of Food Hygiene \(CXC 1-1969\)](#).

⁶ This definition is taken directly from the [WOAH Terrestrial Animal Health Code](#).

⁷ Probiotics may be competitive exclusion products

⁸ This definition is taken directly from the [Guidelines for the safe use and reuse of water in food production and processing CXG 100-2023](#)

⁹ FAO and WHO. 2023. Measures for the control of non-typhoidal *Salmonella* spp. in poultry meat: meeting report. Microbiological Risk Assessment Series, No. 45. Rome.

¹⁰ FAO and WHO. 2024. Measures for the control of *Campylobacter* spp. in chicken meat: meeting report. Microbiological Risk Assessment Series, No. 46. Rome.

9. PRIMARY PRODUCTION TO CONSUMPTION APPROACH TO CONTROL MEASURES

These guidelines incorporate a “primary production to consumption” flow diagram which includes guidance from *General Principles of Food Hygiene* (CXC 1-1969) in each section and identifies all steps in the food chain where control measures can potentially be applied. It facilitates a systematic approach to the identification and evaluation of all potential control measures. Consideration of all steps in the food chain allows different combinations of control measures to be developed. This is particularly important where differences between countries occur in primary production and processing systems and risk managers need the flexibility to choose risk management options that are appropriate in the national context. General guidelines at each step refer to GHP measures and where appropriate, hazard-based recommendations are noted in text boxes.

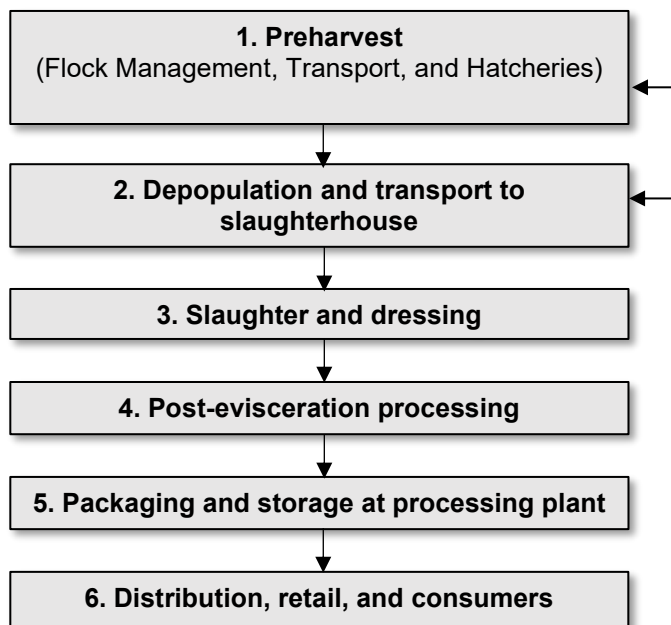
Unless otherwise specified, where appropriate, the general principles for primary production, establishment design and equipment, training and competence, establishment maintenance, personal hygiene, control of operation, product information, consumer awareness, transportation, and HACCP system and guidelines for its application apply. Refer to the *General Principles of Food Hygiene* (CXC 1-1969).

Where applicable, criteria should be established to verify the efficacy and performance of control measures designed to minimize or eliminate *Campylobacter* and *Salmonella* from the farm and production environments that considers pathogen-specific risk factors, the distribution of microorganisms in raw chicken meat at various stages of production, potential changes to microflora during storage and distribution, and the intended use of the final product. Refer to the *Principles and guidelines for the Establishment and Application of Microbiological Criteria related to Foods* (CXG 21-1997) and section IV of the *Guidelines for the Validation of Food Safety Control Measures* (CXG 69 -2008).

Generic flow diagram for application of control measures

A generic flow diagram is presented in sequence on the following pages. Individual premises will have variations in process flow and should adapt the design of HACCP plans accordingly when applied.

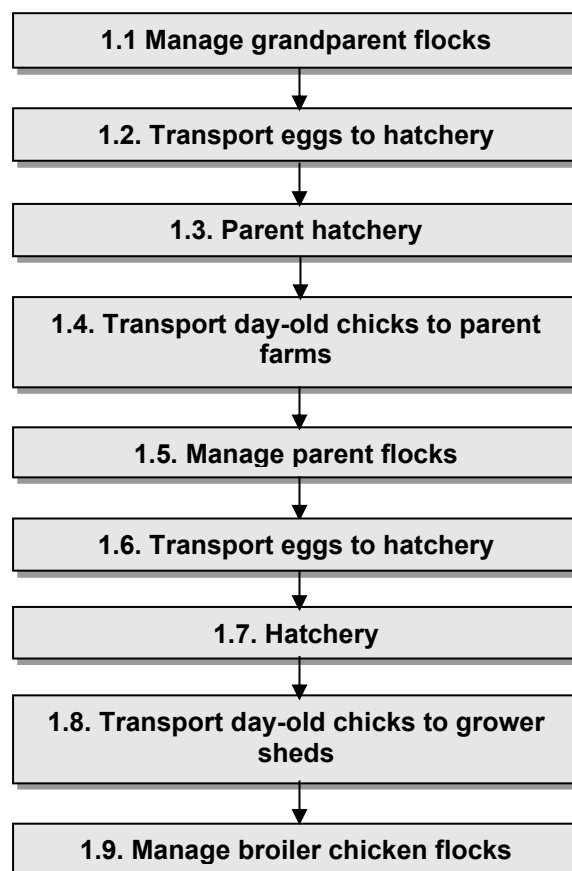
Figure 1. Example flow diagram of chicken primary production to consumption



Source: Authors' own elaboration based on CXG 78-2011.

9.1 Preharvest (Flock Management, Transport, and Hatcheries)

Figure 2. Example flow diagram of chicken primary production



Source: Authors' own elaboration based on CXG 78-2011.

Flock management (Steps 1.1, 1.5, and 1.9)

Control of *Campylobacter* and *Salmonella* in chicken flocks is strengthened by the application of a combination of biosecurity and personnel hygiene measures. This combination of control measures adopted at a national level should be determined in consultation with relevant stakeholders. The recommendations in this section are applicable for all stages of flock management.

General flock management control measures for *Campylobacter* and *Salmonella*

- When designing or maintaining production farms, consideration should be given to ensure adequate ventilation, air quality, humidity, temperature, lighting, flock welfare, housing type, population density, building age, and layouts that facilitate access for cleaning and disinfection to reduce contamination levels and the potential for horizontal transmission.
- Staff training and strict compliance with biosecurity and personnel hygiene measures are necessary to ensure effective management systems and to prevent contamination to subsequent flocks in the same house. Infected broiler flocks increase the risk of spread in the slaughter environment and the potential for contamination of raw chicken meat.
- Production systems utilizing outdoor areas should consider risks associated with exposure to external environmental hazards (e.g., soil, vegetation cover, wild birds, pests, standing water).
- Pest control programs should be specific to the challenges in a given farm or geographic location and may include a combination of physical, chemical, and biological control methods. Use of chemical pesticides may require approval by a competent authority.
- Measures such as change-in-change-out or shower-in-shower-out in an anteroom where possible should be

implemented for chicken house workers.

- f. Removal of organic material should be carried out prior to cleaning. Cleaning and disinfection protocols should include critical locations in such as drinking cups, drain holes, and floor cracks.
- g. Reused litter should be subjected to treatments that inactivate pathogens (e.g., composting, chemical treatments). These control measures should be validated and treated litter tested on occasion for verification purposes.
- h. The use of dedicated tools, equipment, biosecurity barriers, and personal protective equipment (PPE) for individual chicken houses and separated paddocks on farms is an effective way to reduce the risk of transmission.
- i. Total depopulation of the flock should be carried out where possible. Where this is not practicable and partial depopulation is practiced, particular attention should be paid to strict biosecurity and hygiene of catchers and the equipment they use to minimize the risk of cross-contamination between flocks.
- j. Proper cleaning and disinfection of crates, catcher's clothing, and transport vehicles is critical when catchers move between farms, and especially after total depopulation. These measures are essential to reduce the risk of contamination.
- k. Feed should be handled in a manner that prevents contamination. Feed should preferably be delivered in dedicated vehicles or in closed containers used only for feed transport. The effectiveness of these measures should be verified (e.g., by testing feed, or dust from feed silos or storage containers).
- l. Specific to free-range production systems:

Free-range flocks interact with the outdoor environment and that can increase their exposure and risk of contamination and colonization with *Campylobacter* and *Salmonella*. Access to areas where wild birds visit (e.g., trees, vegetation, water sources) should be limited and FBOs should consider keeping feed, feeders, and drinking water indoors or sequestered from wildlife and pests to discourage wild birds from populating outdoor areas used by free-range birds. Farms should include secure housing that can be used, when necessary, to sequester chickens from wild birds and other animals.

Farms should assess previous and current land uses and should evaluate contamination risks for free-range areas and birds. Any unique risks associated with accessing outdoor areas should be managed (e.g., monitoring the environment, evaluating whether the time between livestock grazing and foraging by a flock is sufficient).

If litter is used in outdoor areas, it should be kept dry and regularly rotated out of the free-range area.

Specific flock management control measures for *Campylobacter*

The use of fly screens to reduce or eliminate fly infestation in broiler houses has been shown to decrease the percentage of *Campylobacter*-positive flocks in controlled-environment housing when implemented with other biosecurity measures. Where flyscreens are deployed, fans with adequate power should be installed to ensure sufficient air circulation and screens should be cleaned frequently to keep them clear of feathers and detritus.

Specific flock management control measures for *Salmonella*

- a. The use of *Salmonella*-infected eggs will most likely result in the flock being infected. As appropriate, as an additional measure for breeders to reduce contamination of chicks after incubation, hatching eggs could be cleaned and sanitized as soon as possible after collection, using a suitable sanitation regime.
- b. Where possible, breeder flocks should be *Salmonella*-free at both the parent and grandparent flock levels. The sampling frequency in breeders should allow the FBO and/or competent authority to implement control measures before progeny chicks are transported from the hatchery.
- c. When a flock is found to be *Salmonella*-positive, a range of responses, detailed in the WOA *Terrestrial Animal Health Code*, "Prevention, Detection and Control of *Salmonella* in Poultry", should be implemented. Surveillance and traceback requirements should be designed by a competent authority and based on contextually relevant public health concerns.
- d. Where feasible (e.g., in countries or situations with low *Salmonella* prevalence), depopulation of *Salmonella*-

positive breeder flocks can reduce the risk of horizontal and vertical transmission¹¹.

Flock Management Hazard-Based Control Measures

General

- Antimicrobial agents should only be used to control *Campylobacter* and *Salmonella* in flocks in accordance with *Code of Practice to Minimize and Contain Foodborne Antimicrobial Resistance* (CXC 61-2005)

Specific to *Salmonella*

- The use of control measures such as probiotics, prebiotics, competitive exclusion bacteria, organic acids in pre-slaughter drinking water, and organic acids (e.g., formic acid combined with propionic acid) or formaldehyde in feed, may reduce prevalence when used in a multi-hurdle approach with other measures. The use may require approval by a competent authority
- Vaccination of breeders and broilers with live or inactivated *Salmonella* vaccines, done according to manufacturer's instructions, has shown to be effective in reducing the prevalence of *Salmonella* at the slaughterhouse. Vaccination of breeder chickens has been shown to be effective at reducing vertical transmission of *Salmonella*
- The use of live and inactivated vaccines may require approval by the competent authority to permit their use

Transport – Hatchery Eggs and Live Birds (Steps 1.2, 1.4, 1.6, and 1.8)

The recommendations in this section are applicable for all references to transportation of eggs to hatchery and live birds.

General eggs and live bird transport control measures for *Campylobacter* and *Salmonella*

- a. Personnel involved in the transportation of live birds should follow appropriate biosecurity procedures to avoid cross-contamination of live birds during loading and unloading. All live bird transport trucks, crates and modules should be effectively cleaned, disinfected, and dried on site before reuse.
- b. Personnel should not enter any buildings used to house livestock without following appropriate biosecurity protocols. Measures should be taken to prevent cross-contamination of live birds during loading and unloading.

Specific eggs and live bird transport control measures for *Salmonella*

- a. Only eggs from *Salmonella*-negative flocks should be transported for hatching. When this is not practical, the eggs from *Salmonella*-positive flocks should be transported separately from other eggs and either discarded or handled according to guidance established by a competent authority.
- b. Where possible, eggs from *Salmonella*-positive flocks should not be used for propagation. This may not be possible where there is a limitation on the methods of analysis and/or the use of eggs from *Salmonella*-positive flocks is necessary to maintain food security.
- c. Lining paper used in crates used to transport chicks is an effective critical control point that may facilitate verification testing for *Salmonella* in flocks.

Hatchery Management (Steps 1.3 and 1.7)

The recommendations in this section are applicable for all stages of hatchery management.

General hatchery management control measures for *Campylobacter* and *Salmonella*

Measures such as change-in-change-out or shower-in-shower-out in an anteroom where possible should be implemented for chicken house workers.

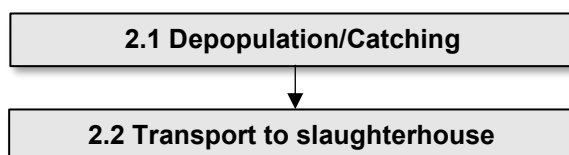
¹¹ Transmission of infectious disease or pathogens from a parent bird to an offspring through an egg.

Specific hatchery management control measures for *Salmonella*

- a. If possible, only eggs from *Salmonella*-negative flocks should be hatched.
- b. Trace back of contamination to the infected breeder flocks should be performed and control measures should be reviewed.
- c. Where the use of shared equipment is unavoidable, such as conveyors for hatching incubators, chicks hatched from *Salmonella*-negative flocks should be conveyed and packed before chicks from *Salmonella*-positive flocks. Conveyors and related equipment should be thoroughly cleaned and sanitized before reuse for chicks from *Salmonella*-negative flocks. Testing and monitoring should be implemented to verify sanitation efficacy.

9.2 Depopulation and Transport to Slaughterhouse

Figure 3. Example flow diagram of depopulation and transport to slaughterhouse



Source: Authors' own elaboration based on CXG 78-2011.

General depopulation and transport control measures for *Campylobacter* and *Salmonella*

- a. Total depopulation or catching of the entire flock is recommended and should be carried out at one time. Where this is not feasible, partial depopulation can be performed. Because partial depopulation carries an increased risk of contamination and transmission of pathogens, particular attention should be paid to strict biosecurity, catcher hygiene, and the equipment used.
- b. Chicken houses and outdoor areas should have dedicated tools and PPE for partial depopulation. It is strongly recommended that sheds be thoroughly cleaned and sanitized after full depopulation.
- c. Measures such as change-in-change-out or shower-in-shower-out in an anteroom where possible should be implemented for chicken house workers.
- d. When partial depopulation is scheduled on the same day as total depopulation, it is preferable to catch birds from chicken houses scheduled for partial depopulation before those being fully depopulated. This minimizes the risk of contamination and transmission of pathogens to areas where live birds will continue to be maintained. Considering that partial depopulation increases the risk of infection, it is advisable to complete the depopulation of these birds after depopulation of flocks that are less likely to be infected.
- e. All live-bird transport trucks, crates, and modules should be effectively cleaned, disinfected, and dried before reuse.
- f. Specific to free-range production systems:

In mixed-farm situations (a combination of controlled-environment housing and free-range flocks) where partial depopulation is practiced, or where catchers move between farms, flocks raised in controlled-environment housing should be caught prior to the free-range flocks to minimize the risk of horizontal transmission. The risk status of a flock is dependent on the individual circumstances of the flock and should be determined prior to partial depopulation.

Farm workers should take additional biosecurity and sanitation measures to minimize cross-contamination from free-range areas prior to harvest.

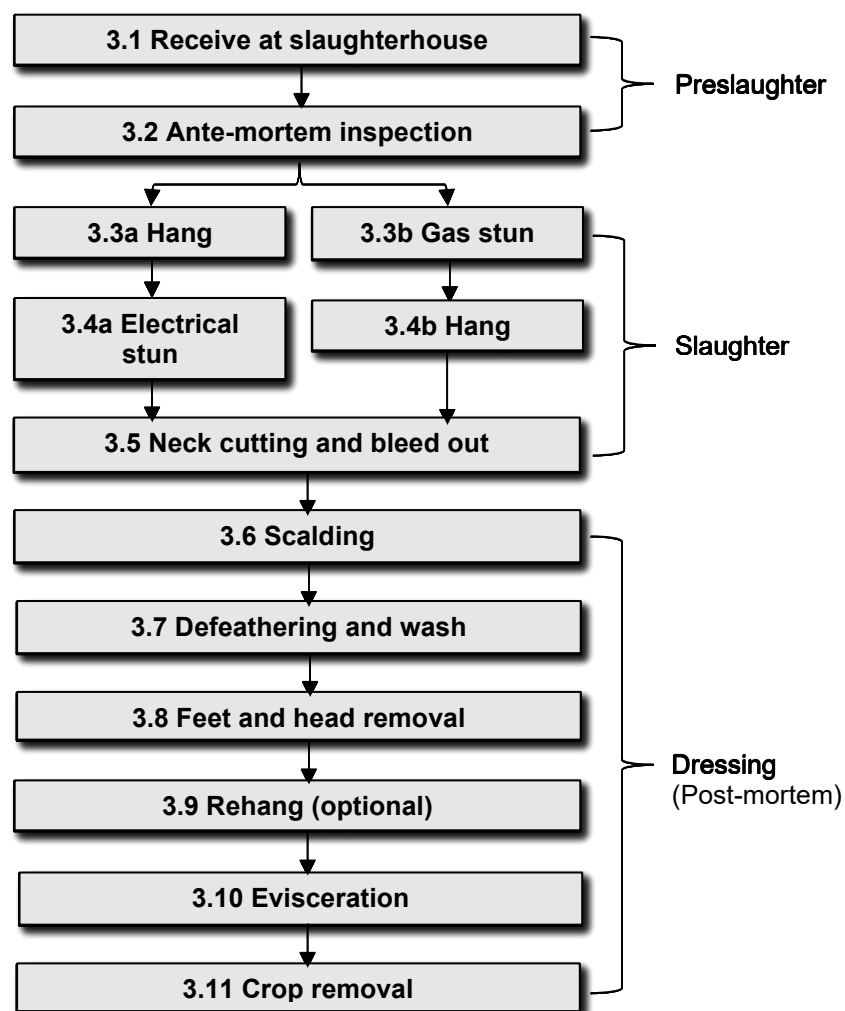
Depopulation and Transport Hazard-Based Control Measures

General

- Ensure appropriate feed withdrawal fasting (usually a minimum of 8-12 hours) prior to slaughter to minimize gastrointestinal spillage during processing
- When feed withdrawal is practiced, water additives such as lactic acid may be used to acidify the crop contents and reduce bacterial contamination of the crop, which can rupture during processing and lead to cross-contamination

9.3 Slaughter and Dressing

Figure 4. Example flow diagram of slaughter and dressing



Source: Authors' own elaboration based on CXG 78-2011.

Preslaughter (Steps 3.1 and 3.2)

General preslaughter control measures for *Campylobacter* and *Salmonella*

- Animal welfare should be supported through measures such as dim lighting, minimizing noise, optimal temperature, weather protection, minimal handling and avoiding delays in processing¹².

- b. Poultry producers should provide documentation detailing flock health status and medication history to assist slaughter establishments in risk identification and intervention selection before slaughter.
- c. Specific to free-range: FBOs should have a management plan and process control measures to prevent cross-contamination between controlled-environment and free-range flocks.

Specific preslaughter control measures for *Salmonella*

Where appropriate to the national situation, information about the *Salmonella* status should be provided to the establishment and competent authorities in a timely manner to allow for logistical slaughter planning and/or diversion of raw chicken meat to appropriate intervention measures.

Slaughter (Steps 3.3 to 3.5)

General slaughter control measures for *Campylobacter* and *Salmonella*

- a. Where applicable, measures should be taken to minimize bird stress at live hanging, (e.g., use of blue light, breast comforter and suitable line speed).
- b. Birds must be slaughtered in accordance with good commercial practices in a manner that will result in thorough bleeding of the carcasses and ensure that chickens are dead prior to scalding. In addition to ensuring proper animal welfare, this will reduce the amount of blood entering the scald¹².
- c. Hangers and transport trolleys should have a validated protocol that includes washing, disinfection, and rinsing to reduce cross-contamination between carcasses.

Specific slaughter control measures for *Salmonella*

Where appropriate to the national situation:

- a. Apply logistic slaughter which prioritizes slaughter of *Salmonella*-negative flocks first and slaughter of *Salmonella*-positive flocks at the end of the day or week.
- b. Positive flocks may be diverted for specific processing and/or treatment.

Dressing (Steps 3.6 to 3.11)

General dressing control measures for *Campylobacter* and *Salmonella*

- a. To minimize carcass contamination, control measures may include:
 - Washing with abundant, fit-for-purpose water
 - Trimming the carcass to remove unwanted parts
 - Reprocessing or disposal/condemnation of carcasses with visible fecal contamination prior to dressing
 - Use of other physical methods approved by the competent authority
 - Use of chemical decontaminants approved by the competent authority
- b. These control measures can be applied alone or in combination at key process steps. Care should be taken to avoid combining interventions that may reduce the efficacy of a given control measure such as conditions that neutralize decontaminants (e.g., inappropriate pH for a rinse or spray).
- c. Control measures may be evaluated by qualitative or quantitative metrics to evaluate performance against regulatory limits established by the competent authority.
- d. All carcasses which drop on the floor should be condemned or reprocessed under specific conditions as determined by the competent authority. Any dropped product should trigger corrective actions as appropriate, such as trimming and re-washing.

¹² Refer to chapter on "Animal Welfare during Slaughter" of the [WOAH Terrestrial Animal Health Code](#)

General scalding control measures for *Campylobacter* and *Salmonella*

a. Contamination during scalding can be minimized by:

- Using pre-scald brush and wash systems
- The use of counter-current, high-flow rates of fit-for-purpose water with an adequate degree of agitation
- Maintaining an optimal scalding temperature¹³ that helps to reduce the bacterial load and at a duration specific to the respective type of scalding process (e.g., hard, medium, or soft scalding)
- Using multi-staged tanks, where practical
- Emptying and cleaning tanks at the end of a processing period and cleaning and disinfecting tanks at least daily
- Incorporating approved disinfectants (i.e., biocidal agents applied to non-living surfaces) as a multi-hurdle approach to reducing contamination
- Using a water treatment to ensure that reused water is fit-for-purpose

Scalding Hazard-Based Control Measures

Specific to *Campylobacter*

Hard scalding (elevated temperatures, shorter time) has been shown to reduce *Campylobacter* contamination on chicken carcasses.

General defeathering and wash control measures for *Campylobacter* and *Salmonella*

Cross-contamination at defeathering can be minimized by:

- Prevention of feather build-up on equipment
- Continuous rinsing of equipment and carcasses with fit-for-purpose water
- Regular adjustment and maintenance of equipment, paying particular attention to the cleaning of moving parts
- Regular inspection, cleaning, and replacement of plucker fingers
- Ensuring complete removal of debris and any last remaining feathers with a post-plucker wash

General feet and head removal control measures for *Campylobacter* and *Salmonella*

Head pulling or removal should be carried out in a manner that prevents leakage from the crop. Heads should be pulled downwards to reduce contamination due to crop rupture.

General rehang control measures for *Campylobacter* and *Salmonella*

Using automated transfer (rehang), where possible, rather than manual transfer of carcasses between the defeathering and evisceration lines can reduce external surface cross-contamination

General evisceration control measures for *Campylobacter* and *Salmonella*

Improper evisceration may result in cross-contamination of carcasses. Slaughter establishments should consider monitoring for cross-contamination caused by accidental spillage during venting, opening, evisceration, and dressing. Properly maintained, calibrated, and operated equipment minimizes the risk of ruptured viscera and the spread of gastrointestinal contents or feces, and included:

- Ensuring birds of similar size are processed together. Inconsistent carcass weight and sizes (for example, because of poor bird size uniformity within a grower house or processing male and female birds together) can result in mis-cuts and fecal contamination
- Ensuring carcasses are shackled correctly and monitored as they move through the process

¹³ Taking into consideration, suitability requirements (i.e. not affecting the skin)

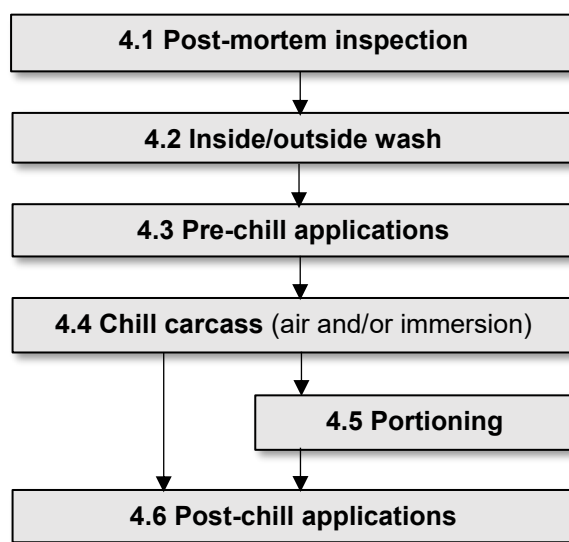
- Ensuring evisceration blades are kept sharpened and thoroughly clean
- Keeping equipment in good sanitary condition and free of intestinal contents
- Careful adjustment, calibration, and regular maintenance of machinery to effectively handle the type (e.g., size and average live weight) of birds to be slaughtered
- Training in appropriate utensil use, sanitation, and hand washing is essential to reduce cross-contamination when manual evisceration is performed. Refer to the *Code of Hygienic Practice for Meat* (CXC 58-2005) section 9.4: Hygiene Requirements for Slaughter and Dressing to ensure manual evisceration is carried out in accordance with established GHPs

General crop removal control measures for *Campylobacter* and *Salmonella*

- Where possible, crops should be extracted in a manner that is likely to limit carcass contamination.
- The use of cropper systems allows the release of accumulated dirty water in the carcass cavity, so efforts to remove collected water prior to chilling should be considered.

9.4 Post-Evisceration Processing

Figure 5. Example flow diagram of post-evisceration processing



Source: Authors' own elaboration based on CXG 78-2011.

Post-Mortem Inspection

General post-mortem inspection control measures for *Campylobacter* and *Salmonella*

- Line speed, adequate presentation of the carcass and its viscera, and the amount of light in the facility should be appropriate for effective post-mortem inspection of carcasses for visible contamination, organoleptic defects, and relevant gross pathology.
- Monitor for fecal contamination prior to pre-chill applications to ensure that chicken carcasses contaminated with visible fecal material do not enter the chiller.

Inside/Outside Wash

General inside/outside wash control measures for *Campylobacter* and *Salmonella*

The inside and outside of all carcasses should be thoroughly washed, using potable water with sufficient water pressure and proper direction to remove visible contamination. Appropriate equipment should be used to ensure direct water contact with the carcass. The removal of contaminants may be aided by the use of brushing apparatus installed in line with the inside/outside wash. The water pressure can be validated as sufficient by using qualitative or quantitative metrics to assess performance in relation to the regulatory limits established by the competent authority.

Pre-Chill Applications

Pre-Chill Applications Hazard-Based Control Measures

General

- An on-line reprocessing¹⁴ spray system incorporating acidified sodium chlorite (ASC) has been shown to reduce *Campylobacter* in the whole carcass rinse sample and to reduce the prevalence of *Salmonella* positive carcasses
- Additional significant reductions in *Campylobacter* and *Salmonella* can be achieved by post-chilling decontamination sprays or dips
- Several different chemicals (e.g., trisodium phosphate) have been demonstrated to be effective in reducing carcass contamination at different washing steps.

Specific to *Salmonella*

- The use of a pre-chill ASC spray or ASC for dipping carcasses has been shown to reduce *Salmonella* prevalence on carcasses
- Sequential application of ozonated water to skin and subcutaneous tissue of drumsticks has been shown to reduce *Salmonella* loads below detectable levels

Chill Carcass (Air and/or Immersion)

General chill carcass (air and/or immersion) control measures for *Campylobacter* and *Salmonella*

- a. Raw chicken meat should be chilled, using air and/or immersion chilling, as quickly as possible to limit the growth of microorganisms on the carcass.
- b. Potable water should be used in any chilling system.
- c. Design and operation of chilling systems should ensure that the target temperature of chilled carcasses is achieved by the time carcasses exit the chiller.
- d. Chilling relies on carcasses reaching temperatures relevant to controlling microbial growth. Care should be taken to monitor carcass temperature, application of processing aids, and pH to ensure efficacy.
- e. Specific to air chilling: If water sprays are used during air chilling to prevent desiccation of carcasses, they should be arranged to minimize cross-contamination.
- f. Specific to immersion chilling:
 - Chilled water may be used, or ice made from potable water may be added. When reclaimed or reused water is used, it should be treated and maintained in a way that prevents any increased risk of food contamination
 - Water flow should be counter-current and may be agitated to assist cooling and washing action. The water and agitation create a secondary washing effect that helps to remove organisms from the carcass
 - Chlorine in the chill tank may not act as a decontaminating agent directly on the contaminated carcass but instead may inactivate *Campylobacter* and *Salmonella* when these are washed off from the carcass into the water, and by preventing re-attachment and cross-contamination. This requires the addition of chlorine at a level sufficient to maintain a free residual chlorine concentration in the water
 - The number of birds, the water back-flow rate, temperature, pH, and the level of decontaminants (e.g., free available chlorine) in the immersion tank should be carefully balanced and controlled as excess organic matter will reduce the effectiveness of the decontaminant thereby allowing greater cross-contamination of carcasses. Free movement of water around carcasses should be maintained

¹⁴ Additional washing or trimming step performed without removing the chicken carcass from the main processing line. This is used as a control measure that aims to eliminate fecal or ingesta contamination.

- Post-chilling, any excess water should be allowed to drain away from the carcasses to minimize cross-contamination at subsequent steps in the processing chain
- Drip trays should be considered to prevent cross-contamination from dripping water

Chill Carcass (Air and/or Immersion) Hazard-Based Control Measures

General – Immersion Chilling

- Where possible, immersion chilling of carcasses combined with decontaminants (e.g., according to their specified permissible limits by competent authority (e.g., chlorine, organic acids, cetylpyridinium chloride [CPC]) can reduce the concentration of *Campylobacter* and *Salmonella* and is more effective than air chilling in terms of reducing surface concentrations on carcasses
- Where considered necessary for control of *Campylobacter* and *Salmonella*, antimicrobial processing aids may be added to the chiller water. These should be approved by the competent authority within their specified permissible limits and may include, among others:
 - Free chlorine (as produced by chlorine gas, sodium-hypochlorite, calcium hypochlorite tablets or electrolytically generated hypochlorous acid)
 - Organic acids (e.g., citric, lactic or peracetic acid)
 - Other oxidants (e.g., hydrogen peroxide, peroxyacids, chlorine dioxide, acidified sodium chlorite)

Specific to *Campylobacter* – Air and/or Immersion Chilling

Forced air chilling (blast chilling) and/or immersion chilling has been shown to reduce the concentration of *Campylobacter* on chicken carcasses

Portioning

Portioning is the cutting up (e.g., trimming, deboning, slicing, dicing) of chilled, raw chicken carcasses into parts prior to packaging or further processing. Portioning chicken carcasses can lead to cross-contamination between carcasses and parts and from the surface tissues to the internal, uncontaminated muscle tissue.

General portioning control measures for *Campylobacter* and *Salmonella*

- Portioning should be carried out:
 - In a way to avoid cross-contamination by separating portioning areas from earlier, higher-contamination operations and with unidirectional product and personnel flow
 - In exclusive, isolated, and pre-chilled areas, with adequate temperature control and recording equipment
- Ensure an orderly workflow by controlling work-in-process volumes and implement limits for time and temperature based on scientific criteria.
- Minimize the product-to-product, handlers-to-product, and product-to-surface contact, especially for skin-on parts where *Campylobacter* and *Salmonella* are frequently present on the skin.
- Smooth, preferably self-cleaning conveyor belts should be used to minimize accumulation of raw chicken meat, trimmings, and byproducts. The work surface should have effective drainage to prevent liquid buildup.
- Accumulation of raw chicken meat, trimmings, and byproducts on processing lines should be avoided to prevent an increase in product temperature during operations.
- Maintain product temperatures at those that prevent the growth of *Campylobacter* and *Salmonella* during mechanical boning and throughout portioning and staging (e.g., through pre-chilled rooms, chilled tables, and short exposure times).

Portioning Hazard-Based Control Measures

General

Where considered necessary for control of *Campylobacter*, and *Salmonella*, antimicrobial processing aids (e.g., organic acids, peroxyacids) may be applied, if authorized by competent authority. Products used should be applied within their specified permissible limits with documented control of concentration, pH, oxygen reduction potential, temperature and contact time

Post-Chill Applications

Post-Chill Applications Hazard-Based Control Measures

Specific to *Salmonella*

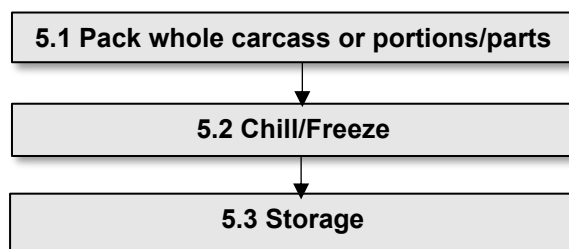
- Several different antimicrobial processing aids have been demonstrated to be effective in reducing carcass contamination at different washing steps and should be used to permissible limits specified by a competent authority
- The use of ASC post-chill has been shown to reduce the prevalence of *Salmonella* positive carcasses
- Spray applications of chlorinated water have been shown to reduce the prevalence of *Salmonella*-positive carcasses
- A chlorine dioxide generating system applied as a dip post-chill resulted in a reduction in *Salmonella* prevalence
- Immersion in peroxyacetic acid (PAA) has been shown to reduce *Salmonella* populations
- High pressure processing may be effective in reducing *Salmonella* in chicken liver

Specific to *Campylobacter*

- Spray applications of PAA have been shown to reduce the prevalence of *Campylobacter* positive carcasses

9.5 Packaging and Storage at Processing Plant

Figure 6. Example flow diagram of packaging and storage at processing plant



Source: Authors' own elaboration based on CXG 78-2011.

Pack whole carcass or portions/parts

General packaging control measures for *Campylobacter* and *Salmonella*

- a. Care should be taken when packaging to minimize external contamination of the pack, e.g., by use of leakproof packaging or absorbent pads.
- b. Pre-packed chicken products intended to be cooked by the consumer should be labelled with safe handling, cooking, and storage instructions as appropriate to the national situation.

Packaging Hazard-Based Control Measures**General**

Various doses of Gamma rays or electron beams applied to warm, chilled, or frozen carcasses have been shown to be effective at eliminating *Campylobacter* and *Salmonella*. Where irradiation is permitted, levels should be validated and approved by the competent authority

Chill/Freeze**Chill/Freeze Hazard-Based Control Measures****Specific to *Campylobacter***

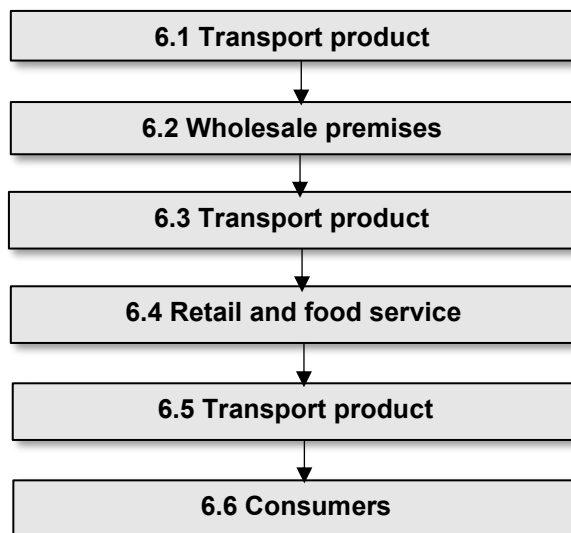
- Freezing carcasses has been shown to reduce *Campylobacter* prevalence in chicken liver and meat
- Crust freezing using continuous carbon dioxide belt freezing of chicken meat products has been shown to reduce level of *Campylobacter* on the surface of chicken meat

StorageSpecific storage control measures for *Salmonella*

Products should be stored frozen or at temperatures sufficient to prevent the growth of *Salmonella*. Temperature recommendations should be determined by a competent authority and while differing by country of origin, are typically -5°C or below and. Packaging in modified atmosphere does not prevent growth of *Salmonella* if temperature abuse occurs.

9.6 Distribution, Retail, and Consumers

Figure 7. Example flow diagram of product distribution channels



Source: Authors' own elaboration based on CXG 78-2011.

Transport Product (Steps 6.1, 6.3, and 6.5)General transport product control measures for *Campylobacter* and *Salmonella*

- For GHP-based control measures for all aspects of transport, refer to the *Code of Practice – General Principles of Food Hygiene* (CXC 1-1969) and the *Code of Hygienic Practice for Meat* (CXC 58- 2005).

- b. Products should be transported at temperatures that prevent the growth of *Campylobacter* and *Salmonella* and in a manner that prevents cross-contamination with other foods and surfaces.

Wholesale premises (Step 6.2)

General wholesale premises control measures for *Campylobacter* and *Salmonella*

Products should be stored at temperatures that prevent the growth of *Campylobacter* and *Salmonella* and in a manner that prevents cross-contamination with other foods and surfaces.

Retail and Food Service (Step 6.4)

Retail

General retail control measures for *Campylobacter* and *Salmonella*

- a. Hygiene measures should be in place to prevent cross-contamination between raw chicken meat, surfaces, cutting boards, utensils, and other food, especially cooked, ready-to-eat products.
- b. Retailers should separate raw chicken meat from cooked or ready-to-eat products.
- c. Hands should be washed and sanitized before and after handling raw chicken meat. Retailers may also provide customers with the means to sanitize hands before and after handling raw chicken meat packs.
- d. Where products are packed at retail for individual selection by customers, packs should be leak-proof.
- e. Extra packaging should be supplied at the display counter to allow customers to separate packaged raw chicken meat from other purchases.
- f. Products should be stored at temperatures that prevent the growth of *Campylobacter* and *Salmonella* and in a manner that prevents cross-contamination with other foods and surfaces.

Food Service

General food service control measures for *Campylobacter* and *Salmonella*

- a. For GHP-based control measures, also refer to the *Code of Hygienic Practice for Precooked and Cooked Foods in Mass Catering* (CXC 39-1993).
- b. Thawing of frozen chicken should be carried out in a manner that minimizes the potential for growth of microorganisms and prevents cross-contamination (e.g., refrigerator thawing at $\leq 5^{\circ}\text{C}$, sealed cold-water submersion with frequent water changes or microwave defrost followed by immediate cooking). Room-temperature thawing should be avoided.¹⁵
- c. Washing of raw chicken meat should not be carried out as it is likely to spread contamination.
- d. Chicken meat should be cooked according to a process that is capable of reaching an internal temperature, as determined by a competent authority, that can inactivate or kill *Campylobacter* and *Salmonella*.
- e. Food service operators should be fully trained and aware of the differences between raw and cooked chicken products in relation to food safety and ensure separation at all times.
- f. Food service operators should have hygiene measures in place that minimize cross-contamination between raw chicken and hands, contact surfaces, cutting boards, and utensils, and should prevent contamination of other foods, especially ready-to-eat foods.
- g. Products should be stored and transported at temperatures that prevent the growth of *Campylobacter* and *Salmonella* and in a manner that prevents cross-contamination with other foods and surfaces. Home delivery services should consider safe storage and transportation where space may be limited, and refrigeration may not be available. Where home-delivery or meal-kit services are used, validated insulated packaging and coolant systems should maintain safe temperatures throughout transit and safely segregate raw and ready-to-eat foods.

¹⁵ Refer to the [*Code of Practice for the Processing and Handling of Quick Frozen Foods*](#) (CXC 8-1976)

Consumers (Step 6.6)General control measures for *Campylobacter* and *Salmonella*

a. Consumer education should focus on:

- Proper handwashing and other hygienic measures
- Separating raw and cooked foods to prevent cross-contamination.
- Use separate equipment and utensils such as knives and cutting boards for raw and cooked foods
- Cooking foods to safe minimum internal temperatures
- Prevention of temperature abuse including during transport

The WHO Five keys to safer food¹⁶ can assist in this process.

- b. Special attention should be paid to the education of all people preparing food, and particularly to all people preparing food for vulnerable populations (e.g., the young, elderly, pregnant, and those with compromised immunity).
- c. The above information for consumers should be provided in appropriate languages and forms. Multiple channels such as the internet, media, public health providers, healthcare professionals, food hygiene trainers, product labels, meal-kit recipes, posters and pamphlets, school curricula and cooking demonstrations should be considered when disseminating educational information.
- d. Washing raw chicken in the kitchen should be discouraged to minimize the possibility of cross-contamination of other foods and surfaces that come into contact with food and humans.
- e. Consumers should wash and disinfect food-contact surfaces, including chopping boards, bowls, plates, knives, and other utensils after handling raw chicken to significantly reduce the potential for cross-contamination in the kitchen, and to cooked, ready-to-eat foods.

10. RISK-BASED CONTROL MEASURES

GHPs provide the foundation for most food safety control systems. Where possible and practical, food safety control systems should incorporate hazard-based control measures and risk assessment to determine risk-based control measures. Identification and implementation of risk-based control measures can be elaborated by the application of a RMF process as advocated in the *Principles and Guidelines for the Conduct of Microbiological Risk Management* (MRM) (CXC 63-2007).

While these guidelines provide generic guidance on the development of GHPs and hazard-based control measures for *Campylobacter* and *Salmonella*, the development of risk-based control measures for application at single or multiple steps in the food chain are primarily the domain of competent authorities at the national level. Industry may derive risk-based measures to facilitate the application of process control systems.

Development of risk-based control measures

Competent authorities operating at the national level should develop risk-based control measures for *Campylobacter* and *Salmonella* where possible and practical. Risk modeling tools used to explore risk management options and contribute to risk management decisions should be fit for purpose. The risk manager needs to understand the capability and limitations of the risk modeling tools they select.¹⁷ When developing risk-based control measures, competent authorities may use quantitative examples of the likely level of control of a hazard at certain steps in the generic food chain in this document, as a peer-reviewed scientific resource. Competent authorities formulating risk management metrics as regulatory control measures should apply a methodology that is scientifically robust and transparent.

Availability of a web-based decision support tool

FAO/WHO developed through JEMRA a web-based decision support tool¹⁸ to assist with the development of risk-based control measures for *Campylobacter* and *Salmonella* in the raw chicken meat food chain at the national level. This web-based tool can be used, complementary to these guidelines, to model different food chain

¹⁶ <https://www.who.int/publications/i/item/9789241594639>

¹⁷ [Principles and Guidelines for the Conduct of Microbiological Risk Assessment \(CAC/GL 30-1999\)](#)

¹⁸ <https://tools.fstools.org/poultryrmtool/>

scenarios and to estimate relative risk reduction and/or ranking consequential to:

- Implementation of a specific control measure at a particular step in the food chain (from primary production through to consumption),
- Implementation of a combination of control measures at different steps in the food chain, and
- Modeling of different food chain scenarios similar to the flow diagrams presented in this document

Industry may also make use of the decision support tool when designing premise-specific food safety programs that may differ in the availability of specific control measures.

The user of the decision support tool should:

- Take responsibility for the appropriateness of the scientific data that is introduced
- Be aware of the uncertainty that inevitably accompanies risk modeling and, in conjunction with the risk manager, use the web-based tool to *explore* risk management options and *inform* risk management decisions, rather than provide a prescriptive base

11. VALIDATION, IMPLEMENTATION, AND VERIFICATION OF CONTROL MEASURES

Validation

Refer to the *Guidelines for the Validation of Food Safety Control Measures* (CXG 69 -2008). Note: GHP-based control measures are not subject to validation. Prior to the validation of hazard-based control measures for *Campylobacter* and/or *Salmonella*, the following tasks should be completed:

- Identification of the specific measures to be validated. This would include consideration of any measures approved by the competent authority and whether any measure has already been validated in a way that is applicable and appropriate to specific commercial use, such that further validation is not necessary
- Identification of any existing food safety outcome or target, established by a competent authority or industry. Industry may set stricter targets than those set by a competent authority

Validation of measures may be carried out by a competent authority and/or industry and should be carried out prior to implementation. Where validation is undertaken for a measure based on a hazard control for *Campylobacter* and/or *Salmonella*, evidence will need to be obtained to show that the measure is capable of controlling *Campylobacter* and/or *Salmonella* to a specified target or outcome. This may be achieved by the use of a single measure or a combination of measures. The *Guidelines for the Validation of Food Safety Control Measures* (CXG 69 -2008) provide detailed advice on the validation process (section VI).

Implementation

Refer to section 9.2 of the *Code of Hygienic Practice for Meat* (CXC 58-2005) and the *General Principles of Food Hygiene* (CXC 1-1969).

Industry has the primary responsibility for implementing, documenting, applying, and supervising process control systems to ensure the safety and suitability of raw chicken meat that they produce or handle. These activities should incorporate GHPs and validated measures (HACCP) for control of *Campylobacter* and/or *Salmonella* as appropriate to national government requirements and industry specific circumstances.

Implementation involves:

- Giving effect to the selected control measures
- Developing an implementation plan
- Communicating the control measures and implementation plan with stakeholders
- Ensuring that the regulatory framework and infrastructure are in place for implementation
- Establishing an evaluation process to assess whether the control measures have been properly implemented

The documented process control systems should describe the activities applied including any sampling procedures, specified targets, such as performance objectives or performance criteria set specifically for *Campylobacter* and/or *Salmonella*, industry verification activities, and corrective and preventive actions.

In regulatory systems, the competent authority should provide guidelines and other implementation tools for the development of process control systems to industry as appropriate. The competent authority may choose to approve the documented process control systems for GHPs and HACCP and stipulate verification frequencies.

Verification

Refer to section 9.2 of the *Code of Hygienic Practice for Meat* (CXC 58-2005) and section IV of the *Guidelines for the Validation of Food Safety Control Measures* (CXG 69 -2008).

Industry verification should demonstrate that all control measures for *Campylobacter* and/or *Salmonella* have been implemented as intended. Verification should include observation of processing activities, documentary checks, and sampling for *Campylobacter* and/or *Salmonella* testing as appropriate. Verification frequency should vary according to the operational aspects of process control, the historical performance of the establishment and the results of verification itself.

In regulatory systems, the competent authority⁴ should verify that all regulatory control measures implemented by industry comply with regulatory requirements as appropriate for control of *Campylobacter* and/or *Salmonella*. Microbiological testing requirements should be provided for verification of HACCP systems where specific targets for control of *Campylobacter* and/or *Salmonella* have been stipulated.

The competent authority⁴ may choose to use a competent body (e.g., independent verifiers, academia, trade associations, professional societies) to undertake specific verification activities in relation to the industry's process control systems. Where this occurs, the competent authority should stipulate specific functions to be carried out.

12. MONITORING AND REVIEW

Monitoring the effectiveness of control measures and review of food safety control systems are essential components of the application of an RMF³. It contributes to process control verification and demonstrating progress towards achieving public health goals. Monitoring systems allow for the precise application of control measures such as breeder flock status which informs control measures for day-old progeny and pre-slaughter monitoring of broilers that can inform control measures for slaughter of infected flocks. These data, together with public health surveillance data, are used in risk assessments and risk profiles of pathogen/food combinations to prioritize foods and pathogens considered to be a country's highest priority (e.g., those strains with virulence factors capable of causing severe illness or considered to cause significant illness in that country).

Information on the level of control of *Campylobacter* and *Salmonella* at appropriate points in the food chain can be used for several purposes. For example, to validate and/or verify outcomes of food control measures, to monitor compliance with hazard-based and risk-based regulatory goals, and to help prioritize regulatory efforts to reduce foodborne disease. Systematic review of monitoring information allows the competent authority and relevant stakeholders to make decisions in terms of the overall effectiveness of the food safety control systems and make improvements where necessary. Refer to the *Principles and Guidelines for the Establishment and Application of Microbiological Criteria Related to Foods* (CXG 21-1997).

Monitoring

Monitoring should be carried out at appropriate steps¹⁹ in the food chain using randomized or targeted sampling.

Primary production and processing:

Examples of monitoring systems for *Campylobacter* and/or *Salmonella* throughout primary production and processing include:

- Environmental sampling (e.g., drag swabs, boot swabs, cloacal samples, feed, lining paper from chick trays) and surveillance at breeder farms and hatcheries to inform flock risk, status, and preharvest control measures
- Environmental sampling prior to transport to slaughter to determine flock status and permit logistic scheduling and/or channeling of positive chickens for specific processing steps such as heat treatment or freezing
- Whole bird rinse, neck skin, parts, or other sampling at the end of processing (e.g., after immersion or air chilling) to verify compliance with hazard-based regulatory or company performance goals. A moving

¹⁹ Recommendations on surveillance in poultry flocks for *Salmonella* are provided in the WOA *Terrestrial Animal Health Code*, Chapter "Prevention, Detection and Control of *Salmonella* in Poultry"

window approach as described in Section 4.9 of CXG 21-1997 can be considered

Regulatory:

Regulatory monitoring programs should be designed in consultation with relevant stakeholders and the results and trend analyses be made available to them in a timely manner. Given the importance of monitoring data in risk management, sampling and testing components should be standardized on a national basis and be subject to quality assurance. The type of data collected in monitoring systems should be appropriate for the outcomes sought. Examples of monitoring systems in a regulatory environment include:

- Ongoing or periodic national or regional surveys for establishing baseline levels of contamination and assisting in the development of regulatory performance goals and pathogen reduction programs within the food chain
- Sampling and trend analysis of chicken meat and ceca during processing and/or chicken meat at retail to determine contamination trends
- Routine whole genome sequencing of *Salmonella* isolates from feed, *Salmonella* and *Campylobacter* isolates from live chickens, and from sampling retail meat to provide information on circulating strains, and to assist in outbreak investigations

Laboratory testing of raw chicken meat during and after processing is vital to surveillance and verification activities. The results should be used to determine prevalence, and when possible, quantification, of pathogens of public health concern as determined by a competent authority.

Where live *Salmonella* vaccines are used, precise testing that differentiates between vaccine strains and field strains of the pathogen is essential. Otherwise, there is a risk that the use of the vaccine increases the prevalence of positive *Salmonella* results from slaughterhouse samples. Utilizing proper diagnostic methods, such as molecular tests, serological tests and serotyping, is necessary for monitoring vaccination efficacy and implementing appropriate biosecurity measures.

Wherever possible, monitoring information from the food chain should be combined with human health surveillance data and food source attribution data to validate risk-based control measures and to verify progress towards risk-reduction goals. Activities supporting an integrated response include:

- Surveillance of clinical salmonellosis and campylobacteriosis in humans
- Epidemiological investigations, including outbreaks and sporadic cases
- Surveillance for antimicrobial resistance in isolates from clinical, bird, and food samples. Refer to the *Guidelines on Integrated Monitoring and Surveillance of Foodborne Antimicrobial Resistance* (CXG 94-2021)

Reliable surveillance for *Salmonella* spp. and *Campylobacter* spp. should utilize reference methods validated by independent bodies or official organizations that are accredited for the use of international standards for microbiological testing. *Salmonella enterica* is one of two *Salmonella* species that represent over 2500 distinct serovars with a small subset of these representing most human salmonellosis infections across the globe. Because of this, where possible, a robust surveillance system should include methods that can distinguish *Salmonella* serovars of differing levels of public health concern. Serovars of higher concern to human health vary geographically and temporally and should be prioritized for monitoring and control at the national level. These serovars can be distinguished by a variety of technologies and cross-referenced with clinical data to determine public health priorities. This highlights the importance of laboratory testing to ensure pathogens of public health concern are identified.

Review

Monitoring data on *Campylobacter* and *Salmonella* and associated risks should be reviewed on a periodic basis to provide information on the effectiveness of risk management decisions and actions. *Campylobacter* and *Salmonella* spp. sampling results should be shared with competent authorities so that the information can be integrated into trend analyses.

Periodic review of monitoring data at relevant process steps should be used to inform future decisions on selection of specific control measures and provide a basis for their validation.

Information gained from monitoring in the food chain should be integrated with public health surveillance, food source attribution data, and withdrawal and recall data, where available, to evaluate and review the effectiveness

of control measures.

Where monitoring of hazards or risks indicates that regulatory performance goals are not being achieved, risk management strategies and/or control measures should be reviewed.

APPENDIX VII

**REVISED GUIDELINES ON THE APPLICATION OF GENERAL PRINCIPLES OF FOOD HYGIENE TO
THE CONTROL OF LISTERIA MONOCYTOGENES IN FOODS (CXG 61-2007)**

(For adoption at Step 5/8)

1. INTRODUCTION

1. *Listeria (L.) monocytogenes* is a ubiquitous non spore forming Gram-positive bacterium that occurs widely in nature (soil, vegetation, silage, faecal material, sewage, water), aquacultural, and food processing environments. *L. monocytogenes* can be found in the intestinal tract of humans. Faecal carriage among asymptomatic individuals has been reported to range from less than 1% to as high as 10%. Generally, *L. monocytogenes*:
 - can grow in low oxygen conditions and at refrigeration temperatures;
 - is more resistant to various environmental conditions (e.g. high salt or acidity) compared to other non-spore forming, foodborne pathogenic bacteria (e.g. *Salmonella* spp., enterohemorrhagic *Escherichia coli*);
 - does not grow at a pH less than 4.4 or a water activity less than 0.92;
 - can survive for long periods in the environment, on foods, in food processing establishments, and in the household refrigerator; and
 - can form, colonise, survive in and persist in biofilms.
2. *L. monocytogenes* mainly infects humans through contaminated food. It can cause invasive listeriosis, wherein the microorganism penetrates the lining of the gastrointestinal tract and then establishes infections in normally sterile sites within the body. The likelihood that *L. monocytogenes* can establish a systemic infection is dependent on a number of factors, including the number of microorganisms consumed, the susceptibility of the host, and the virulence of the particular *L. monocytogenes* strain ingested. While almost all strains of *L. monocytogenes* are considered to be capable of causing illness, virulence among strains and lineages varies significantly as reflected in the occurrence in clinical isolate genotypes of lineage I twice as frequently as lineage II.
3. Listeriosis is an infection that most often affects susceptible populations, including pregnant individuals (and their foetuses or neonates infected in utero or during delivery), adults aged 65 or older, and those with immunosuppression—whether due to chronic diseases such as cancer, diabetes, renal or liver failure, inflammatory diseases, heart disease, or AIDS—or as a result of treatment with immunosuppressive drugs (e.g. transplant recipients). The bacterium most often affects the placenta, the blood stream, or the central nervous system. Manifestations of invasive listeriosis include, but are not limited to, bacteremia, septicaemia, meningitis, encephalitis, miscarriage or stillbirth, premature birth, and neonatal disease. Long-term consequences affecting health have also been reported (e.g. chronic sequelae). Incubation periods prior to individuals becoming symptomatic can be from a few days to three months. In otherwise healthy individuals, *L. monocytogenes* can also cause mild febrile gastro-enteritis (i.e. non-invasive listeriosis), a less severe form of the disease.
4. Available epidemiological data show invasive listeriosis occurs both as sporadic cases and outbreaks, with the majority of illnesses being sporadic (i.e. not associated with an identified outbreak). Invasive listeriosis is a relatively rare, but often severe disease with incidence rates of 2 to 7 cases per 1,000,000 individuals, hospitalisation rates >90%, and case fatality rates of 15 to 30%.¹ Earlier efforts by industry and competent authorities in many countries resulted in a reduced incidence of listeriosis. Such efforts included:
 - implementing Good Agriculture Practices (GAPs), Good Hygienic Practices (GHPs)₁ and applying Hazard Analysis Critical Control Points (HACCP) to reduce the frequency, extent, and level of *L. monocytogenes* in ready-to-eat (RTE) foods,
 - improving the integrity of the cold chain through processing, distribution, retail and the home to reduce the incidence of temperature abuse conditions that foster the growth of *L. monocytogenes*,
 - encouraging the use of processing aids, post-packaging treatments, and formulations that reduce

¹ FAO and WHO. 2022. *Listeria monocytogenes in ready-to-eat (RTE) foods: attribution, characterization and monitoring – Meeting report*. Microbiological Risk Assessment Series No. 38. Rome.
<https://doi.org/10.4060/cc2400en>

levels or suppress the potential growth of *L. monocytogenes* in RTE food, and

- enhancing risk communication, particularly for consumers at increased risk of listeriosis.

However, following the initial reduced incidence of listeriosis due to these early efforts by food business operators (FBOs) and competent authorities, the incidence of listeriosis has remained unchanged or, in some cases, increased in recent years.

- Transitory increases in incidence rates have also been associated with large foodborne outbreaks attributable to specific foods, often from specific FBOs. In such cases, the incidence of listeriosis returned to prior baseline values after the causative food was removed from the market, and consumers received effective public health information pertaining to appropriate food choices and handling practices.
- Sporadic cases and outbreaks of listeriosis are generally associated with RTE foods especially, but not limited to, those held for extended periods under refrigeration temperatures. It should be noted that some foods associated with listeriosis outbreaks, such as certain frozen vegetables, were intended by the FBO to be cooked by the consumer before consumption. However, frozen vegetables (as with some other frozen foods) are palatable without cooking, and consumers do not always follow the cooking instructions on the product labels.
- Outbreaks of listeriosis can vary greatly in size, involving as few as two cases to potentially more than a hundred cases. For example, the largest known listeriosis outbreak occurred in 2017-2018, with over 1,000 identified cases and over 200 confirmed deaths. Contaminated processed RTE meat products (i.e. polony) were identified as the cause of this outbreak.
- L. monocytogenes* has been isolated from a wide range of foods, including fresh, fresh-cut and frozen fruits and vegetables, raw and pasteurised fluid milk, cheeses made from unpasteurised and pasteurised milk (particularly soft-ripened varieties), ice cream, butter, fermented raw-meat sausages, raw and cooked poultry, raw and processed meats (all types), raw and processed seafood (all types), as well as plant-based foods and beverages.
- The wide variety of foods from which *L. monocytogenes* has been at least occasionally isolated has made it difficult to effectively focus control programmes on those specific foods that contribute to the greatest risk to foodborne listeriosis. As a means of addressing this and other related questions, a full farm-to-table risk assessment on *L. monocytogenes* in selected foods was undertaken by the Food and Agriculture Organization of the United Nations/World Health Organization (FAO/WHO) Joint Expert Meeting on Microbiological Risk Assessment (JEMRA) to review, modify, and update previous risk assessments^{2,3,4}. In particular, past risk assessment models⁵ addressed risk from the point of distribution to consumption, while the updated risk assessments by FAO/WHO considered diverse commodity sub-groups and all steps from primary production to consumption. More specifically, to strengthen local risk management strategies, JEMRA's publicly accessible, open-source quantitative risk assessment models, together with the WHO-supported web-based tool⁶, can be applied under relevant conditions and practices for *Listeria monocytogenes* in RTE diced cantaloupe, frozen vegetables, and RTE cold-smoked fish.
- These risk assessments articulate concepts that countries can use to identify and categorise foods that represent a significant risk of foodborne listeriosis. Several factors that were identified as contributing strongly to the risk of listeriosis associated with foods include:
 - strain virulence;
 - host susceptibility;
 - amount and frequency of consumption of a food;
 - frequency, extent, and level of contamination of a food with *L. monocytogenes*;
 - presence of *L. monocytogenes* in the processing environment;

² FAO and WHO. 2022. *Listeria monocytogenes* in ready-to-eat (RTE) food: attribution, characterization and monitoring: meeting report. Microbiological Risk Assessment Series, No. 38. Rome.

³ FAO and WHO. 2024. Risk assessment of *Listeria monocytogenes* in foods part 1: formal models: meeting report. Microbiological Risk Assessment Series, No. 47. Rome.

⁴ FAO and WHO. 2025. Risk assessment of *Listeria monocytogenes* in foods part 2: risk assessment: meeting report. Microbiological Risk Assessment Series, No. 48. Geneva.

⁵ FAO and WHO. 2004. Risk assessment of *Listeria monocytogenes* in ready-to-eat foods: technical report. Microbiological Risk Assessment Series, No. 5.

⁶ WHO Risk Estimation Tool for *Listeria monocytogenes* in Foods. Available at: https://worldhealthorg.shinyapps.io/Shiny_qraLm/

- potential for transfer of *L. monocytogenes* from the processing environment to RTE food;
 - ability of the food to support the growth of *L. monocytogenes*;
 - temperature of refrigerated or chilled food storage;
 - duration of refrigerated or chilled storage; and
 - consumer knowledge or behaviour and impact of non-intended use (i.e. consumer non-compliance with recommended storage, preparation and consumption practices).
11. In addition, these risk assessments concluded that a combination of interventions is generally more effective in controlling the risk rather than any single intervention.
 12. Risk assessments have consistently identified the ability of an RTE food to support the growth of *L. monocytogenes* as a significant risk factor for listeriosis. Formulation of RTE foods can be one way to substantially reduce the risk of listeriosis, such that one or more of the parameters influencing the growth of the bacterium (e.g. pH, water activity, presence of inhibitory compounds) is altered so the food no longer supports growth.
 13. Multiplication of low numbers of *L. monocytogenes* to levels that cause illness can occur during holding and storage, or distribution of RTE foods that support the growth of *L. monocytogenes*, even when the food is maintained at refrigeration temperatures. Strict control of temperature so that, where feasible, the food never exceeds 5°C (preferably 2°C - 4°C, as growth of *L. monocytogenes* is significantly reduced at these lower temperatures) and shortening the duration of the food's refrigerated or chilled shelf-life are means of minimising the potential for growth of *L. monocytogenes* before the food is consumed.
 14. The production process for many RTE foods includes a listericidal treatment. In such foods, the frequency, extent and level of contamination with *L. monocytogenes* is typically associated with contamination of the food after the listericidal treatment and before packaging. Other RTE foods may not have a listericidal treatment in their production process. In these foods, the frequency, extent and level of contamination with *L. monocytogenes* may be associated with contamination of the food (or its ingredients) at any step in the production process, including primary production. Examples of control measures that can influence the frequency, extent and level of contamination include the proper design and maintenance of facilities and equipment, effective cleaning and disinfection procedures, and maintaining the integrity of the cold chain. The latter has been clearly identified as a risk factor for listeriosis (i.e. the temperature of refrigerated or chilled storage). For some RTE foods, an additional listericidal treatment after final packaging may be introduced to further reduce the risk of listeriosis.
 15. The presence of *L. monocytogenes* in the food processing environment is a major risk for contamination of RTE food. Environmental monitoring programmes (EMPs) that involve the sampling and testing of equipment surfaces (both food contact and non-food contact) and processing environment surfaces can be used to verify the effectiveness of control measures implemented to maintain hygienic conditions and prevent contamination of exposed RTE foods with *L. monocytogenes* (see Annex I).
 16. RTE foods may also be contaminated with *L. monocytogenes* during distribution, retail, and consumer use. For example, the shared use of equipment in retail operations (e.g. slicers used to cut meats or cheeses in delis) has been identified as a significant risk for transferring *L. monocytogenes* between foods, most importantly if *L. monocytogenes* were to be transferred to RTE foods that support its growth. In addition, it is important to note that the ability of a food to support growth of *L. monocytogenes* and the likelihood of its consumption without further listericidal treatment can depend on consumer practices which may deviate from the intended use of the food by the manufacturer. For this reason, FAO/WHO has advised caution when classifying foods into strict categories of RTE versus non-RTE or into RTE foods that support the growth of *L. monocytogenes* versus those that do not.
 17. Risk assessments (including those recently conducted by FAO/WHO) continue to indicate that in order for food control programmes to be effective, they must be capable of consistently meeting the microbiological criteria for *L. monocytogenes* in RTE foods (see Annex III). Such risk assessments clearly indicate that the greatest risk associated with RTE foods is the small proportion of products with high contamination levels of *L. monocytogenes*.
 18. The effects of climate change (e.g. variation in temperature or humidity, increased frequency or severity of weather events) may influence the frequency, extent and level of *L. monocytogenes* contamination of ingredients and foods (e.g. increased contamination of soil, agricultural lands, ground and surface water from flooding of fields, failure to maintain the integrity of the food supply cold chain resulting in microbial growth)⁷.

⁷ FAO and WHO. 2023. Prevention and control of microbiological hazards in fresh fruits and vegetables: parts 1 & 2: general principles: meeting report. Microbiological Risk Assessment Series, No. 42. Rome.

2. OBJECTIVES

19. These guidelines provide advice to FBOs and competent authorities on a framework for the control of *L. monocytogenes* in RTE foods, with a view towards protecting the health of consumers and ensuring fair practices in food trade. The primary purpose of these guidelines is to provide information that will help minimise the likelihood of illness arising from the presence of *L. monocytogenes* in RTE foods. This information may also be of interest to food industry associations, consumers, and other interested parties.

3. SCOPE

20. These guidelines are intended for RTE foods and are applicable throughout the food chain, from primary production to consumption. Based on the results of the FAO/WHO risk assessments, other available risk assessments and epidemiological evaluations, these guidelines will focus on control measures that can be used, where appropriate, to minimise and prevent the contamination or the growth of *L. monocytogenes* in RTE foods. These guidelines focus on key control measures that affect the most significant factors that influence the frequency, extent and levels of *L. monocytogenes* contamination in RTE foods, thereby highlighting the greatest means of reducing the risk of listeriosis. Control measures described for processing environments may apply to distribution, retail, and consumer environments. In many instances, these control measures are articulated in a general manner in the *General Principles of Food Hygiene* (CXC 1-1969) as part of the general strategy for control of foodborne pathogens in all foods. In providing these guidelines, it is assumed that these *General Principles of Food Hygiene* are being implemented. Those principles that are restated reflect the need for special attention for the control of *L. monocytogenes* in RTE foods.
21. GHPs as specified in the *General Principles of Food Hygiene* (CXC 1-1969) and other applicable codes of hygienic practice should be sufficient to control *L. monocytogenes* in non-RTE foods. However, the additional measures described in these guidelines could also be considered and implemented, as necessary, to further control *L. monocytogenes* in non-RTE foods.

4. USE

22. Together with the *General Principles of Food Hygiene* (CXC 1-1969), these guidelines and their annexes are complementary to and should be used in conjunction with any relevant Codex texts, such as:
 - *Principles and Guidelines for the Establishment and Application of Microbiological Criteria Related to Foods* (CXG 21-1997);
 - *Principles and Guidelines for the Conduct of Microbiological Risk Assessment* (CXG 30-1999);
 - *Principles and Guidelines for the Conduct of Microbiological Risk Management (MRM)* (CXG 63-2007);
 - *Guidelines for the Safe Use and Reuse of Water in Food Production and Processing* (CXG 100-2023);
 - *Guidelines for the Validation of Food Safety Control Measures* (CXG 69-2008);
 - *Principles and Guidelines for the Exchange of Information in Food Safety Emergency Situations* (CXG 19-1995);
 - *General Standard for the Labeling of Pre-packaged Foods* (CXS 1-1985);
 - *Code of Hygienic Practice for the Transport of Food in Bulk and Semi-Packed Food* (CXC 47-2001);
 - *Code of Hygienic Practice for Milk and Milk Products* (CXC 57-2004);
 - *General Guidelines on Sampling* (CXG 50-2004);
 - *Code of Hygienic Practice for Aseptically Processed and Packaged Low-Acid Foods* (CXC 40-1993); and
 - *Guidelines on the Management of Biological Foodborne Outbreaks* (CXG 96-2022).

5. GENERAL PRINCIPLES

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

6. DEFINITIONS

24. Refer to Section 6 of the *General Principles of Food Hygiene* (CXC 1-1969) and Section 2 of the *Principles and Guidelines for the Conduct of Microbiological Risk Management (MRM)* (CXG 63-2007), together with the following:
25. **Ready-to-eat 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 foreseeable⁸, based on evidence of consumer habits or practices, that it will be eaten without such treatment.

26. **Listericidal treatment** – Any validated⁹ treatment that reduces *L. monocytogenes* sufficiently to achieve food safety.

GOOD HYGIENE PRACTICES

7. INTRODUCTION AND CONTROL OF FOOD HAZARDS

27. Refer to Section 7 of the *General Principles of Food Hygiene* (CXG 1-1969), together with the following:
28. Control of *L. monocytogenes* for many RTE foods will typically require application of GHPs, some to a greater degree than for non-RTE foods, and other supportive prerequisite programmes, as applicable. Prerequisite programmes, together with HACCP, provide a successful framework for the control of *L. monocytogenes*.
29. For the effective identification and implementation of GHPs for the control of *L. monocytogenes*, the following factors should be considered:
- the intrinsic parameters of the food (e.g. water activity, pH, inhibitory compounds);
 - where in the process the food can be contaminated and where contamination is removed;
 - its history of contamination within the specific facility and within the food type across the international market; and
 - the intended use of the food and the anticipated frequency (based on evidence) the food is used without a subsequent listericidal treatment by another manufacturer or the consumer (i.e. the reasonably foreseeable use of the food).
30. After reviewing and assessing the conditions and activities of the FBO, it may be determined that GHPs alone may be sufficient to control *L. monocytogenes*. However, it may also be determined that it is necessary to place greater attention on some GHPs that are particularly important in the control of *L. monocytogenes* in RTE foods (e.g. increased stringency for cleaning and disinfecting a slicer used for producing deli meats) or the implementation of a critical control point (CCP) consistent with HACCP principles.

8. PRIMARY PRODUCTION

31. Refer to Section 8 of the *General Principles of Food Hygiene* (CXG 1-1969), together with the following:
32. Objectives: Primary production (i.e. those steps in the food chain up to and including storage and, where appropriate, transport of outputs of farming) should be managed in a way to control *L. monocytogenes* when growing crops, raising fish and animals, and harvesting plants, animals or animal products, as applicable.
33. On-farm primary production operations should be controlled to reduce the likelihood of contamination of raw foods and ingredients with *L. monocytogenes*, and prevent growth during storage and transportation. Additional controls at primary production (e.g. drying) can be used to decrease the likelihood that the food will support the growth of *L. monocytogenes* during subsequent processing.
34. Rationale: To reduce the likelihood of introducing *L. monocytogenes* into the food chain, during on-farm activities, which can be a source of contamination.
35. For RTE foods subject to one or more listericidal treatments during subsequent processing or preparation, attention to animal health and the general application of GAPs and GHPs, including animal husbandry practices and use of fit-for-purpose water, is usually sufficient to help reduce the introduction of *L. monocytogenes* to raw materials (e.g. meat, fish, vegetables, fruit).
36. However, for RTE foods that are processed without a listericidal treatment (e.g. raw milk and raw milk cheeses, fresh produce), in addition to those practices described above, extra attention is needed at primary production. For example, increased focus may be needed on personal hygiene, water management programmes, control of contamination in livestock (e.g. mastitis in dairy animals), and in the environment at primary production (e.g. the feeding of inadequately fermented silage or use of wet feeding systems) to mitigate *L. monocytogenes* from known sources of contamination.
37. Primary production methods vary depending on the characteristics of the food. The history of *L. monocytogenes* in raw materials (e.g. meat, fish, vegetables, fruit) or the primary production environment,

⁸ 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.

⁹ See *Guidelines for the Validation of Food Safety Control Measures* (CXG 69-2008).

as well as factors that can impact the risk of contamination of the food with *L. monocytogenes* should be considered. Some of these factors could include:

- seasonality (e.g. microbial kinetics in soil and on the leaves of vegetables);
- primary production practices (e.g. cultivation in open fields, protected agriculture and hydroponic conditions for crops, harvesting practices, irrigation, fertilisation, and other on-farm management practices; harvesting in open waters (sea or fresh) or in farmed environments (aquaculture) for fish and other production activities such as rearing, feeding, milking and capturing); and
- the effects of climate change (e.g. adverse weather events such as heavy rainfall and flooding), which could, for example, increase prevalence of *L. monocytogenes* in soil, increase soil transfer to fresh produce or decrease agricultural water quality.

38. Where appropriate (e.g. when other more effective tools are not available and where raw material testing would be expected to improve the degree of protection offered to the consumer), analysis of raw materials for *L. monocytogenes* can be a tool for verifying that the control measures at primary production are adequately limiting the frequency, extent and level of contamination to those needed to achieve the required level of control during subsequent processing.

8.2 Hygienic production

39. For RTE foods that are processed without a listericidal treatment, it is of particular importance to identify activities where a high likelihood of contamination from *L. monocytogenes* exists and take specific measures to reduce the likelihood to the extent possible. The design and maintenance of equipment used for growing or harvesting food that is consumed without a listericidal treatment (e.g. fresh leafy greens, melons) should prevent the harbourage of *L. monocytogenes* that could lead to contamination of the food.

8.3 Handling, storage and transport

40. After harvest, RTE foods that are processed without a listericidal treatment should be held at temperatures that minimise the growth of *L. monocytogenes*, whenever feasible and appropriate. The period between harvest and storage should be as short as possible.

8.4. Cleaning, maintenance and personnel hygiene

41. The cleaning and disinfection of equipment used for growing, harvesting, and transporting food that is consumed without a listericidal treatment should be conducted at a frequency sufficient to minimise or prevent the contamination of the food and subsequent processing areas with *L. monocytogenes*. The effectiveness of cleaning and disinfection programmes should be periodically verified and the programmes modified, as necessary, to consistently achieve the required level of control during subsequent processing. One way to verify the effectiveness of cleaning and disinfection is with an EMP (see Annex I).

9. ESTABLISHMENT – DESIGN OF FACILITIES AND EQUIPMENT

42. Refer to Section 9 of the *General Principles of Food Hygiene* (CXG 1-1969), together with the following:

43. Objectives: Equipment and facilities should be designed, constructed and laid out to facilitate cleanability and to minimise the potential for *L. monocytogenes* harbourage sites and the contamination of RTE food.

44. Rationale:

- The introduction of *L. monocytogenes* into the RTE processing environment has, at times, resulted from inadequate separation of raw and RTE food processing areas and from poor control of employee or equipment traffic.
- The inability to properly clean and disinfect equipment and premises due to poor design or poor accessibility has resulted in biofilms containing *L. monocytogenes* and harbourage sites that have been a source of contamination.
- The dispersion of microorganisms in aerosols, such as by high-pressure spray during cleaning procedures, has been linked to the spread of *L. monocytogenes* in the processing environment.
- Inadequate ventilation that allows condensate to form on surfaces in food processing environments has resulted in the presence of *L. monocytogenes* in droplets and aerosols, increasing the risk of product contamination. Once *L. monocytogenes* finds harbourage in an establishment (e.g. in a biofilm or in difficult to clean areas) it can be very difficult to eradicate.

9.1 Locator and structure

9.1.2 Design and layout of food establishment

45. Processing facilities should be designed to separate the storage and processing areas for raw and RTE food. This can be accomplished in a number of ways, including linear product flow (raw to RTE) with filtered airflow in the opposite direction (RTE to raw) or physical partitions. Positive air pressure should be maintained on the RTE side of the operation relative to the raw side (e.g. maintain lower air pressures in raw processing areas and higher pressures in RTE processing areas).
46. For RTE foods that are processed without a listericidal treatment, the entire processing area (i.e. from receiving to packaging) should be designed to prevent or minimise the potential for contamination of the RTE food with *L. monocytogenes*.
47. For RTE foods that are processed with one or more listericidal treatments, a greater focus should be placed on the design of processing areas after a listericidal treatment to prevent or minimise the potential for contamination of RTE food with *L. monocytogenes*.
48. Where feasible, the washing areas for removeable food equipment and utensils involved in the processing of RTE food should be located in a separate room from the RTE processing area. In addition, these washing areas should not be used to clean and disinfect equipment and utensils used in the handling of ingredients, particularly those that are raw.
49. Processing areas where RTE foods are exposed to the environment should be designed to avoid the accumulation of moisture on surfaces. Wet operations, especially those with excessive accumulation of moisture on surfaces, often enhance the growth and spread of *L. monocytogenes*.

9.2 Facilities

9.2.4 Temperature

50. Adequate facilities should be available for controlling the temperature of RTE foods to minimise growth of *L. monocytogenes* whenever feasible and appropriate. Control of ambient temperature during processing can also be important in the control of *L. monocytogenes*.

9.2.5 Air quality and ventilation

51. Where applicable, air handling systems that supply air to RTE processing areas should be designed (e.g. to include adequate filtration) such that the air does not introduce *L. monocytogenes* to the processing environment. Where possible, air handling units, including air ducts and ventilation systems, should not be located directly above RTE food equipment or blow air directly onto RTE food or RTE food contact surfaces.
52. Condensate from air handling units and ventilation systems has been an identified source of *L. monocytogenes* in RTE processing areas. The formation of condensate on such equipment and structures should be minimised; however, if it does occur, condensate should be collected in drip pans and transferred directly to a drain. Drip pans and piping or tubing used to collect and transfer condensate should be cleaned and disinfected on a regular basis such that they do not become sources of contamination by *L. monocytogenes*.

9.2.7 Storage

53. Adequate facilities should be available for storing refrigerated or frozen RTE foods at temperatures that minimise growth of *L. monocytogenes*. Refrigerated storage rooms should be designed so that a refrigerated product temperature, where feasible and appropriate, does not exceed 5°C (preferably 2°C - 4°C, as growth of *L. monocytogenes* is significantly reduced at these lower temperatures). Frozen storage rooms should be designed so that an appropriate frozen product temperature is maintained.
54. Raw materials should be stored separately from RTE food. For example, chillers for cooked product should be separate from those for raw product to prevent cross-contamination.

9.3 Equipment

9.3.1 General

55. Due to the ability of *L. monocytogenes* to exist in biofilms and persist in harbourage sites for extended periods, processing equipment should be designed, constructed and maintained to avoid, for example, cracks, crevices, rough welds, hollow tubes and supports, close fitting metal-to-metal or metal-to-plastic surfaces, worn seals and gaskets or other sites that cannot be reached during routine cleaning and disinfection of food contact surfaces, non-food contact surfaces, and adjacent areas.
56. Where possible, equipment should be designed and installed in a manner that facilitates easy access for efficient cleaning and disinfection, e.g. it can be easily dismantled and thus avoid the formation of biofilms containing *L. monocytogenes* and harbourage sites.

57. Racks or other equipment used for transporting exposed products, especially RTE foods, should have easily cleanable cover guards over the wheels to prevent contamination of the food from wheel spray.
58. Cold surfaces (e.g. refrigeration and freezing units) can be sources of *L. monocytogenes*. As with ventilation systems, condensate from refrigeration unit pans should be directed to a drain via a hose or drip pans should be emptied, cleaned and disinfected on a regular basis. Insulation should be designed and installed in a manner that it does not become a harbourage site for *L. monocytogenes* (wet insulation has previously been identified as a source of *L. monocytogenes*).

9.3.2 Food control and monitoring equipment

59. In equipment used for reducing or eliminating *L. monocytogenes* during processing, critical parameters should be maintained, monitored and recorded, e.g. cooking time and temperature; washing volume, pH and biocidal concentration; pressure and time; or irradiation dose and time.
60. In equipment used for cooling or holding or storing RTE food under refrigerated conditions, especially for RTE food that supports growth of *L. monocytogenes*, temperatures should be maintained and monitored so that, where feasible and appropriate, food is cooled below and consistently does not exceed 5°C (preferably 2°C - 4°C, as growth of *L. monocytogenes* is significantly reduced at these lower temperatures). For frozen foods, an appropriate frozen temperature should be maintained.
61. Refrigerated and frozen storage equipment should not be filled or loaded beyond their capacity such that they cannot maintain proper temperatures of RTE food, especially RTE food that supports the growth of *L. monocytogenes*.

10. TRAINING AND COMPETENCE

62. Refer to Section 10 of the *General Principles of Food Hygiene* (CXG 1-1969), together with the following:
63. Objective: Those engaged in food operations who come directly or indirectly in contact with RTE foods should be trained and instructed in food hygiene and the control of *L. monocytogenes* to a level appropriate to the operations they are to perform.
64. Rationale: Controls specific to *L. monocytogenes* are generally more stringent than routine GHPs.

10.1 Awareness and responsibilities

65. FBOs are responsible for providing specific training and instructions for control of *L. monocytogenes* relevant to their products but may rely on resources from trade associations or other organisations.

10.2 Training programmes

66. As appropriate to their role and responsibilities (e.g. in the facility's management, design of food safety systems, production, processing, handling, distribution or retail of RTE food), personnel should receive effective training in:
 - the nature of *L. monocytogenes*, its typical harbourage sites in primary production and processing equipment or areas, and its resistance to various environmental conditions;
 - determining whether or not the food supports the growth of *L. monocytogenes*;
 - identifying processing conditions that may increase the likelihood for *L. monocytogenes* to grow and spread to the food;
 - evaluating the intended consumer, and the intended and reasonably foreseeable use of the food;
 - control measures for reducing the risk of *L. monocytogenes* associated with RTE food during primary production, processing, distribution, retail, use and storage;
 - effective cleaning and disinfection techniques to reduce the risk of *L. monocytogenes* - including the dilution and contact times of the chemical being used;
 - the means for verifying effectiveness of control programmes, including sampling and analytical techniques; and
 - actions to be performed in order to address a *L. monocytogenes* or *Listeria* spp. positive (or presumptive positive) result obtained from an environmental sample or RTE food testing, as applicable.

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

67. Refer to Section 11 of the *General Principles of Food Hygiene* (CXG 1-1969), together with the following:
68. Objectives: To provide specific guidance on how preventive maintenance as well as cleaning and disinfection

procedures, along with an effective EMP can reduce contamination of RTE food with *L. monocytogenes*, especially when the food supports growth of *L. monocytogenes*. Well-structured cleaning and disinfection procedures should be targeted against *L. monocytogenes* in food processing areas where RTE foods are exposed to reduce:

- the likelihood that the food will be contaminated from *L. monocytogenes* that may be present in the processing environment; and
- the level of contamination in the finished RTE food.

69. Rationale: Cleaning and disinfection programmes are critical to control *L. monocytogenes*. An EMP for *L. monocytogenes* or, preferably, *Listeria* spp. in processing areas where RTE foods are exposed is necessary to assess the effectiveness of control measures and, therefore, the likelihood of contamination of the food (see Annex I).

11.1 Maintenance and cleaning

11.1.1 General

70. Establishments should implement an effective, scheduled preventive maintenance programme to prevent equipment failures during operation and the development of harbourage sites. Equipment failures during processing increase the risk of *L. monocytogenes* contamination as equipment is being repaired. Harbourage sites for *L. monocytogenes* can be created in certain equipment parts (e.g. gaskets) when they breakdown.
71. The preventive maintenance programme should be written and include a defined maintenance schedule, including a schedule for the replacement of parts known to deteriorate over time and the repair of equipment before it becomes a source of contamination. Equipment should be inspected periodically for harbourage sites (i.e. parts that are rusted, cracked, heavily scratched or etched, worn or have developed spaces where food and moisture accumulate). Preventive maintenance should include periodic examination and maintenance of all equipment parts, including: conveyors, filters, gaskets, pumps, slicers, filling equipment, and packaging machines, cleaning equipment as well as support structures for equipment. When equipment parts have deteriorated such that they have created a potential harbourage site before their scheduled replacement, the time period for their replacement within the preventive maintenance programme should be shortened accordingly. Air filters connected to fans that bring outside air into the establishment should be examined and changed based on manufacturer's specification or more frequently based on pressure differential or microbiological monitoring.
72. Where possible, tools used for maintenance of equipment to which RTE foods are exposed should be dedicated to the RTE processing area. Such tools should be washed and disinfected prior to use. Maintenance personnel in the RTE processing area should comply with the same hygiene requirements as the RTE processing employees. Food contact surfaces should be cleaned and disinfected after maintenance work, prior to operational use. Equipment at risk of becoming contaminated during maintenance work on facility utilities (e.g. air system, water system) or during construction or remodeling activities should be cleaned and disinfected prior to use.
73. Due to the ability of *L. monocytogenes* to survive in the processing environment for long periods of time, disturbances caused by the breakdown of equipment, construction, or modification of layouts can spread *L. monocytogenes* from harbourage sites to the environment. Where appropriate, care should be taken to:
 - isolate the construction area from processing areas, including ventilation and air-handling systems as needed;
 - restrict the movement of processing personnel and equipment;
 - enhance hygienic operations;
 - increase environmental monitoring to detect *Listeria* spp. during construction or renovation; and
 - verify hygienic conditions before resuming operations.

11.1.2 Cleaning and disinfection methods and procedures

74. Experience indicates that over-reliance on the chemicals alone for cleaning can lead to increased levels of microbial contamination. The cleaning and disinfection chemicals must be applied at the recommended use-concentration, for sufficient time, at the recommended temperature and with sufficient force (i.e. turbulence, scrubbing) to remove soil and biofilm. Instances of *L. monocytogenes* contamination have been linked, in particular, to insufficient manual scrubbing during the cleaning process.
75. Research and experience further indicate that *L. monocytogenes* is not inherently more resistant to disinfectants or more capable of attaching to surfaces than other vegetative pathogens (e.g. *Salmonella* spp., *E. coli*, *S. aureus*). However, it is noted that *L. monocytogenes* can form biofilms and persist on a variety of

surfaces. To avoid the persistence of *L. monocytogenes*, physical disruption of biofilms combined with the rotational application of disinfectants, where applicable, should be implemented.

76. Equipment used for cleaning (e.g. brushes, bottle brushes, mops, floor scrubbers, vacuum cleaners, hoses, hose reels) often stay wet and should be maintained, inspected, cleaned and disinfected so they do not become a source of contamination. The cleaning equipment should be dedicated for use in either raw or RTE processing areas, and their dedicated use should be easily distinguishable (e.g. colour-coded cleaning tools for different processing areas).
77. To prevent aerosols from contacting RTE foods, food contact surfaces and food packaging materials, the use of high-pressure water hoses should be avoided where possible. High-pressure water hoses should not be used during processing (including processing on lines adjacent to, or in the same room as, those being cleaned or disinfected) or after equipment has been cleaned and disinfected, or to clear or clean a drain.
78. It has been shown that *L. monocytogenes* can become established and persist in floor drains. Therefore, drains should be cleaned and disinfected in a manner that prevents contamination of other surfaces in the room. Equipment for cleaning drains should be dedicated to that purpose and be easily distinguishable (e.g. colour-coded) and stored separately from equipment for other cleaning purposes to minimise the potential for contamination. Employees who have been cleaning drains should not contact or clean food contact surfaces without changing clothes and washing and disinfecting hands.
79. Floor drains should not be cleaned during processing operations. If a drain backup occurs, processing should stop until the water has been removed and the areas have been cleaned and disinfected.
80. Solid forms of disinfectants such as blocks of quaternary ammonium compounds (QAC) can be placed in the drip pan of refrigeration and freezing units while rings can be placed in drains to help control *L. monocytogenes*. Granulated forms of disinfectants such as QAC, hydrogen peroxide and peroxyacetic acid can be applied to floors after routine cleaning and disinfecting. However, the use of solid forms of disinfectants should not replace control measures designed to prevent the entry or spread of *L. monocytogenes* within a processing environment (e.g. hygienic entry procedures, separation of raw and RTE processing areas, control of personnel and equipment traffic patterns).

11.1.3. Monitoring of effectiveness

81. The effectiveness of cleaning and disinfection programmes should be periodically verified and the programmes modified, as necessary by trained personnel. Verification activities and changes should be recorded. The goal is to consistently achieve the level of control needed for the food operation to prevent *L. monocytogenes* contamination of RTE food and RTE food contact surfaces. Recommendations for the design of an EMP are given in Annex I.

12. PERSONAL HYGIENE

82. Refer to Section 12 of the *General Principles of Food Hygiene* (CXG 1-1969), together with the following:
83. Objectives: To prevent workers from transferring *L. monocytogenes* from contaminated surfaces to RTE food, food contact surfaces, or food packaging material.
84. Rationale: Workers can serve as a vehicle for *L. monocytogenes* contamination by physically transporting and transferring the organism through the facility. Workers should be aware of the steps that need to be taken to manage this risk (e.g. handwashing, boot washes, clean clothing).

12.3 Personal cleanliness

85. Employees who touch RTE food, food contact surfaces, or food packaging material should wash and disinfect hands and change gloves any time they touch an unclean surface, including parts of their own body (e.g. nose, eyes, ears). Adequate training, instruction and supervision should be provided to be confident that hygienic practices are accomplished.

12.4 Personal behaviour

86. Employee hygienic practices play an important role in preventing contamination of exposed RTE foods with *L. monocytogenes*. For example, employees who handle money, trash, floor sweepings, drains, packaging waste or scrap product among other contaminated surfaces, should not touch RTE food, food contact surfaces or food packaging material, unless they change their smock or outer clothing, wash and disinfect hands, and wear clean new gloves for tasks requiring gloves.

13. CONTROL OF OPERATION

87. Refer to Section 13 of the *General Principles of Food Hygiene* (CXG 1-1969), together with the following:
88. Objectives: Processing operations should be controlled to avoid contamination in RTE foods, to reduce the

likelihood that the RTE food will be contaminated and/or will support the growth of *L. monocytogenes* during subsequent distribution, retail and consumer use.

89. Rationale: For some RTE foods, listericidal treatments can appropriately reduce the risk of listeriosis. However, not all RTE foods receive such treatment. Furthermore, RTE foods that are exposed before or at packaging may be subject to *L. monocytogenes* contamination from the processing environment. Prevention of contamination, strict control of time and temperature, and formulation of RTE foods to suppress the growth of *L. monocytogenes* can minimise the risk of listeriosis.

13.1 Description of products and processes

13.1.1 Product description

90. In addition to the intended use of the food, FBOs should also consider information on ways in which the next FBO in the supply chain or the consumer are known to use the food other than those intended by the FBO (i.e. reasonably foreseeable use) when developing control measures. Such information can include investigational data from foodborne outbreaks or consumer surveys about food preparation or consumption habits within a population, supply chain, or region. For example, listeriosis outbreaks have been associated with the consumption of frozen peas or enoki mushrooms which were intended to be cooked but were consumed without a heat treatment. Another example are other frozen foods that are intended to be cooked, but are widely known to be consumed without cooking. These foods intended by the FBO to be non-RTE may require some level of *L. monocytogenes* control to account for known unintended use of the product without cooking. FBOs should not consider all conceivable uses or isolated reports of misuse of a food as a reasonably foreseeable use.
91. FBOs should determine whether RTE foods will not support the growth of *L. monocytogenes* and have a written rationale. In some RTE foods, single parameters (e.g. a pH less than 4.4, a water activity less than 0.92), may be relied upon to prevent *L. monocytogenes* growth. In other RTE foods, a combination of parameters is used. Validation should be undertaken to confirm the effectiveness of these parameters in situations where combinations of parameters or bacteriostatic compounds or agents are relied upon. These parameters should be regularly monitored and results documented. If there is insufficient information to demonstrate that *L. monocytogenes* will not grow in an RTE food during its expected shelf-life under reasonably foreseeable conditions of distribution, storage and use, the food should be treated as an RTE food in which growth of *L. monocytogenes* can occur (see Annex III).
92. Although *L. monocytogenes* will not grow under frozen conditions, frozen foods that are generally not consumed in the frozen state may be handled or used at retail or by the consumer such that *L. monocytogenes* may grow (e.g. they may be thawed and held under refrigeration). When frozen conditions are used as the sole means of preventing *L. monocytogenes* growth in an RTE food, such reasonably foreseeable use of the food should be considered when classifying the RTE food as supporting growth (or not) and when developing risk management strategies.

13.1.2 Process description

93. Flow diagrams, which show the sequence and interaction of all processing steps in the operation, should identify any listericidal treatments. Clearly indicating the listericidal treatments on the flow diagram can allow FBOs and competent authorities to better identify those processing steps or areas after listericidal treatments, where greater focus should be placed to prevent or minimise the contamination of RTE food with *L. monocytogenes* (see section 9.1.2).

13.1.3 Consideration of the effectiveness of GHPs

94. Recommendations to food business operators for an environmental monitoring programme for *Listeria monocytogenes* in primary production and processing areas are given in Annex I. Recommendations to competent authorities for the use of microbiological testing as a means of verifying the effectiveness of HACCP and prerequisite programmes for the control of *Listeria monocytogenes* in RTE foods are given in Annex II.

13.1.4 Monitoring and corrective action

95. Refer to Annex I of this guideline.

13.1.5 Verification

96. Recommendations to Competent Authorities and Food Business Operators for developing and applying microbiological criteria for *Listeria monocytogenes* in ready-to-eat foods are given in Annex III. See also Annexes I and II of this guideline.

13.2 Key aspects of GHPs

13.2.1 Time and temperature control

97. The risk assessments done by FAO/WHO and others on *L. monocytogenes* in RTE foods demonstrated the significant influence of storage temperature on the risk of listeriosis associated with RTE foods that support *L. monocytogenes* growth. It is therefore necessary to control the time and temperature combination used for storage.
98. Monitoring and controlling refrigerated storage temperatures are key control measures. Where feasible and appropriate, the product temperature should not exceed 5°C (preferably 2°C - 4°C, as growth of *L. monocytogenes* is significantly reduced at these lower temperatures). Any loss of temperature control during the storage of RTE foods that support the growth of *L. monocytogenes* should be carefully evaluated to assess potential food safety risk through the product's intended shelf-life.
99. The length of an RTE food's shelf-life is another important factor contributing to the risk associated with foods that support *L. monocytogenes* growth. In that context, the shelf-life of such foods should be consistent with the need to control the growth of *L. monocytogenes*. Since *L. monocytogenes* can grow under refrigeration temperatures, the length of the shelf-life should consider appropriate studies that assess the growth of *L. monocytogenes* in the food taking into consideration reasonably foreseeable conditions of storage, distribution, and use. Shelf-life studies and other information (e.g. scientific literature, microbiological modeling, environmental data, supplier's quality assurance) are important resources in determining the length of an RTE food's shelf-life. Appropriate temperatures for some refrigerated RTE foods may not be maintained throughout the entire food chain until the point of consumption. Temperature abuse of these foods may allow the growth of *L. monocytogenes*, if present, unless intrinsic parameters of the food prevent such growth. Potential temperature abuse, including by the consumer, should be taken into account when conducting studies to establish the shelf-life of refrigerated RTE food. Intrinsic parameters (e.g. pH, water activity, organic acid content) that are important for the shelf-life of the food should be monitored during processing at an appropriate frequency so that the food meets the conditions in the shelf-life study.

13.2.2 Specific process steps

100. Listericidal treatments should be validated to demonstrate that the treatments are effective and can be applied consistently. Equipment parameters for effective listericidal treatments (e.g. temperatures, flow rates, loading capacity) should be identified and monitored to confirm that the conditions which reduce *L. monocytogenes* are being achieved.
101. RTE foods that have undergone a listericidal treatment may be subject to contamination by *L. monocytogenes* from the processing environment after the listericidal treatment and before the food is contained in a sealed package. In these cases, the importance of cleaning and disinfection programmes and other programmes designed to minimise potential for contamination after a listericidal treatment, along with environmental monitoring for verification of such controls, should be emphasised. For RTE foods that support growth of *L. monocytogenes*, additional control measures may be applied if necessary (e.g. freezing the product, shortening the shelf-life, reformulation of the product) to limit the extent of or prevent *L. monocytogenes* growth. Furthermore, a post-packaging listericidal treatment can also be applied to mitigate *L. monocytogenes* in RTE foods (e.g. heating, high pressure treatment, irradiation, where accepted).
102. RTE food that supports the growth of *L. monocytogenes* and will not undergo a listericidal treatment could be contaminated at their source. Therefore, specific control measures should be applied, where possible, to limit the extent of or prevent the growth of *L. monocytogenes*.

13.2.3 Microbiological, physical, chemical and allergen specifications

103. Refer to the *Principles and Guidelines for the Establishment and Application of Microbiological Criteria Related to Foods* (CXG 21-1997).

13.2.4 Microbiological contamination

104. Contamination of RTE foods with *L. monocytogenes* can occur, for example, through direct contact with raw materials, personnel, aerosols, contaminated utensils and equipment or other unclean surfaces. Contamination can occur at any step where the food is exposed to the environment, including primary production, processing, storage, transportation, retail, catering, and consumers' homes.
105. Traffic flow patterns for personnel (e.g. all employees, visitors, and contractors), products, and equipment should be controlled between raw processing, storage areas and RTE processing areas to minimise the transfer of *L. monocytogenes*. For example, personnel should change footwear or use hygienic shoe coverings to prevent the potential transfer of *L. monocytogenes* when entering RTE processing areas that require a higher level of hygiene control (e.g. where RTE food is exposed). Another example is to use a colour coding system to identify personnel assigned to specific areas of the establishment.
106. Utensils, pallets, carts, forklifts and mobile racks should be dedicated for use in either the raw or the RTE

processing area. A colour coding system can be used to identify equipment assigned to specific areas of the establishment. Where dedicated equipment is not practical, these items should be cleaned and disinfected before entering the RTE processing area. Automated foam sprayers can be an effective alternative when carts, forklifts and other portable equipment must enter an area where RTE foods are exposed.

107. Reused brines and recycled process water used in direct contact with food that will not be subjected to further listericidal treatment (including food in permeable or semi-permeable membranes, such as washed rind cheese) should be discarded or decontaminated (e.g. biocide treatment, heat treatment, or some other effective treatment) with sufficient frequency to control *L. monocytogenes*.
108. RTE foods that do not support the growth of *L. monocytogenes* (which may generally contain low levels of this pathogen) should not be a source of contamination to other RTE foods, especially those that support growth. The use of dedicated equipment for RTE food that supports the growth of *L. monocytogenes* should be considered where possible. In some cases, RTE foods that do not support growth may be processed or handled on the same equipment as RTE food that supports growth. In such a case, control measures (e.g. product sequencing, cleaning and disinfection procedures) should be implemented to prevent the contamination of RTE foods that support growth of *L. monocytogenes* with this pathogen that may be present at low levels in RTE foods that do not support its growth.
109. Some RTE foods that do not support growth of *L. monocytogenes* in their finished form (e.g. some frozen RTE foods) are processed in environments that are generally favorable for the growth of the pathogen (e.g. presence of water and temperatures that allow growth). The presence and growth of *L. monocytogenes* in the processing environment, and its subsequent transfer to the food at levels high enough to cause illness, have been considered contributing factors in outbreaks associated with some RTE foods that do not support the growth of the pathogen (e.g. ice cream). Therefore, appropriate control measures should be implemented in these processing environments to prevent or limit the potential harbourage, growth and transfer of *L. monocytogenes* to the RTE food, even though the pathogen may not grow in the finished food.

13.2.8 Incoming materials

110. FBOs should implement appropriate supplier quality assurance activities (e.g. conducting an onsite audit of the supplier, requesting a certificate of analysis for each received incoming material lot) to prevent ingredients from being a source of *L. monocytogenes*. This is especially important when the incoming materials are used in the processing of RTE foods that support the growth of *L. monocytogenes* and there is no listericidal treatment.

13.3 Water

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

13.5 Recall procedures – removal from the market of unsafe food

112. Based on the determined level of risk associated with the presence of *L. monocytogenes* in a given product, a decision may be taken to recall the contaminated product from the market. As such, the need for public warnings should be considered.
113. In food safety emergency situations, competent authorities should rapidly share information through formal and informal communication networks to minimise or prevent further spread of contaminated food throughout and between countries^{10,11}.

14. PRODUCT INFORMATION AND CONSUMER AWARENESS

114. Refer to Section 14 of the *General Principles of Food Hygiene* (CXC 1-1969), together with the following:
115. Objectives: Consumers and caregivers should have enough knowledge of *L. monocytogenes* and food hygiene such that they:
 - can prevent contamination and growth of *L. monocytogenes* by adequately storing and preparing RTE foods;
 - understand the importance of shelf-life and how to interpret date marking written on food labels¹²; and
 - can make informed food choices appropriate to the individual's health status and risk factors for acquiring foodborne listeriosis.

¹⁰ see *Principles and Guidelines for the Exchange of Information in Food Safety Emergency Situations* (CXG 19-1995)

¹¹ see *Guidelines on the Management of Biological Foodborne Outbreaks* (CXG 96-2022)

¹² see *General Standard for the Labelling of Pre-packaged Foods* (CXS 1-1985)

116. Health care providers should have appropriate information on *L. monocytogenes* in foods and listeriosis to give advice to consumers, especially those in susceptible populations.
117. Rationale: Consumers (especially those in susceptible populations), their caregivers, and health care providers need to be informed about safe food handling and preparation practices as well as safe food choices (e.g. avoiding certain foods by susceptible populations or choosing safer food alternatives).

14.2 Product information

118. Information provided to customers and consumers through pamphlets, websites, social media, or other printed or electronic media should provide consistent and clear messaging regarding the intended and safe use of food.

14.3 Product labelling

119. Where appropriate, labels on RTE foods should include information on safe handling practices, recommended storage temperatures and advice on the time frames in which the product should be eaten (e.g. date markings). Labels on foods for which preparation (e.g. cooking) by the consumer is needed to control *L. monocytogenes* should use terminology that clearly communicates such preparation is needed for food safety and should prominently display such preparation instructions, especially if the product must be cooked. It is recommended that such instructions be validated.

14.4 Consumer education

120. Since each country has specific consumption habits, communication programmes pertaining to *L. monocytogenes* are most effective when established by individual competent authorities.
121. Programmes for consumer education should be directed:
- at consumers with increased susceptibility to contracting listeriosis (individuals experiencing pregnancy, individuals experiencing immunosuppression, and adults aged 65 or older) and their caregivers;
 - to help consumers make informed choices about food to purchase, including advising consumers in susceptible populations to avoid higher risk foods, where possible, or to adopt safer alternatives;
 - to educate consumers on the importance of preventing contamination between raw and RTE foods (e.g. frequent cleaning of food preparation surfaces);
 - to educate consumers on the proper storage of food and about the appropriate storage conditions and safe timeframes for keeping unused portions of packaged RTE foods after opening;
 - to educate consumers on the appropriate preparation and consumption (e.g. appropriate cooking of food before consumption when mentioned on the label);
 - to help consumers understand how they can minimise their risk of contracting listeriosis, including consideration for the specific regional conditions and consumption habits;
 - to educate consumers on household practices and behaviours that would specifically keep the numbers of *L. monocytogenes* that may be present in RTE foods as low as possible by setting refrigerator temperatures, so that where feasible and appropriate, the product temperature does not exceed 5°C (preferably 2°C - 4°C, as growth of *L. monocytogenes* is significantly reduced at these lower temperatures);
 - to promote the use of appropriate thermometers inside home refrigerators;
 - to encourage frequent washing and disinfecting of the household refrigerator to prevent it becoming a source of *L. monocytogenes*, contributing to the contamination of RTE food stored inside;
 - to educate consumers on the importance of and differences between various date markings on the labels of RTE foods;
 - to educate consumers about the appropriate storage conditions and safe timeframes for keeping unused portions of packaged RTE foods after opening; and
 - to inform and guide consumers on appropriate actions to take in response to product recalls.
122. Programmes for health care providers should include consumer education information discussed above and be designed to provide guidance that:
- makes possible the rapid communication on preventing listeriosis, particularly to those individuals with increased susceptibility and their caregivers; and

- facilitates rapid diagnosis of foodborne listeriosis.

15. TRANSPORTATION

123. Refer to Section 15 of the *General Principles of Food Hygiene* (CXC 1-1969) and the *Code of Hygienic Practice for the Transport of Food in Bulk and Semi-Packed Food* (CXC 47-2001), together with the following:

124. Objectives: Measures should be taken where necessary to:

- protect food from potential sources of contamination including harbourage sites for *L. monocytogenes* in transportation equipment and to prevent the co-mingling of raw and RTE food;
- provide an adequately refrigerated environment, so that where feasible and appropriate, the temperature of refrigerated RTE food does not exceed 5°C (preferably 2°C - 4°C, as growth of *L. monocytogenes* is significantly reduced at these lower temperatures); and
- provide an adequately frozen environment, so that the temperature of frozen RTE food is maintained.

125. Rationale: Food may become contaminated during transportation if not properly protected. If refrigeration or freezing conditions are inadequate, RTE food may support the growth of *L. monocytogenes* to higher levels and increase the risk of listeriosis.

15.1 General

126. Transportation is an integral step in the food chain and should be controlled.

127. Transportation vehicles should be regularly inspected for structural integrity, cleanliness, and overall suitability when unloading ingredients and prior to loading finished RTE foods. In particular, the structural integrity of transportation vehicles (e.g. tanker trucks) should be monitored for stress cracks that may act as harbourage sites for *L. monocytogenes*. Tankers should be dedicated, where possible, to transport either raw materials, ingredients or RTE foods.

15.3 Use and maintenance

128. Food transportation units, accessories, and connections should be cleaned, disinfected (where appropriate) and maintained to avoid or at least reduce the risk of contamination. It should be noted that different commodities may require different cleaning procedures. Where necessary, disinfection should be followed by rinsing unless manufacturer's instruction indicates on a scientific basis that rinsing is not required¹³. A record should be available that indicates when cleaning and disinfection occurred.

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

16. INTRODUCTION TO HACCP

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

17. PRINCIPLES OF THE HACCP SYSTEM

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

18. GENERAL GUIDELINES FOR THE APPLICATION OF THE HACCP SYSTEM

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

19. APPLICATION

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

¹³ Code of Hygienic Practice for the Transport of Food in Bulk and Semi-Packed Food (CXC 47-2001).

ANNEX I

RECOMMENDATIONS TO FOOD BUSINESS OPERATORS FOR AN ENVIRONMENTAL MONITORING¹⁴ PROGRAMME FOR *LISTERIA MONOCYTOGENES* IN PRIMARY PRODUCTION AND PROCESSING AREAS

1. INTRODUCTION

1. Outbreaks of listeriosis have been associated with contamination of RTE food that was exposed to the environment after the food received a listericidal treatment or of RTE foods that are processed without a listericidal treatment (e.g. raw milk cheeses and fresh produce). Environmental monitoring programmes (EMPs) involve the sampling and testing of both food contact and non-food contact surfaces (e.g. surfaces on equipment or in the processing environment) for the presence of *L. monocytogenes* or an appropriate indicator organism, such as *Listeria* spp. (hereafter *Listeria* spp. is used to represent all indicators). The importance of such an EMP is greatest for equipment and processing environments used for RTE foods which are not given a post-packaging listericidal treatment and in which the growth of *L. monocytogenes* can occur.
2. EMPs are also recommended for RTE foods that do not support the growth of *L. monocytogenes*, particularly when conditions in the processing environment are favourable for its growth (e.g. wet processing environments). The presence and growth of *L. monocytogenes* in the processing environment and subsequent transfer to the food at levels high enough to cause illness have been considered contributing factors in outbreaks associated with some RTE foods that do not support the growth of the pathogen (e.g. ice cream).
3. GAPs and GHPs and other control measures should be designed and implemented to prevent the introduction, establishment and harbourage of *L. monocytogenes* in primary production and processing environments. Notwithstanding the application of these measures, FBOs should recognize that *L. monocytogenes* may be detected occasionally in processing environments due to its ability to persist in equipment and niche areas including through biofilm formation which can reduce the effectiveness of routine sanitation and facilitate recontamination. The purpose of the EMP is to find *L. monocytogenes* (or *Listeria* spp.) and harbourage sites. This is a proactive approach (e.g. “seek and destroy”) to minimise the risk of contamination and maintain food safety.
4. EMPs may not be appropriate for all primary production environments or situations. An effective EMP should be designed considering the factors (A-L) listed below:

A. TYPE OF PRODUCT AND PROCESS/OPERATION

5. **Primary production.** The need for and extent of EMPs at primary production (e.g. during harvest, handling, and packaging) should consider, for example:
 - whether RTE food is grown, harvested, handled and packed at primary production;
 - the characteristics of the food (i.e. supporting or not supporting the growth of *L. monocytogenes*);
 - previous detections of *L. monocytogenes* or *Listeria* spp. in the food, facility, or equipment;
 - the general hygienic conditions and design of equipment, especially food contact surfaces;
 - whether the food will be processed with a listericidal treatment; and
 - the likelihood of contamination from the environment (e.g. harvesting practices, on-farm management practices, the extent of handling by operators).
6. **Processing environments.** The need for and extent of EMPs in processing facilities should consider, for example:
 - the characteristics of each of the RTE foods (i.e. supporting or not supporting the growth of *L. monocytogenes*);
 - previous detections of *L. monocytogenes* or *Listeria* spp. in the raw materials, the processing environment and the RTE food;
 - processing conditions (e.g. temperature, humidity, storage conditions);
 - the general hygienic conditions, layout of the facility, and line configurations for each RTE food;
 - the general hygienic conditions and design of equipment, especially food contact surfaces;
 - whether the process flow includes a listericidal treatment (before or after packaging);
 - the likelihood of contamination of RTE food from the processing environment (e.g. the extent the RTE

¹⁴ Environmental monitoring is not to be confused with monitoring as defined in HACCP.

food is exposed to the environment, the extent of handling RTE food by operators);

- traffic patterns for personnel, products and equipment within the processing environment;
- processing cycles and the frequency of sanitation; and
- the intended consumers (e.g. the general population versus those populations more susceptible to listeriosis).

B. TARGET ORGANISM

7. The EMP should indicate when samples are tested directly for *L. monocytogenes* or *Listeria* spp. For routine environmental monitoring, it is recommended to test environmental samples for *Listeria* spp. because their presence is an appropriate indicator of conditions that would support the potential presence of *L. monocytogenes*. The detection of *Listeria* spp. prior to the start of processing indicates inadequate hygiene. Additionally, in some circumstances, *L. innocua* can outgrow *L. monocytogenes* when present in the same sample resulting in the inability to detect *L. monocytogenes*. The finding of *Listeria* spp. in the processing environment can allow actions to be taken to correct conditions that may increase the likelihood for the contamination of RTE food with *L. monocytogenes*. Where appropriate and shown to be valid, other indicator organisms may be used¹⁵. Biochemical assays (such as Adenosine Triphosphate (ATP) testing) or other assays to evaluate surfaces for the presence of soils are not an appropriate indicator for *Listeria* spp. or *L. monocytogenes*.
8. Testing environmental samples directly for *L. monocytogenes* may be useful when taking follow-up actions related to the positive finding of *L. monocytogenes* in a RTE food or when taking follow-up actions related to the positive finding of *L. monocytogenes* or *Listeria* spp. in the primary production or processing environment.
9. When food contact surfaces used to produce RTE foods are tested for *L. monocytogenes* and the food is not given a post-packaging listericidal treatment, FBOs should consider holding the food until the testing results are received.

C. SAMPLING LOCATIONS

10. The EMP should identify sampling locations that include both food contact and non-food contact surfaces. The number of sampling locations will vary with the complexity of the process, the type of food being processed, and the general conditions of the equipment/facility. Sampling locations should be identified for every processing line, line configuration and processing area in the facility where RTE food is handled or processed, especially those in which the RTE food is exposed to contamination from the environment. All equipment used for RTE foods, including infrequently made products, should be represented in the sampling program. As part of EMP documentation, it is recommended to mark sampling locations on a detailed map of the processing facility. Additionally, the exact sampling point should be recorded in a manner that allows full traceability to the corresponding analytical results (e.g. a generic description such as, "inspection table 1" lacks precision compared to, "inner surface, right side of inspection table 1").
11. FBOs should consider all surfaces that could come into direct or indirect contact with food to be food contact surfaces. Food contact surfaces can include equipment surfaces (e.g. conveyor belts, filler nozzles, hoppers, slicing machines, freezing tunnels), utensils, employee personal protective equipment (e.g. uniforms, aprons, gloves), or other surfaces from which food or other material can drip, fall, be transferred, or be drawn into exposed food or onto direct food contact surfaces (e.g. the underside lip of tables or control panels that are touched by operators who then handle food).
12. Examples of non-food contact surfaces can include equipment surfaces that are not considered direct or indirect food contact surfaces (e.g. equipment framework) and surfaces from within the processing environment (e.g. floors, walls, wheels of carts, electrical conduit, drains, evaporator plates, fans, and condensate drip pans).
13. Information on appropriate sampling locations can be found in published literature, can be obtained by consulting food safety experts with specific process experience, or can be identified by conducting sampling surveys on equipment or in processing areas. In general, surfaces on primary production equipment or in processing environments that may be harbourage sites¹⁶ should be considered for potential sampling locations.
14. The EMP should enable (e.g. by training) and permit operators conducting environmental sampling to regularly

¹⁵ The following attributes would contribute to the scientific support for using a specific organism as an indicator of a specific pathogen: similar survival and growth characteristics; a shared common source for both organisms; direct relationship between the state or condition that contributes to the presence of the pathogen and the indicator organism; and practical, isolation, detection or enumeration methods for the potential indicator organism.

¹⁶ Harbourage sites can include surfaces that are poorly designed, wet, worn or damaged such that they are difficult to adequately clean and disinfect.

collect a certain number of samples from locations of their choice and especially when they observe conditions or activities within the primary production or processing environment that may have increased the risk of harbourage or spread of *L. monocytogenes*. These locations should be documented.

15. Sampling locations can be classified according to their level of proximity to food using a classification system (e.g. food contact surfaces, adjacent non-food contact surfaces, further remote non-food contact surfaces, outside RTE processing areas), often referred to as a “zoning” approach, for the purposes of developing sampling plans that provide adequate coverage of the surfaces on equipment or within a processing environment and for determining appropriate corrective actions should a positive (or presumptive positive) be found (see Section J).
16. The EMP should be reviewed and updated, as necessary, to include new sampling locations identified by operators, when changes are introduced (e.g. new equipment/processing lines, new product types or inputs), when there are changes to traffic patterns within the facility, or when conditions in the facility change with regard to potential harbourage sites.

D. FREQUENCY OF SAMPLING

17. The frequency of environmental sampling should consider the factors outlined under Section A. In general, the frequency of sampling should be higher where there is greater risk of contaminating RTE food with *L. monocytogenes* (i.e. equipment/areas where RTE food is exposed to the environment). The frequency of sampling should also reflect existing data on the presence of *L. monocytogenes* or *Listeria* spp. in the environment of the operation under consideration, especially if the same strain of *L. monocytogenes* has been identified in environmental samples over a period of time indicating that the strain is not being eliminated from the environment through routine cleaning and disinfection (i.e. a persistent strain).
18. In the absence of such information, sufficient suitable data should be generated to correctly define the appropriate frequency. These data should be collected over a sufficient period as to provide reliable information on the prevalence of *L. monocytogenes* or *Listeria* spp. and any variations in prevalence over time (e.g. the impact of seasonality).

E. TIMING OF SAMPLING

19. Over time, the collection of environmental samples should be rotated between every shift of operation (e.g. 1st shift and 2nd shift in a facility that operates with two shifts) and every operating day of the week. Rotating the shifts/days during which samples are collected allows the EMP to detect contamination that may be related to differences in environmental conditions at different times.
20. Preferentially, for environmental monitoring, samples should be collected during primary production and processing at a time when any *L. monocytogenes* that may have been present in a harbourage site has had time to spread within the equipment or the environment (e.g. approximately 3 hours into processing). Environmental samples can also be collected before initiation of processing to help verify the effectiveness of cleaning and disinfection procedures, however if samples are collected from surfaces after disinfection, it is critical to ensure residual disinfectant does not negatively affect testing. The time of sampling and phase of operation (e.g. pre-operational after cleaning and disinfection, 3 hours into processing) should be recorded.

F. NUMBER OF SAMPLES TO BE COLLECTED DURING EACH SAMPLING EVENT

21. The number of samples to be collected during each sampling event depends on how many sampling locations are identified, how often sampling will be conducted (i.e. the frequency of sampling), and over what period of time a FBO wishes to test all of the identified sampling locations.
22. FBOs should consider collecting samples from both food contact and non-food contact surfaces each time samples are collected. Sampling and testing non-food contact surfaces can help detect *L. monocytogenes* or *Listeria* spp. and allow corrective actions to be taken before contamination is spread to food contact surfaces and RTE food.

G. SAMPLING TOOLS AND TECHNIQUES

23. The type of sampling tools and techniques should be appropriate for the type of surfaces and locations from which samples are collected. The most common sampling tools are sterile sponges, cloths and swabs. The most appropriate method for sampling should be evaluated for each unique situation. In general, sponges should be used for collecting samples of large flat surfaces, whereas swabs may be more appropriate for collecting samples from cracks, crevices, or other hard to access surfaces. Food residues on environmental surfaces, if present, can be loosened using a sterile scraper or other similar sterile tool to facilitate the sample collection.
24. The process of sampling should not introduce unnecessary risk. For example, if wet swabs are used to collect samples in dry processing environments, FBOs should consider immediately cleaning and disinfecting the sampled location using an alcohol-based disinfectant or other appropriate non-aqueous solution to facilitate

drying of the surface. Further, accessing food contact surfaces within enclosed processing systems for routine sampling may increase the risk of contamination, therefore FBOs may consider enhancing other routine monitoring and verification activities (e.g. finished product testing) while continuing to sample those food contact surfaces that are easily accessible.

25. Environmental surfaces that may have residual disinfectant present should be sampled using an appropriate “neutralising” solution (e.g. neutralising diluent).
26. Operators collecting environmental samples should be trained to use techniques that prevent the contamination of the sterile sampling tool (e.g. sponge or swab), including its provided storage bag/tube, with hands or other potentially contaminated surfaces. When possible, sterile gloves should be worn when collecting environmental samples.
27. Once collected, environmental samples should be cooled as soon as possible to refrigeration temperatures, then stored and transported (e.g. shipped to a testing laboratory) under refrigeration conditions. Temperatures should be maintained and monitored so that, where feasible and appropriate, samples are cooled below and consistently do not exceed 5°C (preferably 2°C - 4°C). FBOs should develop procedures to manage samples in the event of unforeseen disruptions (e.g. power outages, equipment failure). Environmental samples should not be frozen as this can reduce the likelihood of recovering *L. monocytogenes*. The delay between sampling and testing should be as short as possible. Environmental samples should be tested within 48 hours of collection to maximise the recovery of *L. monocytogenes* or *Listeria* spp., if present.

H. SAMPLE ANALYSIS

28. The analytical methods used to analyse environmental samples should be validated for the detection of *L. monocytogenes* or *Listeria* spp. and the type of surfaces being evaluated (e.g. stainless steel, plastic, concrete). It is important to demonstrate and document that the methods are able to detect the target organisms, with acceptable reproducibility, reliability and sensitivity. In the context of international food trade, analytical methods endorsed by Codex should be considered first, when available¹⁷. Validated rapid detection methods can be used to identify potentially contaminated surfaces faster than conventional cultural methods. However, in the case of a positive result by rapid methods, consideration should be given to the recovery of an isolate for further characterisation. Testing laboratories should use appropriate laboratory practices¹⁸ and, when possible, be accredited for the specific analytical methods used.
29. Under certain circumstances, it may be possible to composite environmental samples without losing the required sensitivity allowing for a more cost-effective EMP, but only when such compositing does not reduce test sensitivity when compared to testing individual analytical units. When environmental samples are composited and the composite is positive for the target organism, additional testing will be necessary to determine the location of the positive sample¹⁹, or all locations represented in the composite should be considered positive. If environmental samples are to be composited, it is recommended that:
 - the entire environmental sample is added to the composite (e.g. sponges are not cut or split);
 - environmental samples collected from food contact surfaces should not be composited with those collected from non-food contact surfaces;
 - environmental samples from different processing lines should not be composited;
 - environmental samples should not be composited with product samples; and
 - samples collected for quantitative analysis should not be composited.
30. Characterising isolates by one or more of the available techniques (e.g. whole genome sequencing, pulsed field gel electrophoresis, multi-locus sequencing typing, certain polymerase chain reaction-based methods) can provide useful information about whether that strain of *L. monocytogenes* has been identified in the facility before (e.g. whether it might be considered a transient or a potential persistent strain to the facility), the potential source of the strain, and potential pathway(s) for the strain to contaminate RTE food. It is recommended that *L. monocytogenes* isolates be retained and stored under appropriate frozen conditions in case further characterisation is desired.

I. DATA REVIEW/MANAGEMENT

31. Testing laboratories should inform FBOs of presumptive and confirmed results for detection of *L.*

¹⁷ *Principles for the use of sampling and testing in international food trade* (CXG 83-2013)

¹⁸ *Guidelines for the Assessment of the competence of testing laboratories involved in the import and export control of food* (CXG 27-1997)

¹⁹ In the event that a composite sample is positive and additional testing cannot identify which location in the composite was positive (i.e. the target organism is not detected in additional testing for each location), then all locations represented in the composite should be considered positive.

monocytogenes and *Listeria* spp. as soon as possible to facilitate prompt review and implementation of actions to mitigate the contamination.

32. The EMP should identify the timeframe within which results from analytical testing will be reviewed and the person(s) who will be responsible for reviewing them. Results from the testing of environmental samples should be reviewed promptly so that actions can be taken as soon as possible should there be a positive (or presumptive positive) sample.
33. It is recommended that actions be initiated upon receiving a presumptive positive result (e.g. a result from a rapid screening method). The time required for confirmation of a presumptive positive result can allow *L. monocytogenes* to spread further within the facility (including to harbourage sites) and potentially into RTE food.
34. The EMP should include a system to record and evaluate the data (e.g. performing trend analyses). Examples of trends that FBOs should consider include:
 - changes in positivity rates over time or during different seasons;
 - increased positives during the production of certain RTE foods, the handling of certain ingredients, or the use of certain equipment; and
 - other potential trends, as appropriate.

J. ACTIONS IN CASE OF POSITIVE (OR PRESUMPTIVE POSITIVE) RESULTS

35. FBOs should react to each positive (or presumptive positive) result as soon as possible. However, the nature and extent of the reaction should generally be greater when one or more of these factors apply:
 - the contaminated surface is a food contact surface;
 - the RTE foods produced on contaminated food contact surfaces support the growth of *L. monocytogenes*;
 - the food being produced will not be further subjected to a listericidal treatment;
 - the contamination was detected on multiple surfaces during the sampling event;
 - there is a history of finding *L. monocytogenes* or *Listeria* spp. in the facility; and
 - the same strain of *L. monocytogenes* has been persistent in the facility after corrective actions have been taken to eliminate it.
36. Root cause investigation and other potential actions that should be considered in reaction to a positive (or presumptive positive) result can include:
 - **Investigative sampling** of environmental surfaces related to the location of the positive sample in an attempt to identify the extent of contamination within equipment and the processing environment and its potential source(s). When equipment breakdown or disassembly is performed to access surfaces not normally exposed during routine cleaning and disinfection, environmental samples should be collected from these surfaces before they are cleaned and disinfected to determine if they may have been a source of the contamination and thereafter to verify the effectiveness of their cleaning and disinfection. Locations for investigative samples can include:
 - potential harbourage sites in proximity to the positive location;
 - surfaces in related high-traffic areas (e.g. floors, which may inform as to where the contamination came from and/or where it may have spread);
 - surfaces from air and cooling systems (e.g. evaporation plates and fans from which contamination may enter the facility or be spread within); or
 - other locations that may be informative about the extent or source of the contamination (e.g. surfaces within the processing area from which contamination may have been rinsed to a floor drain which tested positive).
 - **Additional and/or intensified cleaning and disinfection** of equipment or the processing environment. Intensified cleaning and disinfection can involve different activities and/or practices for cleaning and disinfection such as:
 - the application of more intense physical disruption and the rotation of disinfectants;
 - the use of more powerful chemicals (e.g. the use of a stronger disinfectant or a cleaning agent formulated to remove biofilms);

- the breakdown or disassembly of equipment to access surfaces not normally exposed during routine cleaning and disinfection; or
 - the disinfection of the entire processing area.
 - **Follow-up sampling** of the positive location(s) to verify the effectiveness of additional and/or intensified cleaning and disinfection activities taken in reaction to the positive(s).
 - **Review of hygienic practices and procedures** related to the location of the positive sample in an attempt to identify any breakdown in hygienic controls that could have contributed to the introduction or spread of the contamination. Such review may include interviewing operators, reviewing operational lines/flows, reviewing maintenance and operational records, and observing personnel for implementation of hygienic procedures.
 - **Intensified environmental monitoring** to further verify that hygienic conditions on equipment or the processing environment have been restored. Intensified environmental monitoring could include actions such as temporarily increasing the frequency of sampling and/or the number of samples collected during a sampling event.
 - **Holding and testing of RTE food** to verify that contamination found in environmental locations has not spread to RTE food. When verification activities already include holding and testing RTE food for *L. monocytogenes*, the frequency of testing could be increased (if not already testing every lot) and/or the number of samples collected and tested from each lot could be increased until the restoration of hygienic conditions on equipment or the processing environment has been verified.
37. When the actions taken in response to a positive (or presumptive positive) result are not effective (meaning *L. monocytogenes* or *Listeria* spp. continue to be detected after such actions), then additional actions of an escalated nature or intensity should be taken until the hygienic conditions on equipment and the processing environment have been restored.
38. Structured processes, such as root cause analysis, can be helpful in determining the likely root cause (e.g. the source) of a *L. monocytogenes* contamination event and additional actions that may prevent such contamination from recurring. Some examples of when a structured process could be considered are:
- when *L. monocytogenes* has been confirmed on a food contact surface (or in an RTE food); and
 - when a strain of *L. monocytogenes* has been found to be a resident strain to the facility.

K. SAMPLING FOR SPECIAL CIRCUMSTANCES

39. The EMP should identify special circumstances which may require a temporary increase or modification to the established environmental sampling activities. Such circumstances can include planned events (e.g. construction activities at the facility or the introduction of new equipment, products, or ingredients) or unplanned events (such as roof leaks, drain backups, or flooding of the facility due to extreme weather events).
40. For planned events (e.g. a construction project affecting part of the facility while processing of RTE food continues in other parts of the facility), environmental monitoring activities specific to the planned event should be developed separate from the routine EMP for the facility. Resources needed to support environmental monitoring for a planned event should not reduce the facility's ability to conduct appropriate environmental monitoring in the parts of the facility that continue to produce RTE food during the planned event. Additional sampling locations may need to be identified and the sampling timing/frequency may need to be adjusted depending on the nature of the planned event.
41. FBOs should consider how they could respond to unplanned events with respect to collecting environmental samples and whether to document these activities in the EMP or in procedures developed specifically for responding to such unplanned events.

L. REVIEW OF THE EMP

42. EMPs should be reviewed and updated on a periodic basis (e.g. at least annually) so that the programme continues to be appropriately designed and implemented. Furthermore, the EMP design should be reviewed in response to any situation that could impact the effectiveness of the controls for *L. monocytogenes*, or any event involving the loss of control for *L. monocytogenes* such as repeated detection of a persistent strain.
43. The review of the EMP could include:
- A review of the sampling locations and frequencies so that the EMP is collecting data on all appropriate equipment and the processing environment in the facility at suitable intervals.
 - A review of actions taken in response to positive (or presumptive positive) samples to evaluate their completeness and effectiveness.

- A review of positive (and presumptive positive) locations to determine if there are any trends or patterns in where/when *L. monocytogenes* or *Listeria* spp. has been found in the facility. Such long-term review of the data can reveal low level, intermittent contamination that may otherwise go unnoticed.
 - The collection and testing of a large number of samples from food contact and non-food contact surfaces throughout the RTE processing area of the facility (including locations not identified and sampled as part of the EMP). This activity may be especially helpful if the EMP has not detected any (or very few) positive locations since the last review.
44. It may be helpful to enlist a food safety expert with specific process experience from outside the facility to participate in the review of the EMP.

ANNEX II

RECOMMENDATIONS TO COMPETENT AUTHORITIES FOR THE USE OF MICROBIOLOGICAL TESTING AS A MEANS OF VERIFYING THE EFFECTIVENESS OF HACCP AND PREREQUISITE PROGRAMMES FOR THE CONTROL OF *LISTERIA MONOCYTOGENES* IN READY-TO-EAT FOODS**1. INTRODUCTION**

1. These recommendations are for competent authorities that use microbiological testing (e.g. environmental monitoring and/or process control testing) as part of their regulatory activities. It is also anticipated that this annex will provide guidance that the competent authority can provide to industry.
2. The effectiveness of HACCP, GHPs and other programmes for the control of *L. monocytogenes* in their operating facilities falls within the responsibility of FBOs. Further, FBOs must validate the food safety control systems they have in place. Competent authorities verify that the controls are validated and have been implemented as designed. Example verification activities include conducting inspections, reviewing records of CCP compliance, reviewing the results from an FBO's microbiological testing programs and observing production or processing personnel. Additionally, competent authorities may implement their own microbiological testing programmes as a means of verification activity when FBOs procedures and records do not provide sufficient assurance of compliance.
3. Guidance within Codex regarding microbiological testing is often restricted to the testing of finished RTE foods using traditional lot-by-lot testing. However, the general section of these guidelines emphasises the importance of EMPs to verify the effectiveness of GHPs and other control measures implemented to maintain hygienic conditions and prevent contamination of RTE foods with *L. monocytogenes*. This is further elaborated in Annex I: *Recommendations to Food Business Operators for an Environmental Monitoring Programme for Listeria monocytogenes in Primary Production and Processing Areas*, which provides recommendations to industry on the design and implementation of EMPs.
4. Microbiological test programmes can be implemented for a) environmental monitoring and b) process control verification. These programmes described below can be an important part of the ability of competent authorities to verify the effectiveness of *L. monocytogenes* control programmes over time. These recommendations do not establish specific decision criteria for programmes or specific actions that should be taken to re-establish control. Establishment of such specific criteria and actions is more appropriately the responsibility of competent authorities due to the diversity in products and processing technologies.

2. ENVIRONMENTAL MONITORING

5. In certain instances, competent authorities may incorporate the testing of food contact and/or non-food contact surfaces (e.g. surfaces on equipment or the processing environment) for *L. monocytogenes* or appropriate indicator organisms, such as *Listeria* spp., as part of their regulatory requirements or activities. This sampling/testing can be performed by the competent authority as part of its inspection activities or by the individual FBO (in which case the competent authority can review the testing procedures and results as part of its verification of the FBO's controls).
6. The purpose of conducting or reviewing environmental testing programmes by a competent authority is to verify that a FBO has appropriately identified and controlled *L. monocytogenes* or *Listeria* spp. and potential harbourage sites within the facility.
7. In developing environmental testing programmes, competent authorities should:
 - consider the importance of environmental sampling in verifying appropriate hygienic conditions in facilities that produce both RTE foods that support the growth of *L. monocytogenes* and those that do not;
 - clearly distinguish between sampling of food contact surfaces and non-food contact surfaces;
 - articulate the sampling plan and testing techniques (see Annex I; note that the sampling locations for competent authorities may be similar to those used by FBOs);
 - establish decision criteria that will initiate follow-up actions (including additional testing) when an environmental sample is positive for *L. monocytogenes* or *Listeria* spp.;
 - establish actions that the FBO should initiate when an environmental sample is positive for *L. monocytogenes* or *Listeria* spp.; and
 - include a system to record and evaluate the data.
8. Competent authorities should communicate all positive findings of *L. monocytogenes* or *Listeria* spp. in environmental samples to the FBO as soon as possible. Additionally, competent authorities should consider communicating presumptive positives so that FBOs can take appropriate actions while confirmation methods

are completed. When reporting positive (or presumptive positive) results of *L. monocytogenes* or *Listeria* spp. to FBOs, competent authorities should provide any insights from their analyses that may help the FBO identify and correct the source of contamination. For example, the competent authority could point out that the repetitive isolation of a specific strain of *L. monocytogenes* can indicate a harbourage site that routine cleaning and disinfection activities are insufficient to control.

9. When *L. monocytogenes* is detected in environmental samples by the competent authority, an investigation (by the FBO and/or the competent authority) should be performed to identify:
 - the source(s) of contamination;
 - whether any RTE product was impacted by the positive finding; and
 - specific actions that should be taken by the FBO to correct the problem and prevent its recurrence (see Annex I, section J).
10. Overall, sampling techniques and testing methods should be reproducible, reliable, and sufficiently sensitive for the type of surface being evaluated. Methods used should be appropriately validated for the recovery of *L. monocytogenes* or *Listeria* spp. from environmental samples. Testing laboratories should use appropriate laboratory practices and should be accredited when possible for the specific analytical methods used.

3. PROCESS CONTROL VERIFICATION

11. For a well-designed food safety control system, the FBO is responsible for implementing and maintaining effective controls to prevent and manage *Listeria* contamination within its premises. A competent authority may consider establishing microbiological process control testing (e.g. testing in-process and/or finished RTE foods) and decision criteria for specific products (or groups of products) to identify trends that can be corrected before decision criteria are exceeded. When undesirable trends occur or decision criteria are exceeded, the FBO should investigate the food safety control system to determine the cause and take action to correct the problem(s) and prevent its (their) recurrence. The competent authority should verify that appropriate actions are taken when criteria for *L. monocytogenes* or *Listeria* spp. are exceeded. For example, the decision criteria for process control testing could be the frequency of contamination that would be indicative of a process no longer in control and likely to produce RTE foods that do not meet the microbiological criteria established in Annex III.
12. In addition to verifying that the process controls within the food safety control system are valid and operating as designed, the competent authority should recommend when necessary that FBOs conduct process control testing²⁰ of finished RTE foods to detect changing patterns of contamination, which allows distinction between occasional 'in control' positive samples and an emerging loss of control. Process control testing of finished RTE foods contributes to the assessment of the continuing performance of a food safety control system and helps support that appropriate actions are taken to correct problems before microbiological criteria are exceeded. The competent authority should verify that the food safety control system remains 'in control' or that the FBO has taken appropriate actions to prevent loss of control, which could include immediate corrections or changes to the food safety control system itself. The presence of *L. monocytogenes* in finished RTE foods can indicate the lack of control at primary production and/or in the processing environment.
13. In certain instances, competent authorities may find it useful to establish an industry-wide process control-based criterion for *L. monocytogenes* so that a consistent approach for verification of HACCP or other food safety control systems is applied to specific RTE foods. This can include sampling by competent authorities as part of their inspection activities or sampling performed by the FBO that the competent authority can review as part of its verification of the FBO's records.
14. As with other forms of verification via microbiological testing, the use of process control testing involves the establishment of decision criteria, specification of analytical methods, specification of a sampling plan, and actions to be taken in case of a loss of control. Details of process control testing principles and guidelines are beyond the scope of this annex but are available through standard references.

4. CHARACTERISING *L. MONOCYTOGENES* ISOLATES

15. When competent authorities detect *L. monocytogenes* during inspection activities, it is recommended that they characterize the isolate(s) using one or more of the available genetic techniques (such as whole genome sequencing (WGS), pulsed-field gel electrophoresis (PFGE), multi-locus sequencing typing (MLST), or selected polymerase chain reaction-based (PCR-based) methods). Genetic characterisation of the isolate(s) can provide information on virulence factors, potential antibiotic sensitivity, biocide tolerance, subtyping and allow genetic comparison (e.g. through subtyping) to any isolates obtained and analysed by comparable

²⁰ Sometimes referred to as "cross-lot" testing, which involves a limited number of tests being conducted across lots over time instead of extensive testing of each lot

methods from food, ill persons and/or from previous environmental sampling.

16. These *L. monocytogenes* isolates should be retained and stored under appropriate frozen conditions in case further characterisation is needed (e.g. WGS following an initial PFGE analysis). Furthermore, if the competent authority does not initially characterise the isolate(s), these should be retained and stored under appropriate frozen conditions in case future characterisation is needed. The availability of *L. monocytogenes* isolates and/or such characterisation data supports the development of risk assessments. Competent authorities are encouraged to foster the timely and appropriate sharing of WGS data within and across countries. Such data plays an essential role in enabling thorough risk assessments, enhancing surveillance efforts, and reinforcing food safety systems worldwide.

ANNEX III

RECOMMENDATIONS TO COMPETENT AUTHORITIES AND FOOD BUSINESS OPERATORS FOR DEVELOPING AND APPLYING MICROBIOLOGICAL CRITERIA FOR *LISTERIA MONOCYTOGENES* IN READY-TO-EAT FOODS**1. INTRODUCTION**

1. The microbiological criteria presented in this Annex are intended as advice to competent authorities within a framework for the control of *L. monocytogenes* in RTE foods with a view towards protecting the health of consumers and ensuring fair practices in food trade. They also provide information that may be of interest to FBOs (e.g. Section 3.1).
2. This Annex references and takes into account the *Principles and Guidelines for the Establishment and Application of Microbiological Criteria Related to Foods* (CXG 21-1997) and uses definitions (e.g. for microbiological criterion) as included in these principles. The provisions of this Annex should be used in conjunction with *Annex II: Guidance on Microbiological Risk Management Metrics* of the *Principles and Guidelines for the Conduct of Microbiological Risk Management (MRM)* (CXG 63-2007).
3. Available risk assessments have been considered in the development of the microbiological criteria in this Annex. In addition, factors that might impact the ability of competent authorities and FBOs to implement these microbiological criteria (e.g. methodological limitations, costs associated with different types of qualitative and quantitative testing, and statistics-based sampling needs) were also considered. It should be noted that microbiological testing alone cannot assure the safety of RTE food, and such testing should not be used as a substitute for appropriate and effective control measures for *L. monocytogenes*.

2. SCOPE

4. These microbiological criteria apply to specific categories of RTE foods, as described herein. The competent authority should consider the intended use as well as how specific RTE foods are likely to be handled during retail, catering, or by consumers (including the reasonably foreseeable²¹ use of the food) when developing risk management strategies to determine the appropriateness of applying the microbiological criteria. Competent authorities may apply these criteria, where appropriate, to assess the acceptability of RTE foods in international trade for imported products, at end of manufacture (finished RTE foods) for domestic products, and at point of sale for the expected shelf-life²² under reasonably foreseeable conditions of distribution, storage and use.
5. The microbiological criteria may be used as the basis for the development of additional criteria (e.g. process criteria, product criteria) within a food safety control system²³ to comply with these guidelines.
6. Different criteria or other limits may be applied when the competent authority determines that the use of such an approach provides an acceptable level of consumer protection or when the competent authority determines a more stringent criterion is necessary to protect public health.

3. USE OF MICROBIOLOGICAL CRITERIA FOR *L. MONOCYTOGENES* IN RTE FOODS

7. A microbiological criterion defines the acceptability of a food based on whether the target microorganism is detected/not detected or the number of microorganisms in the food. There are various applications for microbiological criteria for *L. monocytogenes* in RTE foods using risk-based sampling plans²⁴, including:
 - Microbiological testing against a criterion can be used as a means of verifying the continuing effectiveness of a food safety control system (i.e. HACCP System)²⁵. Typically, such applications involve testing on less than a lot-by-lot basis and may be formalised into a system of process control verification testing. However, it should be recognised that coupling environmental monitoring with the testing of RTE foods is a more effective approach for verifying the effectiveness of controls for *L. monocytogenes*.
 - Testing for compliance with a microbiological criterion may also be used as a means of verifying the microbiological status of foods in relation to acceptance criteria specified between FBOs. Such testing

²¹ 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.

²² See definition in the *Code of Hygienic Practice for Milk and Milk Products* (CXC 57-2004).

²³ *Guidelines for the Validation of Food Safety Control Measures* (CXG 69-2008)

²⁴ *General Guidelines on Sampling* (CXG 50-2004)

²⁵ *Principles and Guidelines for the Establishment and Application of Microbiological Criteria Related to Foods* (CXG 21-1997)

may be conducted on a lot-by-lot basis when there is little information about the conditions under which the product has been produced and when other more effective control measures (e.g. listericidal treatments) are not available. Where there is information about the conditions of production/processing, testing for compliance may be conducted less frequently.

- When there is little information about the conditions under which the product has been produced and other more effective control measures are not available, microbiological testing on a lot-by-lot basis can be used as a direct control measure, i.e. sorting of acceptable and unacceptable lots. This type of testing should be limited to those products and/or points of the food chain where the microbiological criteria would be expected to improve the degree of protection offered to the consumer.
8. The frequency of testing RTE foods for *L. monocytogenes* may be modified based on the likelihood of contamination, characteristics of the food, history of the food, conditions of primary production or processing, and other relevant information.
 9. Testing against microbiological criteria for *L. monocytogenes* is not necessary for foods that:
 - receive a validated listericidal treatment after being sealed in final packaging that prevents contamination until the packaging is opened by the consumer or otherwise compromised;
 - are aseptically processed and packaged²⁶;
 - contain a component in their formulation for the rapid inactivation of the pathogen, if present (e.g. products that contain >5 % ethanol); or
 - belong to other categories of RTE foods as defined by competent authorities.
 10. Where possible and practicable, the risk-based approach to development of microbiological criteria²⁷ should be used to contribute to the assurance, that a food control system will achieve the required level of consumer protection.
 11. Risk assessments have consistently identified the ability of an RTE food to support the growth of *L. monocytogenes* as a significant risk factor for listeriosis. Therefore, different microbiological criteria could apply for the following categories of foods:
 - RTE foods in which growth of *L. monocytogenes* will not occur; and
 - RTE foods in which growth of *L. monocytogenes* can occur.
 12. If there is insufficient information to demonstrate that *L. monocytogenes* growth will not occur in an RTE food during its expected shelf-life under reasonably foreseeable conditions of distribution, storage and use, the food should be categorised as an RTE food in which growth of *L. monocytogenes* can occur.

3.1 Recommendations for how FBOs can identify RTE foods in which growth of *L. monocytogenes* will not occur

13. FBOs should determine if growth of *L. monocytogenes* will not occur in RTE foods. Such determination should be based on scientific justification²⁸, including the inherent variability of parameters controlling *L. monocytogenes* in the food. Demonstration that growth of *L. monocytogenes* will not occur in an RTE food can be based upon, for example, food characteristics, the study of naturally contaminated food (i.e. durability studies), challenge studies, predictive modelling, as well as information from the scientific literature, risk assessments, academic institutions and historical records of product characteristics (e.g. pH, a_w), or combinations of these.
14. Parameters such as pH and a_w can be useful in preventing growth. For example, *L. monocytogenes* growth can be controlled in foods where the following characteristics can be maintained throughout the shelf-life²⁹:
 - a pH below 4.4;

²⁶ Code of Hygienic Practice for Aseptically Processed and Packaged Low-Acid Foods (CXC 40-1993)

²⁷ Principles and Guidelines for the Conduct of Microbiological Risk Management (CXG 63-2007)

²⁸ References that have been addressed for identifying properties of ready-to-eat foods which will categorise them as foods in which growth of *L. monocytogenes* will not occur, or as foods in which growth of the pathogen can occur, include *Microorganisms in Foods 5 – Characteristics of Microbial Pathogens* (ICMSF, 1996) and *Microbiological Risk Assessment Series 4 and 5: Risk assessment of Listeria monocytogenes in ready to eat foods: Interpretative Summary and Technical Report* (FAO/WHO, 2004).

²⁹ It should be noted that some food packaging (e.g. that allow for moisture exchange) may not allow these characteristics to be maintained throughout the shelf-life under reasonably foreseeable conditions of distribution, storage and use.

- an $a_w < 0.92$;
 - a combination of $\text{pH} < 5.0$ with $a_w < 0.94$; or
 - other combinations of parameters validated to prevent the growth of *L. monocytogenes* in the food.
15. Growth of *L. monocytogenes* in RTE food can also be controlled by freezing the food (at least during that period when the food remains frozen). Frozen RTE foods that may be thawed and held under refrigerated conditions before consumption should be evaluated to determine if *L. monocytogenes* growth can occur in the food when it is not frozen.
 16. In addition, inhibitory compounds can control the growth of *L. monocytogenes* and synergy may be obtained with other extrinsic and intrinsic parameters that would result in no growth.
 17. When an FBO can demonstrate that the RTE food consistently meets intrinsic parameters shown to inhibit *L. monocytogenes* growth (e.g. by previous studies or microbiological models applicable to the specific RTE food), further documentation may not be needed. For all other cases, a challenge study may be conducted.

3.1.1 Challenge Studies

18. For the purposes of this Annex, a challenge study is a laboratory-based study that provides information on the behaviour of *L. monocytogenes* (growth, survival, or decline) under specified storage conditions when the RTE food is artificially inoculated. Challenge studies are the responsibility of FBOs. They are typically carried out by a contract laboratory on behalf of an FBO but may also be conducted in collaboration with appropriate industry organisations. There are two main types of challenge studies:
 - Growth potential (Δ) assessment
 - Maximum specific growth rate (μ_{max}) assessment.
19. Before initiating a challenge study, it is important that all the relevant information about the RTE food and its processing be provided to the laboratory, as the study design should accurately reflect the food's characteristics. A few key aspects to consider are:
 - Product characteristics (e.g. pH, water activity, or inhibitory compounds);
 - Specifications for background microbial populations;
 - Times and temperatures at various processing steps; and
 - Intra- and inter-batch variability for any factors that may influence the growth of *L. monocytogenes*.
20. Should none of the parameters be known to prevent growth, then growth potential assessments should be used to determine whether the product is an RTE food in which growth of *L. monocytogenes* can occur or in which growth of *L. monocytogenes* will not occur. These assessments are critical for evaluating the adequacy of control measures for preventing the growth of *L. monocytogenes*.
21. Competent authorities may provide guidance on the specific protocols that FBOs should use to conduct studies to demonstrate that growth of *L. monocytogenes* will not occur in an RTE food.
22. Challenge studies to determine if growth of *L. monocytogenes* will not occur in an RTE food^{30,31} should be appropriately designed considering the reasonably foreseeable conditions of the food's distribution, storage and use. For example:
 - **Temperature.** Many refrigerated RTE foods may not be consistently held under adequate refrigerated temperatures during distribution, at retail, and/or in the home refrigerator. Therefore, such studies should be designed to evaluate the growth of *L. monocytogenes* in the food under observed (i.e. actual) temperature conditions experienced in distribution, storage and use or, in the absence of such information, under likely conditions (i.e. assuming moderate temperature abuse³²).
 - **Time.** Studies to determine if *L. monocytogenes* will not grow in an RTE food should be conducted for at least the intended shelf-life of the food (as labeled by the FBO) and potentially longer for an

³⁰ *Guidelines for the Validation of Food Safety Control Measures* (CXG 69-2008)

³¹ See as an example: ISO 20976-1 *Microbiology of the food chain — Requirements and guidelines for conducting challenge tests of food and feed products Part 1: Challenge tests to study growth potential, lag time and maximum growth rate*.

³² Some studies and literature suggest 7°C to represent moderate temperature abuse. However, available data on reasonably foreseeable conditions of distribution, storage and use may suggest other temperatures to be appropriate for certain regions or points along the supply chain, including storage and use by the consumer.

additional margin of safety. For example, some consumers will continue to eat certain RTE foods beyond the labeled shelf-life (i.e. the expected shelf-life). Studies to determine if *L. monocytogenes* will not grow in these RTE foods can be conducted for an additional duration of time beyond the labeled shelf-life as a safety margin to account for such consumption. The length of time used as an additional safety margin can take into account factors such as the likelihood for the food to spoil past the labeled shelf-life, or other information that may impact the likelihood for a consumer to consume the food past its labeled shelf-life.

23. When evaluating or verifying challenge study results, FBOs and competent authorities should take into account the increase in *L. monocytogenes* over the duration of the study as well as the measurement variability (standard deviation) of the quantification method, before concluding that *L. monocytogenes* will not grow in an RTE food.
24. An RTE food in which growth of *L. monocytogenes* will not occur should have an observable increase in *L. monocytogenes* levels less than or equal to (on average) 0.5 log CFU/g³³ for the expected shelf-life of the food under reasonably foreseeable conditions of distribution, storage and use.

³³ 0.5 log is two times the estimated standard deviation (i.e. 0.25 log) associated with the experimental enumeration using viable counting/plate counts.

4. MICROBIOLOGICAL CRITERIA FOR *L. MONOCYTOGENES* IN RTE FOODS

25. Microbiological criteria for *L. monocytogenes* in RTE foods are described in Table 1. The purpose of these criteria is to provide a specified degree of confidence that *L. monocytogenes* will not be present in RTE foods at levels that represent the greatest risk to consumers.

Table 1: Microbiological criteria^a for *L. monocytogenes* in RTE foods from the end of manufacture or port of entry (for imported products) to the point of sale

Type of Food	Microorganism	n	c	m	Type of Class
RTE foods in which growth of <i>L. monocytogenes</i> can occur	<i>Listeria monocytogenes</i>	5	0	Not detected in 25 g (< 0.04 CFU/g) ^b	2 ^c
RTE foods in which growth of <i>L. monocytogenes</i> will not occur	<i>Listeria monocytogenes</i>	5	0	100 CFU/g ^d	2 ^e

^a Where n = the sample size, i.e. the number of sample units to be tested from a lot; c = the maximum number of unacceptable analytical units that can be tolerated without rejecting the lot; m = the microbiological limit that differentiates acceptable ($\leq m$) from unacceptable ($> m$) microbial concentrations.

^b This criterion is based on the use of ISO 11290-1 method. Other methods that provide equivalent sensitivity, reproducibility, and reliability can be employed if they have been appropriately validated (e.g. based on ISO 16140 series).

^c Assuming a log normal distribution, this sampling plan would provide 95% confidence that a lot of food containing a geometric mean concentration of 0.023 CFU/g and a standard deviation of 0.25 log CFU/g would be detected and rejected if any of the five sample units are positive for *L. monocytogenes*. Such a lot may consist of 55% of the 25 g samples being negative and up to 45% of the 25 g samples being positive. 0.5 % of this lot could harbour concentrations above 0.1 CFU/g.

^d This criterion is based on the use of the ISO 11290-2 method. Other methods that provide equivalent sensitivity, reproducibility, and reliability can be employed if they have been appropriately validated (e.g. based on ISO 16140 series).

^e Assuming a log normal distribution, this sampling plan would provide 95% confidence that a lot of food containing a geometric mean concentration of 93.1 CFU/g and a standard deviation of 0.25 log CFU/g would be detected and rejected based on any of the five sample units exceeding 100 CFU/g *L. monocytogenes*. Such a lot may consist of 55% of the samples being below 100 CFU/g and up to 45% of the samples being above 100 CFU/g, whereas 0.002% of all the samples from this lot could be above 1000 CFU/g.

26. The criteria in Table 1 assume appropriate application of the general principles described in these guidelines, including the recommendations for an EMP in primary production and processing areas (Annex I) and the recommendations for the use of microbiological testing for environmental monitoring and process control verification by competent authorities as a means of verifying the effectiveness of HACCP and prerequisite programmes for the control of *L. monocytogenes* (Annex II). Further, these criteria assume that the ability for *L. monocytogenes* to not grow in the RTE food has been determined in accordance with Section 3 of this Annex.
27. Competent authorities should provide guidance on how samples should be collected and handled, and the degree to which compositing of sample units can be employed. Sample units should not be composited when conducting enumeration assays (i.e. quantitative methods).
28. The typical actions to be taken where there is a failure to meet the criteria in Table 1 would be to (1) prevent the affected food from being released for human consumption, (2) recall the food if it has been released for human consumption, and (3) investigate and correct the root cause (or likely root cause) of the failure, including the cleaning and disinfection of food contact surfaces used in the processing of the affected food³⁴.

³⁴ The discussion of root cause investigation following a positive environmental sample (see Annex I) is also relevant to the actions appropriate in response to a RTE food failing to meet the criteria in Table 1.

29. Additionally, a review of the food safety system should be considered if *L. monocytogenes* is detected at less than 100 CFU/g in a RTE food in which growth of the pathogen will not occur, despite the food meeting the criteria in Table 1. This is particularly relevant if such detections occur repeatedly within short time intervals.
30. Another procedure for establishing microbiological criteria for *L. monocytogenes* other than the criteria at specified points in the food chain that are described in Table 1, would be through the application of risk-based metrics (e.g. Food Safety Objective (FSO), Performance Objective (PO)) according to the general principles established in the *Annex II: Guidance on Microbiological Risk Management Metrics* of the *Principles and Guidelines for the Conduct of Microbiological Risk Management (MRM)* (CXG 63-2007).

5. ALTERNATIVE APPROACH

31. Further to the approaches described in section 4, competent authorities may choose to establish and implement other validated microbiological criteria for *L. monocytogenes* in certain RTE foods at the point of consumption (or at other points) that provide an acceptable level of consumer protection. Any microbiological criteria established further to those described in Table 1 should assume appropriate application of these guidelines, including the recommendations for an EMP in primary production and processing areas (Annex I) and the recommendations for the use of microbiological testing for environmental monitoring and process control verification by competent authorities as a means of verifying the effectiveness of HACCP and prerequisite programmes for the control of *L. monocytogenes* (Annex II). Such approaches should also be aligned with the *Principles and Guidelines for the Establishment and Application of Microbiological Criteria Related to Foods* (CXG 21-1997).
32. Due to the large number of different RTE foods in which growth of *L. monocytogenes* can occur, this alternative approach could be applied for specific categories or subcategories of RTE foods in which *L. monocytogenes* is unlikely to grow over the expected shelf-life (see Section 3.1.1 for a discussion of shelf-life and the duration of challenge studies used to demonstrate the limited growth potential of *L. monocytogenes* in RTE foods).
33. In establishing such limited potential for growth of *L. monocytogenes* during the expected shelf-life, the competent authority should clearly articulate the types of information required of FBOs in supporting that the hazard is controlled and to verify that such limited potential for growth is achieved in practice. Information needed by competent authorities for verification should be obtained through validation studies and other sources, and may include:
- specification for physicochemical characteristics of the foods, such as:
 - pH,
 - a_w ,
 - salt content, and
 - concentration of inhibitory compounds;
 - the type of packaging system which may, for example, affect the oxygen content and relative humidity in the package;
 - the possibilities for contamination, considering the processing conditions;
 - the expected shelf-life under reasonably foreseeable conditions of distribution, storage and use; and
 - consultations of available scientific literature and research data regarding the growth and survival characteristics of *L. monocytogenes*.
34. When appropriate, validation studies should be conducted based on the above-mentioned information. These studies should consider seasonal and regional variations and may include:
- predictive mathematical modelling established for the food in question, using critical growth or survival factors for *L. monocytogenes* in the product; and
 - challenge tests, to evaluate the growth of *L. monocytogenes* artificially inoculated into the food during the expected shelf-life under reasonably foreseeable conditions of distribution, storage and use.
35. Once the shelf-life of an RTE food has been established and validated, FBOs should consider ongoing verification activities such as durability studies to confirm that under the reasonably foreseeable condition of distribution, storage, and use, the presence and growth of *L. monocytogenes* remain within the established safety limits throughout the expected shelf-life. Verification activities may include but are not limited to analysis of representative batches throughout the shelf-life, for example durability studies on naturally occurring

L. monocytogenes contamination in food. These assessments are critical for evaluating the adequacy of control measures for preventing the growth of *L. monocytogenes*.

APPENDIX VIII

CCFH FORWARD WORKPLAN

Part 1									
Title of Work	Last Revision	Information to Update (Yes/No) ¹	Impact to Public Health (High= 20/ Medium = 14/ Low = 8)	Trade Impact (10/5/4/2/0) ²	Project document/ discussion paper (Yes/No)	Status of scientific advice (Required/ Requested/ Ongoing/ Available)	Alignment required with the revised CXC 1- 1969	Comments	Total
<i>Code of Practice for Processing and Handling of Quick Frozen Foods</i> (CXC 8-1976)	2008	Yes	Committee did not propose a rating during PWG	Committee did not propose a rating during PWG	Yes			This CoP was originally developed by the TFPHQFF; however, the proposed changes need to be considered from a microbiological food safety perspective.	
Development of Code of Hygienic Practice for Manufacturing of Cell-Based Foods	NA	Yes	Committee did not propose a rating during PWG	Committee did not propose a rating during PWG	Yes				
<i>Code of Practice on Food Allergen Management for Food Business Operators</i> (CXC 80- 2020)	2019	Yes (FAO/WHO Expert consultations) /No (CCFL input)			Yes	Available	Yes	CCFL48 completed revisions to provisions relevant to allergen labelling in the <i>General standard for the labelling of pre-packaged foods</i> (CXS 1-1985), in particular the definitions and the new list of foods or ingredients that should be declared on a label. There is now a need to ensure consistency of the <i>Code of practice on allergen management for food business operators</i> (CXC 80–2020) with the updated CXS 1-1985. Work on Precautionary allergen labelling continues, although it has been	30

¹ Information to Update (Currency of information): Is there new information/data that would justify the need to review the existing code(s) or establish a new one? Are there new technologies that would justify the need to review existing codes or establish a new one? Is there duplication or inconsistency with existing codes that should be addressed? If there is an existing code in place and a determination is made that the code is sufficient, no new work should proceed.

² Global Trade Impact, High Consumption: 10; Regional Trade Impact, High Consumption: 5; Global Trade Impact, Low Consumption: 4; Regional Trade Impact, Low Consumption: 2; No trade impact: 0

							adopted at Step 5 and FAO/WHO have in November 2025 convened another expert meeting on this topic. Consideration needs to be given to how to initiate the alignment updates or plan for a more comprehensive update, perhaps at the next session. priority allergen list https://doi.org/10.4060/cb9070en threshold https://doi.org/10.4060/cc2946en precautionary labelling https://doi.org/10.4060/cc6081en exemptions https://doi.org/10.4060/cc9554en other threshold https://doi.org/10.4060/cc8387en guidance for risk assessment (<i>summary report</i>) https://openknowledge.fao.org/handle/20.500.14283/cd6046en (full report in 2026). gluten (<i>Summary report</i>) https://openknowledge.fao.org/handle/20.500.14283/cd7703en (full report in 2026).		
Code of Hygienic Practice for the Storage of Cereals	N/A	Yes			Yes ³		N/A		13

³ Discussion paper on development of Code of Hygienic Practice for the storage of cereals (prepared by India) FH/44 CRD 9, included in the Forward Workplan by the 44th session of the CCFH, 12-16 November 2012

Part 2

Texts below are ordered most recent to oldest. There is no request to update, however, revisions may be needed for alignment with CXC 1-1969 and other documents or new scientific information may be forthcoming

Title of Work	Last Revision	Information to Update (Yes/No) ⁴	Impact to Public Health (High= 20/ Medium = 14/ Low = 8)	Trade Impact (10/5/4/2/0) ⁵	Project document/ discussion paper (Yes/No)	Status of scientific advice (Required/ Requested/ Ongoing/ Available)	Alignment required with the revised CXC 1-1969	Comments	Total
<i>Code of Hygienic Practice for Low-Moisture Foods</i> (CXC 75- 2015)	2018	No				Available low-moisture foods (MRA26) https://doi.org/10.4060/cc0763en spices and dried aromatic herbs (MRA 27) https://doi.org/10.4060/cb8686en	Yes	Sections should be re- aligned with revised GPFH sections. There is a semi-quantitative risk assessment tool in the MRA 27, which could be cited in the CoP.	
<i>Code of Hygienic Practice for Fresh Fruits and Vegetables</i> (CXC 53-2003) Five annexes on: (1) ready-to-eat, fresh, pre-cut fruits and vegetables, (2) sprouts, (3) fresh leafy vegetables, (4) melons, (5) berries.	2017	No				Available/ongoing (links are on the right side)	Yes	GPFH definitions - types of water should reference updated text of GPFH/ expert information. There are three JEMRA reports on FFV includes, (1) Leafy vegetables and herbs, (2) Berries and tropical fruits, (3) Melon and tree fruits, (4) Seeded and root vegetables. (MRA42 , MRA43 and MRA44) The JEMRA reports on water (MRA33 and MRA37), Listeria (MRA38 , MRA47 and MRA48), Virus (MRA49) FAO summary report on Clostridium , protozoan and helminths (full report in 2026).	
<i>Guidelines on the Application of General Principles of Food Hygiene to the Control of Foodborne Parasites</i> (CXG 88- 2016)	2016	No				Available/ongoing (links are on the right side)	Completed	FAO have also convened two expert meetings in 2025 on foodborne parasites (see agenda item 3) FAO summary report on protozoan and helminths (full report in 2026).	

⁴ Information to Update (Currency of information): Is there new information/data that would justify the need to review the existing code(s) or establish a new one? Are there new technologies that would justify the need to review existing codes or establish a new one? Is there duplication or inconsistency with existing codes that should be addressed? If there is an existing code in place and a determination is made that the code is sufficient, no new work should proceed.

⁵ Global Trade Impact, High Consumption: 10; Regional Trade Impact, High Consumption: 5; Global Trade Impact, Low Consumption: 4; Regional Trade Impact, Low Consumption: 2; No trade impact: 0

<i>Guidelines for the control of non-typhoidal Salmonella in Beef and Pork</i> (CXG 87-2016)	2016	No					Yes	Editorial: 8h) Should move superscript 17 to end of second sentence and reference direct to Section 7.3 of revised GPFH. Similar for superscript 22 – repeat as above.	
<i>Guidelines for the Control of Trichinella spp. in Meat of Suidae</i> (CXG 86-2015)	2015	No				Available/ongoing (links are on the right side)	Completed	FAO have convened two expert meetings in 2025 on risk assessment of helminth parasites in foods (see agenda item 3) FAO summary report on helminths (full report in 2026).	
<i>Guidelines for the Control of Taenia saginata in Meat of Domestic Cattle</i> (CXG 85-2014)	2014	No				Available/ongoing (links are on the right side)	Completed	FAO have convened two expert meetings in 2025 on risk assessment of helminth parasites in foods (see agenda item 3) FAO summary report on helminths (full report in 2026).	
<i>Principles and Guidelines for the Conduct of Microbiological Risk Assessment</i> (CXG 30- 1999)	2014	No					No	Hazard definition should be updated. Hazard identification should reference GPFH as a starting point.	
<i>Principles and Guidelines for the Establishment and Application of Microbiological Criteria related to Foods</i> (CXG 21-1997)	2013	No					No	Editorial updates: 4.1 (para 11) should be updated with reference to GPFH. Suggest "The choice of the approach should be aligned with GPFH (CXC 1-1969), the risk management objectives and decisions relating to food safety and suitability." 4.12 should be updated to refer to Section 7.4 of revised GPFH document.	
<i>Code of Hygienic Practice for Collecting, Processing and Marketing of Natural Mineral Waters</i> (CXC 33-1985)	2011	No					Priority for 2026	GPFH reference should be dated (CAC/RCP 1-1969). HACCP should be referenced to revised GPFH. Sections references to GPFH should be updated to align with revised GPFH sections.	
<i>Code of Hygienic Practice for Powdered Formulae for Infants and Young Children</i> (CXC 66- 2008)	2009	No					Yes	Section formatting should be updated to align with revised GPFH sections. Review of HACCP should occur to align with revised GPFH GHP and HACCP use. Remove reference to HACCP annex.	
<i>Code of Hygienic Practice for Milk and Milk Products</i> (CXC 57-2004)	2009	No					Yes	Format follows GPFH sections therefore will need re-alignment with revised GPFH. HACCP reference should be changed from 'Annex' to 'Chapter Two'. Use of HACCP should be re- evaluated in line with revised GPFH approach. Consider use of GHP and HACCP as appropriate to cover hygienic practice, rather than HACCP alone. Allergens need re-evaluating in relation to milk itself as an allergen, rather than allergens from other sources. Water should be re-evaluated to align with revised GPFH and water advice.	

<i>Principles and Guidelines for the Conduct of Microbiological Risk Management (MRM)</i> (CXG 63-2007)	2008	No					No	Annex II. The Introduction should reference GPFH as the foundation for integration of MRM metrics within a food safety control system. Other wording within this annex should be re-considered for revision given the revised GHP/HACCP approach within the revised GPFH Editorial: Definitions - should reference GPFH and cover both GHP and HACCP. This would also include relevant definitions (hazard, control measure, CCP, CL etc.). 6.1.2 – should reference GPFH as source guidance for specific documents and guidelines.	
<i>Code of Hygienic Practice for Eggs and Egg Products</i> (CXC 15-1976)	2007	No					Yes	Context of use of hazard analysis, HACCP / HACCP system should be reviewed and updated in line with revised GPFH. Contents and referenced sections of GPFH should be updated throughout the document aligning as appropriate to revised sections of GPFH. Allergen information should be specifically referenced.	
<i>Code of Hygienic Practice for Meat</i> (CXC 58-2005) ⁶	2005	No					Yes	Should be updated for sections referenced to GPFH to align with revised GPFH sections.	
<i>General Standard for Irradiated Food</i> (CXS 106-1983)	2003	No						Remove reference to Rev 3 and wording on HACCP as HACCP covered within GPFH text	
<i>Code of Practice for Radiation Processing of Food</i> (CXC 19- 1979)	2003	No					Yes	Introduction – last paragraph should be updated to reflect HACCP application as in revised GPFH. Sections should be updated to align with revised GPFH.	
<i>Code of Hygienic Practice for Bottled/Packaged Drinking Waters (other than natural mineral waters)</i> (CXC 48-2001)	2001	No					Priority for 2026	GPFH reference should be updated to be consistent with requirements (remove Rev 3). Sections should be re- aligned to referenced sections within revised GPFH. Definitions reference should be updated to revised GPFH Definitions (not section 2.3). HACCP reference should be to the revised GPFH, not an Annex. Should consider water usage and reference to updated water section within GPFH and expert reports.	

⁶ Code developed by the Codex Committee on Meat Hygiene

<i>Code of Hygienic Practice for the Transport of Food in Bulk and Semi-packed Food</i> (CXC 47-2001)	2001	No					Priority for 2026	GPFH references should be consistent with current requirements, e.g. CAC/RCP 1-1969. Sections should be aligned with the revised GPFH sections. HACCP and hazard identification as mentioned in section 5 should be checked to see whether the wording here adds any further specific application above the HACCP approach in Chapter 2 of the revised GPFH. 5.5 Water should reference updated information in line with revised GPFH. Appendix on Hurdles – should be revised with consideration of HACCP text within Chapter 2 revised GPFH	
<i>Code of Hygienic Practice for Refrigerated Packaged Foods with Extended Shelf-life</i> (CXC 46-1999)	1999	No					Yes	Sections will need re- alignment with the revised GPFH. Section 5.1 should be revised in accordance with chapter 2 HACCP in the revised GPFH	
<i>Code of Hygienic Practice for Precooked and Cooked Foods in Mass Catering</i> (CXC 39- 1993)	1993	No					Yes	GPFH references should be updated (first reference to GPFH has no dated number; second reference in 5.2.1 is obsolete referring to 1985 GPFH). Explanatory preface C should be revised and aligned with HACCP application within the revised GPFH. Remove out- of- date references. Use of hazard and CCP notes throughout the document should be revised and aligned as necessary with GHP/HACCP application in the revised GPFH. Sections should be updated to align with revised GPFH sections and be complementary to the GPFH. Definitions (contamination, disinfection, food handler, food hygiene) should be updated to align with the revised GPFH definitions and other definitions should be included, e.g. to replace 'potentially hazardous food'. HACCP definitions should be referenced to GPFH if not included. Section 4.3.12 Water Supply should be updated and aligned with revised GPFH. Allergen management should get specific mention for mass catering and be referenced to the revised GPFH. Noting that this text has some text on clostridia, FAO have convened an expert meeting on microbiological risk assessment of toxigenic clostridia in foodborne disease in 2025	
<i>Code of Hygienic Practice for Low-acid and Acidified Low- acid Canned Foods</i> (CXC 23- 1979)	1993	No					Yes	Definitions - cleaning, disinfection, and potable water should be updated to align with revised GPFH. Sections should be updated to align as appropriate with revised GPFH. GHP and HACCP application should be considered and updated to align with use in revised GPFH, including Appendix IV (should have wider application than salvaged cans).	

<i>Code of Hygienic Practice for Aseptically Processed and Packaged Low-acid Foods</i> (CXC 40-1993)	1993	No					Yes	GPFH references should be updated to align with revised GPFH. Section and sub section references should be updated to align with revised GPFH. Sections and contents should be updated to align with and be complementary to revised GPFH. HACCP and its application should be referenced to revised GPFH. Definitions (cleaning, disinfection), should be updated to align with revised GPFH. Water should be aligned with revised GPFH.	
<i>Guideline Procedures for the Visual Inspection of Lots of Canned Foods for Unacceptable Defects</i> (CXG 17-1993) ⁷	1993	No					Yes		
<i>Code of Hygienic Practice for Canned Fruit and Vegetable Products</i> (CXC 2-1969)	1969	No					Yes	Needs revision and should reference GPFH as supporting text in a Scope and Use section. Sections should be aligned with the revised GPFH, including definitions. References to water use and supply should refer also to updated information provided by FAO/WHO on water. Note use of hazard (hygienic and health) and this should be revised in line with current definition of hazard.	
<i>Code of Hygienic Practice for the Processing of Frog Legs</i> (CXC 30-1983)	1983	No					Yes	GPFH should be referenced earlier as supporting text for whole document. Definitions should be updated (contamination, disinfection) to align with revised GPFH. Sections should be updated to align with revised GPFH, including 5.2.1 which currently has reference to GPFH. GHP and HACCP should be applied across the whole document as appropriate and in accordance with the revised GPFH.	

⁷ Documents developed by the Codex Committee on Processed Fruits and Vegetables.

PART 3 Scientific advice for CCFH

Topic	Background and questions to be answered	Reference	Timeline for delivery	Relevant work stream/Codex text
Safety of Powdered infant formula	CCFH55 requested JEMRA to: i. conduct a risk assessment on spore-forming pathogens, including <i>Clostridium botulinum</i> and <i>Bacillus cereus</i>, in powdered infant formula; ii. update the existing risk assessment and scientific advice on environmental pathogens (e.g. <i>Cronobacter</i> and <i>Salmonella</i>); and iii. provide other relevant scientific advice that would inform recommendations on strengthened control measures across the production environment, covering all stages from primary production and packaging through to the reconstitution of the product, and including environmental monitoring programmes	CCFH55 Paragraphs 76, 89		Revision of the <i>Code of Hygienic Practice for Powdered Formulae for Infants and Young Children</i> (CXC 66- 2008)
Scientific advice on the holding frozen temperature threshold to guarantee food safety for a range of different food commodities	CCFH55 requested FAO and WHO to provide scientific advice on the holding frozen temperature threshold to guarantee food safety for a range of different food commodities as indicated in CXC 8-1976, also considering the related impact on quality and for products that had been both quick frozen or subject to normal freezing processes, noting that this might require a stepwise approach and that products of terrestrial and aquatic origin could be addressed as the first priority	CCFH55 Paragraph 157-161		Potential work on the revision of the <i>Code of Practice for Processing and Handling of Quick Frozen Foods</i> (CXC 8-1976) Review of Frozen food temperatures in other texts
Continue work on risk assessment tool in support of the virus guidelines	CCFH55 encouraged JEMRA to continue to develop the risk assessment tool in a manner that would support implementation of the revised guidelines.	CCFH55 Paragraph 161-168		Revision of the <i>Guidelines on the application of general principles of food hygiene to the control of viruses in food</i> (CXG 79-2012)