CODEX ALIMENTARIUS COMMISSION

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Food and Agriculture Organization of the United Nations

World Health Organization

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REP17/FH

JOINT FAO/WHO FOOD STANDARDS PROGRAMME

CODEX ALIMENTARIUS COMMISSION

Fortieth Session

CICG, Geneva, Switzerland

17 – 22 July 2017

REPORT OF THE FORTY-EIGHTH SESSION OF THE CODEX COMMITTEE ON FOOD HYGIENE

Los Angeles, California, United States of America

7 – 11 November 2016

TABLE OF CONTENTS

SUMMARY AND STATUS OF WORK

Responsible Party	Purpose	Text/Topic	Code	Step	Para.
Members CCEXEC73 CAC40	Adoption	Proposed Draft Revision of the *Code of Hygienic Practice for Fresh Fruits and Vegetables*	CAC/RCP 53-2003	5/8	36
CCEXEC73 CAC40	Proposal	Proposed Draft Regional Code of Hygienic Practice for Street-Vended Foods in Asia (endorsement)	-	-	9
CCFL44	Proposal	Revision of the *General Standard for the Labelling of Prepackaged Foods*: date marking	CODEX STAN 1-1985	-	7
EWG/PWG (United Kingdom, France, Ghana, India, Mexico, United States of America) CCFH49	Redrafting	Proposed Draft Revision of the *General Principles of Food Hygiene* and Its HACCP Annex	CAC/RCP 1-1969	2/3	32
EWG (Japan, United States of America) CCFH49	Redrafting	Proposed Draft Guidance on Histamine Control	-	2/3	39-51
CCFH48	Discontinuation	Proposal to Merge All Guidance for Control of Foodborne Parasites: Guidelines on the Application of General Principles of Food Hygiene to the Control of Foodborne Parasites	CAC/GL 85-2014, - CAC/GL 86-2015 and CAC/GL 88-2016	-	55
Members PWG (United States of America) CCFH49	Comments/ Discussion	New work proposals / Forward Workplan	-	-	59
United States of America, Uruguay JEMRA (2017) CCFH50	Drafting	Discussion paper on future work on Shiga toxin-producing *Escherichia coli* (STEC)	-	-	63
FAO/WHO CCFH49	Request	Guidance for the use of clean water	-	-	64

LIST OF ABBREVIATIONS

CAC	Codex Alimentarius Commission
CCFH	Codex Committee on Food Hygiene
CCFL	Codex Committee on Food Labelling
CCP	Critical Control Point
CRD	Conference Room Document
EU	European Union
EWG	Electronic Working Group
FAO	Food and Agriculture Organization of the United Nations
GHP	Good Hygienic Practice
HACCP	Hazard Analysis and Critical Control Point
ISO	International Organization for Standardization
JEMRA	Joint FAO/WHO Expert Meetings on Microbiological Risk Assessment
OIE	World Organization for Animal Health
PWG	Physical Working Group
SFP	Scombrotoxin fish poisoning
STEC	Shiga toxin-producing *Escherichia coli*
VTEC	Verotoxigenic *E. coli*
WHO	World Health Organization
WG	Working Group

INTRODUCTION

1. The Codex Committee on Food Hygiene (CCFH) held its 48th Session in Los Angeles, California, the United States of America, from 7 to 11 November 2016, at the kind invitation of the Government of the United States of America. Dr Emilio Esteban of the United States of America Department of Agriculture, chaired the Session. The Session was attended by participants from 49 member countries, one member organization, 9 observer organizations and FAO and WHO. The list of participants, including the Secretariats, is given in Appendix I to this report.

OPENING OF THE SESSION[1]

2. Ms Mary Frances Lowe, U.S. Codex Manager U.S. Department of Agriculture opened the Session and extended her warmest welcome to all the participants. Dr Christine Bruhn, Consumer Education Specialist, Emerita, Food Science and Technology, University of California, Davis, as keynote speaker, gave a presentation on "Safe Food for Consumers" (CRD7).

Division of Competence[2]

3. The Committee noted the division of competence between the European Union (EU) and its Member States, according to paragraph 5, Rule II, of the Rules of Procedure of the Codex Alimentarius Commission.

ADOPTION OF THE AGENDA (Agenda Item 1)[3]

4. The Committee adopted the Provisional Agenda as its Agenda for the Session.

MATTERS REFERRED BY THE CODEX ALIMENTARIUS COMMISSION AND/OR OTHER CODEX SUBSIDIARY BODIES TO THE FOOD HYGIENE COMMITTEE (Agenda Item 2)[4]

5. The Committee considered the information presented in CX/FH 16/48/2, noting that several matters were for discussion under the relevant agenda items.

Revision of the *General Standard for the Labelling of Prepackaged Foods* (CODEX STAN 1-1985): date marking

6. The Committee noted that regardless of the preservative nature of the foods stipulated in 1.1 (i.e. alcohol, salt, acidity, low water activity), the safety and quality of these foods were still dependent on the storage conditions and therefore proposed to merge bullets 1.1 and 1.2 as a single criterion: " *Where safety is not compromised and quality does not deteriorate because the preservative nature of the food is such that it cannot support microbial growth (e.g. alcohol, salt, acidity, low water activity) under stated storage conditions."*

Conclusion

7. The Committee agreed to forward the proposed revised text to CCFL for its consideration.

Proposed Draft Regional Code of Hygienic Practice for Street-Vended Foods in Asia

8. The Committee considered the endorsement of the Proposed Draft Regional Code of Hygienic Practice for Street-Vended Foods in Asia and proposed the following changes:

- Revision of Bullet 1 to para 11, to indicate that "When the use of gloves is necessary, they should be disposable and clean", as the use of the disposable gloves was not applicable in all situations.
- Addition in para 45: "When washing raw meat/poultry, caution should be taken to prevent cross contamination of other foods", because washing can spread microorganisms.
- Revision of para 46, to (i) indicate that "Frozen food should be thawed only once and used for food preparation immediately after thawing", as this practice was important in preventing bacterial growth; and (ii) to replace "cooked" with "food preparation" as frozen food was not always "cooked" before consumption.

Conclusion

9. The Committee endorsed the Proposed Draft Regional Code of Hygienic Practice for Street-Vended Foods in Asia and recommended CAC40 to consider the above-mentioned modifications (Appendix II).

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1 CRD7
2 CRD1
3 CX/FH 16/48/1
4 CX/FH 16/48/2; Comments of European Union and Thailand (CRD2); the United States of America (CRD12); Dominican Republic (CRD17)

MATTERS ARISING FROM THE WORK OF FAO, WHO AND OTHER INTERNATIONAL INTERGOVERNMENTAL ORGANIZATIONS (Agenda Item 3)

Progress Report on the Joint FAO/WHO Expert Meetings on Microbiological Risk Assessment (JEMRA) and Related Matters (Agenda Item 3(a))[5]

10. The Representatives of FAO and WHO noted the information in CX/FH 16/48/3 and provided the Committee with updates on the work of JEMRA as well as other related work, including histamine, whole genome sequencing, and antimicrobial resistance, highlighting that World Antibiotic Awareness Week would take place on the week of 14 – 20 November 2016. The Representative also noted that FAO and WHO continue to strengthen the foundations of their scientific advice programme and were in the process of updating their risk assessment methodologies, as well as the JEMRA roster of experts. Countries were encouraged to share the forthcoming Call for experts (end November) and support national experts to respond to the Call.

Shiga toxin-producing *Escherichia coli* (STEC)

11. The Representative referred to the outcome of the expert meeting held in Geneva, Switzerland in July 2016, noting that the work on STEC was progressing in four areas: 1) the burden of disease which was collating all the STEC related information generated under the WHO project on the Global burden of foodborne diseases; 2) the source attribution to food categories which was being developed based on case-control studies and outbreak data; 3) the development of a set of criteria to support a harmonized approach to hazard identification and characterization, and 4) the preparation of an overview on monitoring and assurance programs, including a review of available methodologies.

12. The Representative highlighted the limited information received from some regions in response to the Call for Data and encouraged countries to provide more data, especially on monitoring and quality assurance programs, as well as identify experts for the peer-review process. The Committee was explicitly asked to confirm if the ongoing work was in line with their needs.

13. In response to questions on whether the scope of the STEC work also included transmission pathways and an assessment of interventions for STEC, the Representative noted that these aspects were not currently under consideration and that the Committee should indicate if these were areas in which they also needed advice. The Representative also noted the suggestions for accessing additional data from the African region.

Water quality

14. The Representative provided an overview of the available WHO and FAO guidance on water quality and safety and highlighted the key concepts underlying the WHO Water Quality Guidelines[6], including the evidence-based approach, risk assessment, multiple barriers for risk management, and incremental improvement. Shealso noted the similarities to the Microbiological Risk Management Framework that had previously been developed by the Committee.

15. The Representative noted that the existing documents extensively addressed risk assessment and management of water safety, but had not been explicitly developed for food safety management. Although clean water was not a concept that had been addressed in these guidelines, they did provide the flexibility to establish targets that were relevant to the local context.

16. In moving forward the Representative indicated that the development of illustrative examples on applying the existing water quality guidelines for specific food-related water uses could provide a way of bridging the existing guidance and the needs for the food safety management community.

17. The importance of this issue, including the need to define the different potential uses of clean water and the need for capacity development in this area in developing countries, was highlighted.

Conclusion

18. The Committee agreed to discuss further the issues related to the FAO/WHO work on STEC and water quality under Agenda item 8 in order to further refine the request for advice.

19. The Representatives of FAO and WHO expressed their appreciation to the Members who provided resources to support the work of JEMRA and encouraged more countries to join them in doing so.

20. The Committee expressed appreciation to FAO and WHO for their work, noting their importance for the work of the Committee.

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[5] CX/FH16/48/3; Comments of European Union and India (CRD3)

[6] Guidelines for Drinking-Water Quality http://apps.who.int/iris/bitstream/10665/44584/1/9789241548151_eng.pdf
Guidelines for the safe use of wastewater, excreta and greywater
http://www.who.int/water_sanitation_health/sanitation-waste/wastewater/wastewater-guidelines/en/

Information from the World Organisation for Animal Health (OIE) (Agenda Item 3(b))[7]

21. The Committee noted the paper, which provided information on relevant activities of OIE.

PROPOSED DRAFT REVISION OF THE *GENERAL PRINCIPLES OF FOOD HYGIENE* (CAC/RCP 1-1969) AND ITS HACCP ANNEX AT STEP 4 (Agenda Item 4)[8]

22. France, as co-Host with Chile, Ghana, India and the United States of America, introduced the report of the EWG and recalled the decision of CCFH47 to start new work on the revision of the *General Principles of Food Hygiene* (RCP/CAC 1-1969). The co-Host noted that 44 members and observers had participated in the EWG and that the document (CX/FH 16/48/5) had received a large number of comments.

23. The co-Host further explained that the revised document consisted of three parts: (i) Introduction; (ii) GHP; and (iii) HACCP. The EWG had drafted only the first part "Introduction" and had recommended for the other two parts:

- GHP: to retain the current structure to minimise the impact on other codes of hygienic practice, which follow the same format; to simplify the document to facilitate its use by small or less developed businesses; to update the document to address new issues, e.g. allergens; to remove all references to HACCP, which would be addressed in the third part of the document.
- HACCP: to retain the current structure and the seven HACCP principles; to consider new concepts, e.g. the two types of control measures; to clarify and provide additional guidance to assist small or less developed businesses, e.g. verification/validation, chemical and physical hazards.

General discussion

24. The Chair invited the Committee to have a general discussion on the proposed structure of the document with a view to guiding the further development of the work.

25. Delegations generally supported the structure of the document in three parts.

26. Delegations made the following comments and suggestions which include but are not limited to: to consider keeping the terminology consistent with that used in texts developed by other international organisations (e.g. ISO); to consider a revised title of the chapter on GHP, as the current title seemed too limiting; to broaden the GHP chapter to consider food safety management and pre-requisite programmes; to clarify in the Introduction the relationship between GHP and HACCP and links to other codes of practice, and explain how food safety management systems should work in an integrated way; to consider the three categories of control measures,; to consider include references to the ISO 22000 document; to address control measures which do not have a critical limit; and to be mindful that GHP could be applied stand alone, and HACCP could be applied where necessary.

27. The Committee agreed to the proposal of the Chair to establish an in-session WG, chaired by the United States of America, to:

- Conclude how to address the following items, which were prioritized according to the comments submitted:
  i. Paragraphs 3 to 5 (describing the relationship between GHPs and HACCP) and Basic Principles in the draft Introduction;
  ii. Inclusion of two types of Control Measures/Monitoring;
  iii. Inclusion of Primary Production;
- Decide if examples would be useful to clarify some concepts, and in which part they are needed.
- Propose a time table for the revision work.

Report of the in-session WG

28. The United States of America, as Chair of the in-session WG, introduced CRD14 and explained that the WG had addressed all terms of reference and considered some additional matters.

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7 CX/FH 16/48/4; Comments of Dominican Republic (CRD17)

8 CX/FH 16/48/5; Report of In-session WG (CRD14); Comments of Argentina, Brazil, Canada, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Japan, Malaysia, Mexico, Nicaragua, New Zealand, Paraguay, Switzerland, Uruguay, United States of America, FAO, IDF, IFU, SSAFE (CX/FH 16/48/5-Add.1 rev2); Benin, Ecuador, European Union, Gambia, Ghana, Kenya, Nigeria, Norway, Philippines, Senegal, Thailand, Zambia, African Union (CX/FH 16/48/5-Add.2); Ecuador (CRD6); Guinea, India, Indonesia, Republic of Korea, Somalia (CRD9); Dominican Republic (CRD17)

29. The Committee concurred with the recommendations of the in-session WG to: (i) establish an EWG to continue the revision of RCP/CAC 1-1969; and (ii) use examples on control measures (including those that cannot be addressed as CCPs) and a comparison table of GHP and HACCP control measures, to support the work.

30. One member suggested that the EWG (when considering the examples and comparison table of GHP and HACCP control measures) should consider if the implementation of current section 5 on control operations of GPFH, could address the control measures that are not CCP.

31. The Committee also noted that the use of English, French and Spanish would facilitate broader participation.

Conclusion

32. The Committee agreed:

(i) To establish an EWG, hosted by the United Kingdom and co-hosted by France, Ghana, India, Mexico and United States of America, taking into account the output of the in-session WG (CRD14), working in English, French and Spanish to:

- Continue revision of the Introduction and undertake the revision of the second and third parts, in parallel, for circulation for comments at Step 3.
- Consider if aspects on commitment and responsibility on food safety, including food safety culture, should be incorporated.

In undertaking this work, the EWG should consider the use of examples of control measures, including those that cannot be addressed as CCPs, at all steps in the food chain, as well as a comparison table between GHP, CCP and other type(s) of control measures, which could provide a better understanding of the issue.

The Committee noted that the report of the EWG would be made available to the Codex Secretariat at least four months before the next session.

(i) To establish a PWG, chaired by the United Kingdom and co-chaired by France, Ghana, India, Mexico and United States of America, to be held in conjunction with CCFH49 and working in English, French and Spanish, to consider all comments received and to prepare a revised proposal for consideration by the plenary.

PROPOSED DRAFT REVISION OF THE *CODE OF HYGIENIC PRACTICE FOR FRESH FRUITS AND VEGETABLES* (CAC/RCP 53-2003) AT STEP 4 (Agenda Item 5)[9]

33. Brazil, as co-Host with France, presented the item and summarized the main modifications and discussions agreed in the EWG, including the recommendation not to address the issue of suitable water quality pending the advice of FAO/WHO, and not to have specific provisions for tomatoes and carrots.

34. The Committee agreed to base its discussion on CRD8 which was prepared by the co-Hosts to address the written comments received.

Specific comments

35. The Committee considered the revised proposed draft section by section, noted comments, made editorial corrections and amendments both for purposes of clarity and in order to provide greater flexibility in the text, and took the following additional decisions in the sections indicated:

2.2 *Use*

- Included the *Guidelines for Risk Analysis of Foodborne Antimicrobial Resistance* (CAC/GL 77- 2011) as an additional document to be used in conjunction with this Code; as a consequence deleted reference to these Guidelines in section *3.2.1.4 Agricultural chemicals*.

2.3 Definition

- Agreed to replace the term *Antimicrobial agents* with *Biocides,* as the definition for antimicrobial agents in the *Guidelines for Risk Analysis of Foodborne Antimicrobial Resistance* was not applicable to plants; and therefore to avoid having two definitions for the same term; a definition for biocide was provided.

3.1 Environmental Hygiene

[9] CX/FH 16/48/6; Comments of Argentina, Canada, Colombia, El Salvador, Iran, Mexico, New Zealand, Paraguay, Philippines, United States of America, African Union (CX/FH 16/48/6-Add.1); Benin, Ecuador, European Union, Gambia, Ghana, Japan, Kenya, Nicaragua, Nigeria, Senegal, Thailand, Zambia (CX/FH 16/48/6-Add.2); Guinea, India, Indonesia, Republic of Korea (CRD10); Sudan (CRD16); Dominican Republic (CRD17). Proposed Draft Revision of the Code of Hygienic Practice for Fresh Fruits And Vegetables (CAC/RCP 53-2003) (CRD8)

3.1.1 Location and production site

Added flexibility to the provision for the consideration on geology and soil metal content.

- Provided an explanation of *flood irrigation* system in a footnote.

3.2.1.1 Water for primary production

- Included "chemical water treatment" as an alternative corrective action.
- Added a recommendation on the need for a contingency plan to address situations where all the corrective actions listed may not have an immediate effect.

3.2.3 Personnel health, hygiene and sanitary facilities

- Deleted the handwashing requirements, as these were only relevant to the preparation for ready-to-eat fresh pre-cut fruits and vegetables.

Annex II: Sprout Production (*5.2.2.2.1 Microbiological decontamination of seeds)*

- Added flexibility to the requirement for the decontamination of seeds.

Conclusion

36. The Committee

- Noted that all outstanding issues had been addressed.
- Forwarded the proposed draft revision of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003) to CAC40 for adoption at Step 5/8 (Appendix III).

PROPOSED DRAFT GUIDANCE ON HISTAMINE CONTROL AND SAMPLING PLANS FOR HISTAMINE AT STEP 4 (Agenda Item 6)[10]

37. Japan, as co-Host with the United States of America, presented the Agenda item, summarized the work and recommendations of the EWG, and proposed that the Committee consider four points for discussion: (i) approach to the revision of the *Code of Practice for Fish and Fishery Products* (CAC/RCP 52-2003); (ii) inclusion of the Table 2.3 of the report *Joint FAO/WHO Expert Meeting on the Public Health Risks of Histamine and other Biogenic Amines from Fish and Fishery Products* (July 2012); (iii) work management (start with work on histamine control guidance followed by work on sampling plans), and (iv) establishment of EWG to continue the work on histamine control guidance.

38. The Committee considered the above-mentioned recommendations, noted the comments and took the following decisions.

Approach to revision of *Code of Practice for Fish and Fishery Products* (CAC/RCP 52-2003)

39. The Committee agreed to the recommendation to develop separate guidance on histamine control and to decide at a later stage on the final format in the CAC/RCP 52-2003.

Inclusion of the Table 2.3

40. With regard to Table 2.3, the Representative of FAO provided the Committee with the background on the development of this table, noting that it aimed to provide the most comprehensive list of fish species associated with scombrotoxin fish poisoning (SFP) or high levels of free histidine, the precursor to histamine. The table had been developed as part of the hazard identification step of the risk assessment.

41. The Committee discussed whether to include Table 2.3 in its entirety in CAC/RCP 52-2003 or only selected information from the table.

42. The Committee agreed to include a table with a simplified title as illustrative of the species associated with histamine formation.

43. Those in support of a table only containing the scientific names of fish associated with SFP pointed out that the use of common market names might be confusing, as these varied among countries and furthermore the convention in Codex standards was to use scientific names (family and genus). The inclusion of histidine levels was not necessary, as it could be misinterpreted, and annual production level information was not relevant for the purpose of the table.

[10] CX/FH 16/48/7; Comments of El Salvador, European Union, Ghana, Kenya, Iran, Morocco, Thailand, United States, African Union (CX/FH 16/48/7-Add.1); Benin, Ecuador, Gambia, Nigeria, Senegal (CX/FH 16/48/7-Add.2); Guinea, India, Indonesia (CRD11); Philippines (CRD 13); South Africa (CRD 15)

44. Others were in support of a table containing: (i) both the scientific name and market name of fish because in their view the market name was important information and was relevant for the domestic market; and/or (ii) histidine levels, as these were useful indicators of the potential risk for histamine and provide information for countries to take a decision on the control measures necessary.

Conclusion

45. The Committee agreed to create a table based on Table 2.3 of the Joint FAO/WHO Expert Meeting report in the draft guidance with species associated with histamine formation using only the scientific name; to develop a simplified title for the table; and to provide a link to the Table 2.3.

Salmonidae

46. The Representative of FAO clarified that fish of the Salmonidae family were included in Table 2.3 on the basis of reported scombrotoxicosis-like illness. However, she noted that the data relevant to Salmonidae were limited and that the levels of histamine in implicated salmon were very low. The Representative also noted lower levels of free histidine in Salmonidae compared to other fish species in the table. She confirmed that a recent review of available data on rejections of salmon traded internationally had not identified any rejections linked to histamine.

47. Delegations in support of excluding Salmonidae from the list of susceptible species expressed the following views:

- Histidine levels in Salmonidae were low;
- Whether SFP-like illnesses in connection with the consumption of Salmonidae were actually caused by histamine was uncertain;
- No report on SFP illnesses linked to salmon consumption had been published for more than 20 years.

48. Delegations in favour of including Salmonidae expressed the following views:

- Scientific evidence in the literature demonstrated that Salmonidae had been responsible for an incident of SFP-like illness as mentioned on page 108 of the report of Joint FAO/WHO expert meeting on the Public Health Risks of Histamine and other Biogenic Amines from Fish and Fishery Products;
- As a matter of precaution, Salmonidae should be included until there is full information that it is not implicated in SFP.

Conclusion

49. The Committee noted the prevailing view that the information on Salmonidae indicated that no specific risk management guidance for histamine control for these species was necessary. Considering the concerns raised, the Committee agreed, as a compromise, to request FAO/WHO to conduct a literature review on histamine-related illness in Salmonidae, and provide this to the EWG for its consideration on inclusion of Salmonidae in the list.

Starting histamine control guidance first, followed by the sampling plan/guidance

50. The Committee agreed with this recommendation.

EWG

51. The Committee:

(i) Agreed to establish an EWG, hosted by Japan and co-hosted by the United States of America, working in English with the following terms of reference:

- Revise control guidance of the *Code of Practice for Fish and Fishery Products* for the “hazard of scombrotoxin fish poisoning”, using histamine as the marker biogenic amine for control, and using a GHP and HACCP-based approach, for circulation for comments at Step 3.
- Ensure that the guidance covers the entire food chain (harvesting, storage, handling, processing, and distribution).
- Include, where appropriate, scientific information about histamine formation with the purpose of informing on the importance of time/temperature controls.
- Consider if any products covered by the *Code of Practice for Fish and Fishery Products* need specialized or revised control guidance.
- Consider based on the review of scientific literature by FAO/WHO, the inclusion of Salmonidae in the list of susceptible species in the table which will be adopted from the FAO/WHO Table 2.3..

(ii) Noted that the report of the EWG would be made available at least four months before the next session.

(iii) Agreed to inform CCEXEC72 and CAC40 about its agreement with the original timeline for completion of this work, i.e. adoption at Step 5 in 2018 and adoption at Step 8 in 2020.

PROPOSAL TO MERGE ALL GUIDANCE FOR CONTROL OF FOODBORNE PARASITES: *GUIDELINES ON THE APPLICATION OF GENERAL PRINCIPLES OF FOOD HYGIENE TO THE CONTROL OF FOODBORNE PARASITES* (Agenda Item 7)[11]

52. The Codex Secretariat introduced the proposal as presented in CX/FH 16/48/8, which provided a recommendation for merging all guidance for the control of foodborne parasites into a single document as requested by CCFH47[12].

53. The Secretariat pointed out that while it was possible to include the *Guidelines for the Control of Taenia saginata in Meat of Domestic Cattle* (CAC/GL 85-2014) and the *Guidelines for the Control of Trichinella spp. in Meat of Suidae* (CAC/GL 86-2015) as Annexes to the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Foodborne Parasites* (CAC/GL 88-2016), the Committee should note that:

- The intent and format of CAC/GL 85-2014 and CAC/GL 86-2015 were different from that of CAC/GL 88-2016;
- The inclusion of CAC/GL 85-2014 and CAC/GL 86-2015 as annexes to CAC/GL 88-2016 would give the impression that *Taenia saginata* and *Trichinella* spp have a high level of risk from a human health perspective contrary to the ranking by FAO/WHO.

54. Therefore, the Secretariat proposed as an alternative to retain CAC/GL 85-2014 and CAC/GL 86-2015 as separate documents.

Conclusion

55. The Committee agreed to retain CAC/GL 85-2014 and CAC/GL 86-2015 as separate documents.

OTHER BUSINESS AND FUTURE WORK (Agenda Item 8)

New Work / Forward Workplan (Proposals in reply to CL 2016/18-FH) [13]

56. The United States of America introduced the item and explained that no proposals had been received in response to CL 2016/18-FH.

Forward Workplan

57. The Committee reviewed the forward workplan and agreed to:

- Refer to Shiga toxin-producing *E. coli* (STEC) rather than to Verotoxigenic *E. coli* (VTEC) based on the report of FAO/WHO Core Expert Meeting;
- Remove the work on development of annexes on tomatoes and carrots to the *Code of Hygienic Practice for Fresh Fruits and Vegetables* based on the conclusion of the EWG on the revision of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (Agenda item 5); and
- Remove the work on the *Code of Hygienic Practice for the Processing of Frog Legs* (CAC/RCP 30-1983) as no interest had been expressed.

Prioritization Approach

58. The Committee was informed that no new information was available to justify new work on the revision of the *Code of Hygienic Practice for Meat*. Noting the difficulty to reflect such information in the forward workplan and how this would impact on prioritization of work, the Committee agreed to reconsider the approach for prioritization at its next session, based on a proposal to be prepared by the United States of America.

Conclusion

59. The Committee agreed to:

- The amended forward workplan (Appendix IV);
- Request the Secretariat to issue a Circular Letter requesting proposals for new work;

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11 CX/FH 16/48/8; Comments of El Salvador, European Union (CRD4); Dominican Republic (CRD17)
12 REP16/FH para. 29
13 CL 2016/18-FH; CX/FH 16/48/9; Comments of Benin, Ecuador, Gambia, Nigeria, Zambia, African Union (CRD5)

- Establish a PWG on CCFH Work Priorities, which will be held in conjunction with CCFH49, working in English, French and Spanish, and chaired by the United States of America; and
- Reconsider the prioritization approach, in particular how the YES/NO columns might affect the ranking.

Other matters

Shiga toxin-producing *Escherichia coli* (STEC)

60. In response to the request from FAO and WHO to provide feedback to their work on STEC, i.e. whether the four areas identified were sufficient (Agenda item 3a), the Committee agreed that there were no other aspects to be considered at the present time.

61. In response to a proposal to link the work on STEC with the work on whole genome sequencing, the Representative of FAO clarified that the work underway on hazard identification and the review of available methodology would consider sequencing technology as appropriate, taking into account that this emerging technology was not yet accessible to all countries.

62. The Committee noted the importance to start discussion on future work on STEC taking into account the work of FAO/WHO. In this regard, the Committee noted the willingness of the United States of America and Uruguay to lead this work and the importance for them to attend the forthcoming the FAO/WHO JEMRA meeting on STEC (2017).

Conclusion

63. The Committee:

- Confirmed that the current work underway by FAO and WHO on STEC was in line with the needs of the Committee and agreed to a proposal that control measures for STEC in the foods of greatest concern should be undertaken once the source attribution work had been completed.
- Agreed the United States of America and Uruguay would prepare a discussion paper on future work on STEC for consideration at CCFH50.

Water Quality

64. The Committee requested FAO/WHO to provide guidance for those scenarios where the use of clean water was indicated in Codex texts, in particular, irrigation water, clean seawater, and on the safe re-use of processing water.

65. The Representative of FAO noted that it would not be possible to address all scenarios in Codex texts, but the work could focus on a few representative examples.

66. It was also noted that climate change and the challenges it presents in terms of water availability and accessibility were important considerations and drivers for this work.

DATE AND PLACE OF THE NEXT SESSION (Agenda Item 9)

67. The Committee noted that the next Session was tentatively scheduled to be held in Chicago, Illinois, United State of America, on 13 to 17 November 2017, the final arrangements being subject to confirmation by the Committee Host and the Secretariat.

Appendix I

LIST OF PARTICIPANTS
LISTE DES PARTICIPANTS
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Appendix II

PROPOSED CHANGES TO PROPOSED DRAFT REGIONAL CODE OF HYGIENIC PRACTICE FOR STREET-VENDED FOODS IN ASIA

New texts added are shown in **bold/underlined** font. Deletions are shown in ~~strikethrough~~ font.

SECTION 4 - STAKEHOLDERS IN STREET FOOD VENDING

4.1 Street Food Vendors

11. All those involved in street food vending during conduct of business should observe the following:

Personal hygiene: Should wear clean clothes, ~~clean disposable gloves,~~ hair net etc. **When the use of gloves is necessary, they should be disposable and clean.** Should keep finger nails short and clean at all times, and avoid wearing jewellery, ornaments etc. during food preparation. Non-infected cuts and wound should be completely protected by a waterproof dressing that is firmly secured and routinely changed.

SECTION 8 - FOOD PREPARATION, HANDLING, DISPLAY AND STORAGE

8.2 Preparation/ Cooking

45. Raw food should be thoroughly washed in clean water before cooking. **When washing raw meat/poultry, caution should be taken to prevent cross contamination of other foods.**

46. Frozen food should be thawed only once ~~before cooking~~ **and used for food preparation immediately after thawing.**

Appendix III

PROPOSED DRAFT REVISION OF THE CODE OF HYGIENIC PRACTICE FOR FRESH FRUITS AND VEGETABLES (CAC/RCP 53-2003)

(N04-2016)

(at Step 5/8)

INTRODUCTION

1. Scientific research over recent decades has shown that a diet rich in fruits and vegetables promotes good health. This recognition of the importance of the routine consumption of fresh fruits and vegetables, together with a significant increase in the year-round availability of such products from the global market, has contributed to the substantial increase in their consumption over the past two decades. However, continuing reports of food-borne illness associated with fresh fruits and vegetables have increased concern among public health agencies and consumers about the safety of these products.

2. The microbiological pathogens associated with fresh fruits and vegetables include *Salmonella* spp., *Shigella* spp., *Campylobacter*, pathogenic strains of *Escherichia coli*, *Listeria monocytogenes*, *Yersinia pseudotuberculosis*, norovirus, hepatitis A virus and parasites such as *Cyclospora cayetanensis, Giardia lamblia* and *Cryptosporidium parvum*.

1. OBJECTIVES OF THE CODE

3. This Code addresses Good Agricultural Practices (GAPs) and Good Hygienic Practices (GHPs) that help control microbial, chemical and physical hazards associated with all stages of the production of fresh fruits and vegetables, from primary production to consumption. Particular attention is given to minimizing microbial hazards. The Code provides a general framework of recommendations that can be uniformly adopted across the sector rather than detailed recommendations for specific agricultural practices, operations or commodities.

4. The fresh fruit and vegetable industry is very complex. Fresh fruits and vegetables are produced and packed under diverse environmental conditions. It is recognized that some of the provisions in this Code may be difficult to implement in areas where primary production is conducted in small holdings, whether in developed or developing countries, and in areas where traditional farming is practiced. The Code is therefore, by necessity, a flexible one, to allow for different systems of control and prevention of contamination for different groups of commodities.

2. SCOPE, USE AND DEFINITIONS

2.1 Scope

5. This Code covers general hygienic practices from primary production to consumption of fresh fruits and vegetables cultivated for human consumption in order to produce safe and wholesome products, in particular for those intended to be consumed raw. Specifically, this Code is applicable to fresh fruits and vegetables grown in open fields or in protected facilities (hydroponic systems, greenhouses/net houses, etc.). It concentrates on microbial hazards and addresses physical and chemical hazards only in so far as they relate to GAPs and GHPs.

6. The *Annexes for Ready-to-Eat, Fresh, Pre-cut Fruits and Vegetables* (Annex I), *Sprout Production* (Annex II), *Fresh Leafy Vegetables* (Annex III), *Melons* (Annex IV) and *Berries* (Annex V) are supplements to this Code and include additional recommendations to cover hygienic practices specific to these commodities.

2.2 Use

7. This Code follows the format of the *General Principles of Food Hygiene* (CAC/RCP 1-1969) and should be used in conjunction with it and other applicable codes, such as the *Guidelines on the Application of General* Principles *of Food Hygiene to the Control of Foodborne Parasites (CAC/GL 88-2016), Guidelines on the Application of General Principles of Food Hygiene to the Control of Viruses in Food* (CAC/GL 79-2012), the *Code of Practice for Packaging and Transport of Fresh Fruits and Vegetables* (CAC/RCP 44-1995), the *Code of Practice for the Processing and Handling of Quick Frozen Foods* (CAC/RCP 8-1976), and the *Guidelines for Risk Analysis of Foodborne Antimicrobial Resistance* (CAC/GL 77- 2011). Due to the wide variation in the nature of fruits and vegetables and production practices, flexibility in application is an essential element of this Code. The implementation of any hygienic practices is proportionate to the risk of food-borne illness or the characteristics of the commodity (e.g. conditions and practices associated with growing fruits from tall trees and that have inedible peel, such as durian, mangosteen, coconut and rambutan, present a lower likelihood of contamination at primary production than fruits such as melons or berries grown on or near the ground).

2.3 Definitions

8. Definitions of general expressions are included in the *General Principles of Food Hygiene*. For the purposes of this Code, the following terms are defined as below:

Agricultural inputs – Any incoming material (e.g. seeds, fertilizers, including compost, water, agricultural chemicals, plant support) used for the primary production of fresh fruits and vegetables.

Agricultural worker – Any person who undertakes one or more of the following: cultivation, harvesting and packing of fresh fruits and vegetables.

Biocides – A chemical substance or micro-organism intended to destroy, deter, render harmless or exert a controlling effect on any harmful organism by chemical or biological means.

Biological control – The use of biological agents (e.g. insects, micro-organisms and/or microbial metabolites) for the control of mites, pests, plant pathogens and spoilage organisms.

Biofilm – A microbial consortium adhering to a surface.

Biosolids – Nutrient-rich organic materials resulting from the treatment of sewage sludge (the name for the solid, semisolid or liquid residue generated during the treatment of domestic sewage in a treatment facility).

Composting – A managed process in which organic materials are digested aerobically or anaerobically by microbial action.

Cull – The removal of any product or part of product that is of inadequate quality, including due to physical damage (such as broken skin or decay).

Cultivation – Any agricultural action or practice used by growers to allow and improve the growing conditions of fresh fruits or vegetables whether grown in an open field or in protected facilities (e.g. hydroponic systems, greenhouses/net houses).

Farm – Any premises or establishment in which fresh fruits and/or vegetables are grown and harvested.

Flooding – The flowing or overflowing of a field with water that is not under the control of the grower. Pooled water (e.g. after rainfall) that is not reasonably likely to cause contamination of the edible portions of fresh produce is not considered flooding.

Grower – A person responsible for the management of the primary production of fresh fruits and vegetables.

Greenhouse – An indoor site, generally enclosed by glass or plastic, in which plants are grown.

Harvester – A person responsible for the management of the harvesting of fresh fruits and vegetables.

Hydroponics – A general term for the production of plants without soil in an aqueous nutrient medium.

Manure – Animal excrement, which may be mixed with litter or other material, and may be fermented or otherwise treated.

Micro-organisms – These include yeasts, moulds, bacteria, viruses and parasites; the corresponding adjective is “microbial”.

Packer – A person responsible for the management of post-harvest activities and packing of fresh fruits and vegetables.

Packing or Packaging – The action of putting fresh fruits and vegetables in a container (e.g. box, crate or basket) or package. This may take place in a field or within an establishment.

Packing establishment/Packaging establishment or Pack house/Packing house – Any premises on which fresh fruits and vegetables are packed/packaged.

Post-harvest activities – Activities performed incidental to packing involving minimal transformation of fresh fruits and vegetables, such as washing, sorting, culling, grading, cutting and trimming.

Primary production of fruits and vegetables – The steps involved in the growing and harvesting of fresh fruits and vegetables, including soil preparation, planting, irrigation, the application of fertilizers and agricultural chemicals, field-packing and transport to a packing establishment.

Ready-to-eat fresh fruits and vegetables – Any fruit or vegetable that is normally eaten in its raw state, intended for direct human consumption without any further microbiocidal steps. This may include any fruit or vegetable that has been washed, peeled, cut or otherwise physically altered from its original form but remains in the fresh state.

Standard Operating Procedure (SOP) – A set of detailed instructions describing how to carry out a routine activity.

Types of water:

Clean water – Water that does not compromise food safety in the circumstances of its use.

Potable water – Water which meets the quality standards of drinking water such as described in the World Health Organization (WHO) *Guidelines for Drinking-water Quality*.

3. PRIMARY PRODUCTION

9. Refer to the *General Principles of Food Hygiene* (CAC/RCP 1-1969) in addition to the following:

10. Fresh fruits and vegetables are grown and harvested under a diverse range of climatic and geographical conditions. They can be grown in production sites indoors (e.g. greenhouses) and outdoors, harvested and either field-packed or transported to a packing establishment, using various agricultural inputs and technologies, and on farms of varying sizes. Biological, chemical and physical hazards may therefore vary significantly from one type of production to another. In each primary production area, it is necessary to consider the particular agricultural practices that promote the production of safe fresh fruits and vegetables, taking into account the conditions specific to the primary production area, type of products, and methods used. Procedures associated with primary production should be conducted under good hygienic conditions and should minimize potential hazards to health due to the contamination of fresh fruits and vegetables.

3.1 Environmental Hygiene

11. As far as possible, potential sources of environmental contamination should be identified prior to primary production activities. In particular, primary production should not be carried out in areas where the presence of potentially harmful substances would lead to an unacceptable level of such substances in or on fresh fruits and vegetables after harvest.

12. Where possible, growers should evaluate present and previous uses of both indoor and outdoor fresh fruit and vegetable primary production site(s) and the adjoining land (e.g. crop grown, feed lot, animal production, hazardous waste site, sewage treatment site, industry) in order to identify potential microbial hazards. The potential for other types of contamination (e.g. from agricultural chemicals, mining extraction site, hazardous wastes) should also be taken into consideration.

13. If previous uses cannot be identified, or the examination of the growing or adjoining sites leads to the conclusion that potential hazards exist, the sites should be analysed for contaminants of concern. The assessment of environmental conditions is particularly important because subsequent steps may not be adequate to remove contamination that occurs during production and in some cases may lead to conditions that enable the growth of microbial pathogens. If the environment presents a risk to the primary production site, measures should be implemented to minimize the contamination of fresh fruit and vegetable at the site. When such risks are serious, the production site should not be used for fresh fruit and vegetable production.

14. The effects of some environmental events cannot be controlled. For example, heavy rains may increase the exposure of fresh fruits and vegetables to pathogens if soil contaminated with pathogens splashes onto them. When heavy rains occur, growers should evaluate the need to postpone harvesting fresh fruits and vegetables for direct consumption and/or to subject them to a treatment that will minimize the risk from pathogens. The risk from chemical hazards should also be assessed. The risk of contamination is greatest when heavy rains cause flooding and flood waters come into direct contact with fresh fruits and vegetables. If fruits and vegetables that have come into contact with flood waters are not submitted to any measure to mitigate risks, they should not be eaten raw. This does not include flood irrigation,[1] where the source of water is of known and appropriate quality.

3.1.1 Location of the Production Site

15. Production site locations should be evaluated, including with regard to slope, potential for runoff (including from manure sources), flood risk and hydrological features in proximity to the primary production site.

16. The proximity of high-risk production sites, such as animal primary production facilities, hazardous waste sites and waste treatment facilities, should be evaluated for the potential to contaminate production fields or water sources with microbial or other environmental hazards (e.g. runoff, faecal material, aerosols, organic waste).

[1] An irrigation system whereby water is pumped or brought onto a field and allowed to flow along the ground among the crops.

17. Growers should take measures to mitigate the risks associated with runoff and flooding (e.g. mapping the production field, terracing, digging a shallow ditch to prevent runoff from entering the field).

18. In the case of risk of contamination from dust, drift or aerosols, efforts should be made to protect fresh produce-growing and -handling areas. The use of an effective wind-break (whether natural, such as trees, or a constructed barrier) or protective covering are measures that could be used to reduce pathogen and chemical contamination of the primary production site.

19. Where possible, information about the geology and metal content of the soil should be taken into account in determining which fruits and vegetables to grow, since different crops absorb heavy metals at varying rates (e.g. root crops and cadmium).

3.1.2 Animals and human activity

20. Humans and many animal species that may be present in the primary production environment are known to be potential carriers of food-borne pathogens. Wild animals represent a particularly difficult risk to manage because their presence is intermittent. When the environmental hygiene step (Section 3.1) evaluates the risk as serious, and animals and human activities may present the risk of direct contamination of the crop and soil, as well as indirect contamination via surface water sources and other inputs, efforts should be made to minimize contamination. The following should be taken into consideration:

- Appropriate biological, cultivation, physical and chemical pest-control methods should be used in order to exclude animals from the primary production and handling areas to the extent practicable. Possible methods include the use of physical barriers (e.g. fences), active deterrents (e.g. noise makers, scarecrows, images of owls, foil strips) and/or cultural methods (e.g. crop rotation).
- Primary production and handling areas should be properly designed and maintained to reduce the likelihood of attracting vectors (e.g. insects and rodents). Possible methods include minimizing standing water in fields, restricting animal access to water sources (which may be based on local ordinances for public irrigation systems) and maintaining production sites and handling areas free of waste and clutter.
- Fresh fruit and vegetable primary production areas should be evaluated for evidence of the presence of wildlife or domestic animal activity (e.g. presence of animal faeces, bird nests, hairs/furs, large areas of animal tracks, burrowing, decomposing remains, crop damage from grazing), particularly near harvesting. Where such evidence exists, growers should evaluate the risks to determine whether the affected area of the production site should be harvested for direct consumption.
- To the extent possible, the entrance of non-essential persons, casual visitors and children should be controlled in the harvest area as they may present an increased risk of contamination.

3.2 Hygienic primary production of fresh fruits and vegetables

3.2.1 Agricultural input requirements

21. Agricultural inputs should not contain contaminants (as defined under the *General Principles of Food Hygiene* (CAC/RCP 1-1969)) at levels that may adversely affect the safety of fresh fruits and vegetables, and should take into consideration the *WHO guidelines on the safe use of wastewater and excreta in agriculture and aquaculture*, as appropriate.

3.2.1.1 Water for primary production

22. An adequate supply of water of a suitable quality should be available for use in the various operations in the primary production of fresh fruits and vegetables. The source of the water used for primary production and the method of delivery can affect the risk of contamination of fresh fruits and vegetables.

23. The quality of water may vary. Several parameters may influence the risk of microbial contamination of fresh fruit and vegetables: the type of irrigation (e.g. drip, sprinkler, overhead), the source of water, whether the edible portion of the fresh fruit or vegetable has direct contact with irrigation water, the timing of irrigation in relation to harvesting and the occurrence of pathogenic organisms in the irrigation water. Water for primary production, including for frost protection and protection against sun scald, which has contact with the edible portion of fresh fruits and vegetables should not compromise their safety. The following should be taken into consideration:

- Growers should identify the sources of water used on the farm (e.g. municipality, well, open canal, reservoir, river, lake, farm pond, reused irrigation water, roof water, reclaimed wastewater, discharge water from aquaculture). Examples of water sources that present the lowest risk of contamination are:
    - Water in deep wells or boreholes, provided they are appropriately constructed, maintained, monitored and capped;

- Water in shallow wells, provided they are not influenced by surface waters and are appropriately constructed, maintained, monitored and capped; and
- Rainwater, provided the integrity of the water capture, storage and distribution system is maintained.

- Water sources that pose a higher risk of contamination may need further treatment, for example:
  - Reclaimed or wastewater: before using reclaimed or waste water for crop irrigation, an expert should be consulted to assess the relative risk and determine the suitability of the water source. Reclaimed wastewater subjected to different levels of treatment should be in compliance with the *WHO guidelines for safe use of wastewater, excreta and grey water used in agricultural production*[2] specific to the irrigation of fruits and vegetables marketed to consumers as fresh, fresh-cut, pre-cut or ready-to-eat.
  - Surface water (e.g. rivers, lakes, canals, lagoons, reservoirs): when contaminated, options such as sand filtration or storage in catchments or reservoirs to achieve partial biological treatment should be considered. The efficacy of these treatments should be evaluated and monitored.
- Growers should assess the microbial and chemical quality of water and its suitability for the intended use, and identify corrective actions to prevent or minimize contamination (e.g. from livestock, wildlife, sewage treatment, human habitation, manure and composting operations, agricultural chemicals, or other intermittent or temporary environmental contamination, such as heavy rain or flooding).
- Where necessary, growers should have the water they use tested for microbial and chemical contaminants, according to the risk associated with the production. The frequency of testing will depend on the water source (i.e. lower for adequately maintained deep wells, higher for surface waters), the risks of environmental contamination, including intermittent or temporary contamination (e.g. heavy rain, flooding), or the implementation of a new water treatment process by growers.
- If water testing is limited to non-pathogenic indicators, frequent water tests may be useful to establish the baseline water quality so that subsequent changes in the levels of contamination can be identified. High testing frequency may be considered until consecutive results are within the acceptable range.
- Growers should reassess the potential for microbial contamination if events, environmental conditions (e.g. temperature fluctuations, heavy rainfall) or other conditions indicate that water quality may have changed.
- When testing, growers may consult, if necessary, the competent authority or experts in order to determine and document the following:
  - Which tests need to be conducted (e.g. for which pathogens and/or sanitary indicators);
  - Which parameters should be recorded (e.g. temperature of water sample, water source location and/or weather description);
  - How often tests should be conducted;
  - How test results should be analysed and interpreted over time, for example to calculate the rolling geometric mean, and
  - How test results will be used to define corrective actions.

24. If the water source is found to have unacceptable levels of indicator organisms or is contaminated with food-borne pathogens, corrective actions should be taken to ensure that the water is suitable for its intended use. Possible corrective actions to prevent or minimize contamination of water for primary production may include the installation of fencing to prevent large animal contact, the proper maintenance of wells, water filtering, chemical water treatment, the prevention of the stirring of the sediment when drawing water, the construction of settling or holding ponds or water treatment facilities. The effectiveness of corrective actions should be verified by regular testing. Where possible, growers should have a contingency plan in place that identifies an alternative source of water.

[2] http://www.who.int/water_sanitation_health/sanitation-waste/wastewater/wastewater-guidelines/en/

3.2.1.1.1 Water for irrigation and harvesting

25. The type of irrigation or application method affects the risk of contamination. The timing, the quality of water used, and whether the water has direct contact with the edible portion of the plant should all be considered when selecting the type of irrigation or application method to use. Overhead irrigation presents the highest risk of contamination because it wets the edible portion of the crop. The duration of wetting can be several hours, and the physical force of water-droplet impact may drive contamination into protected sites on the leaf/produce. Subsurface or drip irrigation that results in no wetting of the plant is the irrigation method with the least risk of contamination, although localized problems may still arise, e.g. when using drip-irrigation, care should be taken to avoid creating pools of water on the soil surface or in furrows that may come into contact with the edible portion of the crop.

26. Water for agricultural purposes should be of suitable quality for its intended use. Special attention should be given to water quality in the following situations:

- Irrigation by water-delivery techniques that expose the edible portion of fresh fruits and vegetables directly to water (e.g. sprayers), especially close to harvest time;
- Irrigation of fruits and vegetables that have physical characteristics such as leaves and rough surfaces that can trap water; and
- Irrigation of fruits and vegetables that will receive little or no post-harvest wash treatments prior to packing, such as field-packed produce.

Additionally, growers, where appropriate, should:

- Evaluate the water-distribution system to determine if a contamination source is evident and can be eliminated; and
- Establish no-harvest zones if irrigation source water is known or likely to contain human pathogens and where failure at connections results in overspray of plants or localized flooding.

3.2.1.1.2 Water for fertilizers, pest control and other agricultural chemicals

27. Water used for the application of water-soluble fertilizers, pesticides and agricultural chemicals in the field and indoors should be of the same quality as water used for direct contact irrigation and should not contain microbial contaminants at levels that may adversely affect the safety of fresh fruits and vegetables, especially if they are applied directly on edible portions of the fresh fruits and vegetables close to harvest. Human pathogens can survive and grow in many agrichemicals, including pesticides.

3.2.1.1.3 Hydroponic water

28. Microbial risks of water used in growing fruits and vegetables hydroponically may differ from the microbial risks of water used to irrigate fruits and vegetables in soil because the nutrient solution used may enhance the survival or growth of pathogens.

29. It is especially critical in hydroponic operations to maintain the water quality so as to reduce the risk of contamination and survival of pathogens. The following should be taken into consideration:

- Water used in hydroponic culture should be changed frequently or, if recycled, treated to minimize microbial and chemical contamination;
- Water-delivery systems should be maintained and cleaned, as appropriate, to prevent microbial contamination of water; and
- In the case of combination of aquaculture and hydroponics (i.e. aquaponics), effluent from fish tanks should be treated to minimize microbial and chemical contamination.

3.2.1.1.4 Water for other agricultural uses

30. Clean water should be used for other agricultural purposes, such as dust abatement and the maintenance of roads, yards and parking lots, in areas where fresh fruits and vegetables are grown. This includes water used to minimize dust on dirt roads within or near primary production sites. This provision may not be necessary when water used for this purpose cannot reach the fruits and vegetables (e.g. in the cases of tall fruit trees, live tree fences or indoor cultivation).

3.2.1.2 Manure, biosolids and other natural fertilizers

31. The use of manure, biosolids and other natural fertilizers in the production of fresh fruits and vegetables should be managed to limit the potential for microbial, chemical and physical contamination.

32. Pathogens may be present in manure, biosolids and other natural fertilizers and may persist for weeks or even months, in particular if the treatment of these materials is inadequate. Manure, biosolids and other natural fertilizers contaminated with chemicals at levels that may affect the safety of fresh fruits and vegetables should not be used. Where necessary, in order to minimize microbial contamination, the following practices should be taken into consideration:

- Proper physical, chemical or biological treatment methods (e.g. composting, pasteurization, heat drying, UV irradiation, alkali digestion, sun drying or combinations of these) should be adopted to reduce the risk of potential human pathogen survival in manure, biosolids and other natural fertilizers. The level of pathogen reduction achieved by different treatments should be taken into account when considering suitability for different applications.
- Composting, if done properly, can be a practical and efficient method to inactivate food-borne pathogens in manure. In general, only fully composted animal waste or plant material should be applied to production fields. Manure, biosolids and other natural fertilizers which are untreated or partially treated should not be used after plant emergence or after a transplant is put into the soil unless appropriate corrective actions are being adopted to reduce microbial contaminants, such as waiting for such sufficient time to elapse between application and the harvest of fresh fruits and vegetables as to reduce pathogens remaining in the amended soil to levels that are unlikely to result in contamination of the product.
- When using aerobic composting methods, regularly and thoroughly turn compost heaps to ensure that all of the material will be exposed to elevated temperatures because pathogens can survive for months on the heap surface.
- When using anaerobic methods, special consideration should be given to determining the length of time needed to inactivate pathogens that may be present.
- Growers who are purchasing manure, biosolids and other natural fertilizers that have been treated to reduce microbial or chemical contaminants should pay particular attention to the selection of the supplier, including obtaining documentation from the supplier that identifies the origin, treatment used, tests performed and their results.
- Growers should not use biosolids or other natural fertilizers close to harvest unless properly composted or used in a manner not reasonably likely to contact the edible portion of the produce.
- Contamination from manure, biosolids and other natural fertilizers from adjoining fields should be minimized. If potential for contamination from adjoining fields is identified, preventative actions (e.g. care during application and runoff controls, covering compost piles to avoid contamination from wind drift) should be implemented to minimize the risk.
- Treatment or storage sites should not be located in proximity to fresh fruit and vegetable production areas.
- Cross-contamination from runoff or leaching by securing areas where manure, biosolids and other natural fertilizers are treated and stored should be prevented.

3.2.1.3 Soil

33. Soils should be evaluated for hazards. If the evaluation concludes that such hazards may compromise the safety of crops, control measures (e.g. topsoil replacement or solar-heat disinfection) should be implemented to reduce hazards to acceptable levels. If this cannot be achieved by available control measures, growers should not use these soils for primary production.

34. Fresh fruits and vegetables may come into direct contact with soil during growth and/or harvesting. When necessary, growers should use production practices (e.g. site selection, mulch) to minimize the contact of produce with the soil.

3.2.1.4 Agricultural chemicals

35. Growers should use only agricultural chemicals authorized for the cultivation of the specific fruit or vegetable and in accordance with the manufacturer's instructions for the intended purpose. Residues of agricultural chemicals should not exceed levels as established by the *Codex Alimentarius Commission.*

36. Agricultural workers who apply agricultural chemicals should be trained in proper application and safety procedures.

37. Growers should keep records on the application of agricultural chemicals, which should include information on: the date of application; the chemical used; the crop sprayed; the pest or disease against which it was used; and the concentration, method and frequency of application; They should also keep records on harvesting to verify that the time between application and harvest is appropriate. Agricultural chemical sprayers should be calibrated, as necessary, to control the accuracy of the rate of application.

38. The mixing of agricultural chemicals should be carried out in such a way as to avoid contamination of water and land in the surrounding areas.

39. Sprayers and mixing containers should be thoroughly washed after use, especially when used with different agricultural chemicals on different crops, to avoid contaminating fruits and vegetables. Wash water should be disposed of in a manner that does not contaminate produce or growing areas.

40. Agricultural chemicals should be kept in their original containers, labelled with the name of the chemical and instructions for its application. Agricultural chemicals should be stored in a safe, well-ventilated place, away from production areas and harvested fruits or vegetables, and disposed of in a manner that does not risk contaminating crops or the primary production environment.

41. Empty containers should be disposed of as indicated by the manufacturer. They should not be used for other purposes.

3.2.1.5 Biological control

42. Consumer safety should be considered when using competing biological organisms and/or their metabolites applied for the control of pests, mites, plant pathogens and spoilage organisms in fresh fruits and vegetables.

43. Growers should use only biological controls that are authorized for the cultivation of the specific fruit or vegetable and in accordance the manufacturer's instructions for the intended purpose.

3.2.2 Indoor facilities associated with growing and harvesting

44. For operations where fresh fruits and vegetables are grown indoors (e.g. greenhouses, hydroponic cultures), suitable premises should be used.

45. Some protective agricultural structures are located in the field (e.g. hoop houses, high tunnels). Factors that influence the magnitude and frequency of the transfer of pathogenic micro-organisms in the field – such as climate, weather, topology, hydrology and other geographic characteristics in or nearby the field – may pose a similar risk for the cultivation inside these protective structures. Methods for the adequate maintenance of the environment around such structures include:

- Properly storing equipment, removing litter and waste, and cutting weeds or grass within the immediate vicinity that may constitute an attractant, breeding place or harbourage for pests;
- Adequately draining areas that may act as a source of contamination to prevent:
    - the breeding of pests;
    - runoff, leakage or pooled/settled water flowing into food-growing areas;
    - the transfer of contaminants via equipment or foot traffic; and
- Taking appropriate measures to minimize any risks from surrounding land use or environment.

3.2.2.1 Location, design and layout

46. Premises and structures used to store or pack fresh fruits and vegetables or store food contact equipment should be located, designed, constructed and maintained to avoid contaminating fresh fruits and vegetables and harbouring pests such as insects, rodents and birds.

47. The internal design and layout should permit compliance with good hygienic practices for the primary production of fresh fruits and vegetables indoors, including protection against cross-contamination between and during operations. Each establishment should be evaluated individually in order to identify specific hygienic requirements for each product.

3.2.2.2 Water supply

48. Refer to 3.2.1.1.1 (Water for irrigation and harvesting) and 3.2.1.1.3 (Hydroponic water), in addition, where appropriate, an adequate supply of clean water with appropriate facilities for its storage and distribution should be available in indoor primary production facilities. Non-potable water should have a separate system. Non-potable water systems should be identified and should not connect with or allow reflux into potable water systems.

- Avoid contaminating water supplies by exposure to agricultural inputs used for growing fresh produce;
- Clean and disinfect water storage facilities on a regular basis; and
- Control the quality of the water supply.

3.2.2.3 Drainage and waste disposal

49. Adequate drainage and waste disposal systems and facilities should be provided. These systems should be designed and constructed so as to avoid the potential for contamination of fresh fruits and vegetables, agricultural inputs or water supplies.

50. The following should be considered:

- Good drainage should be maintained around the structure to eliminate standing water.
- All waste should be removed and stored away from the facility to prevent harbourage of pests.
- Plant debris and cull piles should be removed promptly from inside the structure. There should be no permanent plant refuse around the outside of the structure or nearby to attract or harbour pests.
- Refuse containers should be emptied regularly.

3.2.3 Personnel health, hygiene and sanitary facilities

51. Hygiene and health requirements should be followed to ensure that personnel who come into direct contact with fresh fruits and vegetables during or after harvesting are not likely to contaminate them. Visitors should, where appropriate, wear protective clothing and adhere to the other personal hygiene provisions in this Section.

52. If gloves are used, a procedure for glove use in the field should be documented and followed. The procedure should include hand washing before glove use. If the gloves are reusable, they should be made of materials that are easily cleaned and disinfected, and they should be cleaned regularly and stored in a dry clean area. If disposable gloves are used, they should be discarded when they become torn, soiled or otherwise contaminated. Glove use alone is not a suitable substitute for good hand-washing practices.

53. Where appropriate, there should be written Standard Operating Procedures (SOPs) relating to health, hygiene and sanitary facilities. The SOPs should address worker training, facilities and supplies to enable agricultural workers to practice proper hygiene, and company policies relating to expectations for worker hygiene as well as illness reporting. In the context of smallholder farming where written SOPs are not feasible, there should be records related to health, hygiene and sanitary facilities.

3.2.3.1 Personnel hygiene and sanitary facilities

54. Hygienic and sanitary facilities should be available for the maintenance of an appropriate degree of personal hygiene. To the extent possible, the hygienic and sanitary facilities should:

- be located in close proximity to the fields and indoor premises, in sufficient number to accommodate personnel and appropriate for both women and men, so as to encourage their use and reduce the likelihood of agricultural workers relieving themselves in the field;
- be appropriately designed to ensure the hygienic removal of wastes and avoid the contamination of growing sites, fresh fruits and vegetables or agricultural inputs;
- provide adequate means for hygienically washing and drying hands;
- be maintained under sanitary conditions and in good repair;
- include clean running water, soap, toilet paper or equivalent, and single use paper towels or equivalent; multiple use cloth drying towels should not be used; hand sanitizers should not replace hand washing and should be used only after hands have been washed;
- be equipped with an acceptable alternative hand-washing method recommended by the relevant competent authority if clean running water is not available;
- when of a portable nature, not be cleaned in cultivation areas or near irrigation water sources or conveyance systems; growers should identify the areas where it is safe to put portable facilities; and
- be so located as to provide convenience access to toilet and hand-washing facilities for agricultural workers to practice proper hygiene; growers should consider providing areas away from the field and packing lines for agricultural workers to take breaks and eat..

3.2.3.2 Health status

55. People known or suspected to be suffering from or carrying a disease or illness likely to be transmitted through fresh fruits and vegetables should not be allowed to enter any food-handling area, including harvest area, if they are likely to contaminate fresh fruits and vegetables. Any person so affected should immediately report illness or symptoms of illness to the management.

56. The following should be considered:

- Growers should be encouraged to recognize symptoms of diarrheal, or other food-transmissible communicable diseases or conditions such as infected wounds, and reassign agricultural workers as appropriate to an activity that does not affect the safety of the product.
- Agricultural workers should be encouraged and, where feasible, motivated with appropriate incentives to note and report symptoms of diarrheal or food-transmissible communicable diseases.
- Medical examination of agricultural workers should be carried out if clinically or epidemiologically indicated.

3.2.3.3 Personal cleanliness

57. Agricultural workers who have direct contact with fresh fruits and vegetables should maintain a high degree of personal cleanliness and, where appropriate, wear suitable protective clothing and footwear. Dedicated personal protective clothing and equipment should only be used in the assigned areas. Workers should wear clean clothes. When personnel are permitted to continue working with cuts or wounds to the hands covered by waterproof dressings, they should: wear gloves to cover the bandages, thereby providing a secondary barrier between them and the fresh fruits and vegetables they handle; or be reassigned to another working area where they do not handle fresh fruits and vegetables or food contact surfaces directly.

58. Personnel should wash their hands before starting work involving the handling of fruits and vegetables, each time they return to handling areas after a break, immediately after using the toilet, or after handling any contaminated material where this could result in contamination of fresh fruits and vegetables.

3.2.3.4 Personal behaviour

59. Agricultural workers should refrain from behaviour which could result in the contamination of food, for example: smoking, spitting, chewing gum or tobacco, eating, or sneezing or coughing over unprotected fresh fruits and vegetables.

60. Personal effects (e.g. jewellery, watches, purses, backpacks, clothes) should not be worn or brought into fresh fruit and vegetable production areas if they pose a threat to the safety and suitability of the food.

3.2.4 Equipment associated with growing and harvesting

61. Growers and harvesters should follow the technical specifications for the proper usage and maintenance of equipment as recommended by the manufacturer. Harvesting equipment should be cleaned and disinfected seasonally or as needed (e.g. if the equipment runs over an area with heavy animal intrusion and faecal deposits). SOPs should be developed for the maintenance, cleaning and disinfection of growing and harvesting equipment. Specific hygienic and maintenance requirements should be identified for each piece of equipment and the type of fruit or vegetable associated with it. In addition:

- Equipment and tools should function according to the use for which they are designed without damaging the produce.
- Equipment and containers coming into contact with fresh fruits and vegetables should be made of non-toxic materials. They should be designed and constructed to ensure that, when necessary, they can be cleaned, disinfected and maintained to avoid the contamination of fresh fruit and vegetables.
- Policies should be established for the control of equipment when it is not in use, including for its removal from the work area and for its safe storage on-site.
- Containers (including liners of containers made from biodegradable materials) that can no longer be cleaned should be disposed of since they may increase the risk of microbial contamination and chemical migration.
- Containers stored outside should be cleaned and, as appropriate, disinfected before being used to transport fresh fruits and vegetables.
- When not in use, cleaned harvest containers and transport trailers should be covered and kept in a location and in a manner to prevent possible contamination (e.g. from pests, birds, rodents, dust, water).
- Damaged containers or transport trailers should be repaired or replaced.
- Knives and cutting edges should be maintained in condition to retain product quality and safety.

3.3 Handling, storage and transport

3.3.1 Prevention of cross-contamination

62. During primary production and post-harvest activities, effective measures should be taken to prevent the cross-contamination of fresh fruits and vegetables from agricultural inputs or personnel coming into direct or indirect contact with fresh fruits and vegetables. To prevent the potential cross-contamination of fresh fruits and vegetables, growers, harvesters and other agricultural workers should adhere to the recommendations presented elsewhere in Section 3 of this Code in addition to those below.

- The field should be evaluated for the presence of hazards or contamination prior to harvest to determine if the field or portions thereof should not be harvested.
- Harvesting methods vary depending on the characteristics of the product. Specific control measures should be implemented to minimize the risk of contamination from micro-organisms associated with the method of harvesting.
- Mechanical harvest is a common practice for some fresh fruits and vegetables and may lead to food safety hazards if the equipment breaks down during the harvest, has been poorly maintained or cleaned, or damages the harvested plant.
- Growers should avoid moving harvesting equipment across fields where manure or compost was applied.
- Growers should take measures to improve sorting and grading, as the extent of soil and extraneous matter/debris present during and after harvesting may pose a risk of contamination.
- Care must be taken when packing fresh fruits and vegetables in the field to avoid contaminating containers or bins by exposure to manure or other contamination sources.
- The overfilling of totes and bins should be avoided to prevent the transfer of contaminants to fresh fruits and vegetables during stacking.
- Excessive dirt and caked mud should be removed from product and/or containers during harvest.
- Except for root crops and tuber vegetables, setting harvested fresh fruits and vegetables directly on soil after harvest and before loading into the transport vehicle should be avoided so as to avoid contamination.
- Containers used repeatedly during harvest should be cleaned after each load.
- When water is used to remove dirt and debris from fresh fruits and vegetables in the field, clean water should be used.
- Fresh fruits and vegetables unfit for human consumption should be left unharvested or segregated during harvesting. Those which cannot be made safe by further processing should be disposed of properly to avoid contamination of fresh fruits and vegetables or agricultural inputs.
- Harvest workers should avoid handling culled plants in the field in order to prevent cross-contaminating wholesome fresh fruits and vegetables during harvest. It is recommended that culls be hygienically removed from the field or packing facility by a worker who is not handling healthy fruit or vegetables and disposed of so as to avoid it attracting pests.
- When padding is used with post-harvest handling equipment to prevent damage, it should be constructed of material that can be cleaned and disinfected. Ensure that padding is cleaned and disinfected before and during use.
- Harvesting containers that come into direct contact with fresh fruits and vegetables should not be utilized for any other purpose than holding product (e.g. storing personal items, lunch, tools, fuel, waste).
- Harvesting containers should not be placed directly on the ground and should not be stacked if stored on the ground at any time (to avoid the soiled bottom of one container sitting atop another and directly or indirectly contaminating product in other containers).

3.3.2 Storage and transport from the field to the packing facility

63. Fresh fruits and vegetables should be stored and transported under conditions which will minimize the potential for microbial, chemical or physical contamination. The following practices should be adopted:

- Each transporter should have its own SOPs to ensure that shipping containers/trailers are clean, sanitary and in good structural condition.

- Storage facilities and vehicles for transporting the harvested crops should be built in such a manner as to minimize damage to fresh fruits and vegetables and to prevent access by pests. They should be made of non-toxic materials that permit easy and thorough cleaning, and constructed in such a manner as to reduce the opportunity for potential contamination from physical objects such as glass, wood and plastic.
- Fresh fruits and vegetables unfit for human consumption should be segregated before storage or transport. Those which cannot be made safe by further processing should be disposed of properly to avoid contamination of fresh fruits and vegetables or agricultural inputs.
- Agricultural workers should remove as much soil as possible from fresh fruits and vegetables before they are stored or transported. Care should be taken to minimize physical damage to the crop during this process.
- Fresh fruits and vegetables should not be transported in vehicles previously used to carry animal manure, biosolids or pesticides. Receptacles in vehicles and/or containers used to transport fresh fruits and vegetables should not be used to transport any substance that may result in the contamination of products.
- Where conveyances and/or containers are used for transporting anything in addition to foodstuffs, or for transporting different foodstuffs at the same time, products should be separated effectively.
- Products should be covered to maintain integrity of the load as necessary.

64. The length of time of transportation should be as short as possible to minimize the risk of quality loss of fruits and vegetables.

3.4 Cleaning, maintenance and sanitation

65. Premises and harvesting equipment should be kept in an appropriate state of repair and condition to facilitate cleaning and disinfection. Equipment should function as intended to prevent contamination of fresh fruits and vegetables. Cleaning materials should be clearly identifiable, stored separately in secure storage facilities, and used in accordance with manufacturer's instructions for their intended purpose.

3.4.1 Cleaning programmes

66. Cleaning and disinfection programmes should be in place to ensure that any necessary cleaning and maintenance is carried out effectively and appropriately. Cleaning and disinfection systems should be monitored for effectiveness and regularly reviewed and adapted to reflect changing circumstances. Specific recommendations are as follows:

- Proper cleaning and sanitation of equipment is important for manual and mechanical harvesting, since knives and other equipment can damage fruits and vegetables, lead to cross-contamination or facilitate the entry of contaminants that may be in soil or water.
- Harvesting equipment, such as knives, pruners and machetes, that come into direct contact with fresh fruits and vegetables should be cleaned and disinfected regularly or as the situation warrants.
- Clean water should be used to clean all equipment coming into direct contact with fresh fruits and vegetables, including farm machinery, harvesting and transportation equipment, containers and knives.
- When not in use, cleaned harvest containers and transport trailers should be covered and kept in such a location and manner as to prevent possible contamination (e.g. from pests, birds, rodents, dust, water).

3.4.2 Cleaning procedures and methods

67. The appropriate cleaning methods and materials will depend on the type of equipment and the nature of the fruit or vegetable. The following procedures should be adopted:

- Cleaning procedures should include the removal of debris from equipment surfaces, the application of a detergent solution, rinsing with water, and, where appropriate, disinfection.
- Cleaning and disinfection programmes should not be carried out in a location where the rinse might contaminate fresh fruits and vegetables.
- Where appropriate or necessary, cleaning and disinfection procedures should be verified to ensure their effectiveness by a testing regime.
- Cleaning chemicals may be subject to approval by the competent authority and should be handled and used carefully and in accordance with manufacturer's instructions.

3.4.3 Pest-control systems

68. When primary production is carried out in indoor establishments (e.g. greenhouses), the recommendations of the *General Principles of Food Hygiene* on pest control should be followed.

69. When fresh fruit and vegetable packing and/or processing establishments are not used during a certain period, measures should be taken to minimize pest infestations or to correct them and their risk of contamination prior to use.

3.4.4 Waste management

70. Suitable provision should be made for the storage and removal of waste. Waste should not be allowed to accumulate in fresh fruit and vegetable handling and storage areas or the adjoining environment. Storage areas for waste should be kept clean.

4. ESTABLISHMENT: DESIGN AND FACILITIES

71. Refer also to the *Guidelines on the Application of General Principles of Food Hygiene to the Control of Listeria monocytogenes in Ready-to-Eat Foods* (CAC/GL 61-2007), as appropriate, and to the *General Principles of Food Hygiene* (CAC/RCP 1-1969) and additionally:

72. Packing activities can be conducted in the field or within facilities. Field-packing operations should implement the same sanitary practices as facilities where practical or be modified as necessary to minimize risks.

73. The provisions below apply to facilities that pack, cool and process fresh fruits and vegetables.

4.1 Location

74. Refer to the *General Principles of Food Hygiene* (CAC/RCP 1-1969).

4.2 Premises and rooms

75. Premises and rooms should be designed to separate the area for incoming fresh fruits and vegetables from the field and the area for handling (i.e. areas for incoming soiled products and outgoing products) to avoid cross-contamination. This can be accomplished in a number of ways, including linear product flow.

4.2.1 Design and layout

76. Refer to the *General Principles of Food Hygiene* (CAC/RCP 1-1969) and additionally:

77. Where feasible, raw material-handling areas should be physically separated from processing/packing areas. Within each of these areas, cleaning operations should be conducted separately to avoid cross-contamination among equipment and utensils used in each operation.

4.2.2. Internal structures and fittings

78. Pipes should not leak and condensation should be minimized to avoid dripping onto product or packing equipment.

4.3 Equipment

79. Care should be taken to ensure that equipment used in the handling of fruits and vegetables does not damage the product and can be cleaned and disinfected so as to avoid becoming a source of contamination, such as from biofilms.

4.4 Facilities

4.4.1 Water supply

80. Refer to the *General Principles of Food Hygiene* (CAC/RCP 1-1969).

4.4.2 Drainage and waste disposal

81. Adequate drainage in packing, cooling and processing facilities is critical to avoid the risk of contaminating fresh fruits and vegetables. To ensure adequate drainage of standing water, the following aspects should be taken into consideration:

- Drainage in the facility should be designed with sloped floors to effectively drain standing water.
- Floors should be kept as dry as possible using appropriate methods.
- Standing water should be removed or pushed to the drains.
- Drains should be cleaned periodically to prevent the build-up of biofilms that may contain organisms of concern (e.g. *Listeria monocytogenes*).
- Areas for recyclable garbage and compostable waste should be so identified and all waste stored and disposed of in such a manner as to minimize contamination.
- Waste should be disposed of on a frequent basis to avoid attracting pests (e.g. flies, rodents).

5. CONTROL OF OPERATION

5.1 Control of food hazards

82. Refer to the *General Principles of Food Hygiene* (CAC/RCP 1-1969).

5.2 Key aspects of hygiene-control systems

83. Refer to the *General Principles of Food Hygiene* (CAC/RCP 1-1969).

5.2.1 Time and temperature control

84. Refer to the *General Principles of Food Hygiene* (CAC/RCP 1-1969).

5.2.2 Specific process steps

85. Refer to the *General Principles of Food Hygiene* (CAC/RCP 1-1969).

5.2.2.1 Post-harvest water use

86. Water-quality management will vary throughout all operations. Packers should follow GHPs to prevent or minimize the potential for the introduction or spread of pathogens in processing water. The quality of water used should depend on the stage of the operation: for example, clean water could be used for initial washing stages, whereas water used for final rinses should be of potable quality.

- Clean, or preferably potable, water should be used when water is applied under pressure or vacuum during washing, as these processes may damage the structure of and force pathogens into plant cells.
- It is recommended that the quality of the water used in packing establishments be controlled, monitored and recorded by testing for indicator organisms and/or food-borne pathogens.
- If water is used in prewashing and washing tanks, additional controls (e.g. changing water whenever necessary and controlling of product throughput capacity) should be adopted.
- Post-harvest systems that use water should be designed in such a manner as to minimize places where product may lodge or dirt build up.
- Biocides should be used as per GHPs and where necessary to minimize post-harvest cross-contamination with their levels monitored, controlled and recorded to ensure the maintenance of effective concentrations. The application of biocides should be followed by rinsing as necessary to ensure that chemical residues do not exceed levels established by the competent authority.
- Where appropriate, the temperature (e.g. controlled to minimize water infiltration) and other characteristics of post-harvest water that may impact the efficacy of the biocidal treatments (e.g. the pH, turbidity and water hardness) should be controlled, monitored and recorded.
- Recycled water should be treated and maintained in conditions that do not constitute a risk to the safety of fresh fruits and vegetables. The treatment process should be effectively monitored, controlled and recorded. For example, the following may be used to maintain the suitability of the water: primary screening, secondary filtration and biocidal-treatment process.
- Recycled water may be used with no further treatment, provided its use does not constitute a risk to the safety of fresh fruits and vegetables (e.g. use of water recovered from the final wash for the first wash).
- Ice should be made from potable water and produced, handled and stored in such a manner as to protect it from contamination.

5.2.2.2 Chemical treatments

87. Packers should use chemicals or other natural appropriate agents for post-harvest treatments in accordance with GAPs and Good Manufacturing Practices (GMPs). Such treatments should be carried out in accordance with the manufacturer’s instructions for the intended purpose.

88. Sprayers for post-harvest treatments should be calibrated regularly to control the accuracy of the rate of application. They should be thoroughly washed when used with different chemicals and on different fruits or vegetables to avoid contaminating the produce.

5.2.2.3 Cooling of fresh fruits and vegetables

89. Condensate and defrost water from evaporator-type cooling systems (e.g. vacuum cooling, cold rooms) should not drip onto fresh fruits and vegetables. The cleanliness of the interior of cooling systems should be maintained.

90. Potable water should be used in cooling systems where water or ice is in direct contact with fresh fruits and vegetables (e.g. hydro cooling, ice cooling). The water quality in such systems should be controlled and maintained.

91. If water used for cooling enters into direct contact with the fruits or vegetables and is recirculated, it should be controlled, monitored and recorded to ensure that biocides are sufficient to reduce the potential risk of cross-contamination.

92. Forced-air cooling is the use of rapid movement of refrigerated air over fresh fruits and vegetables in cold rooms. Air cooling systems should be appropriately designed and maintained to avoid contaminating fresh produce (e.g. regularly cleaned and disinfected).

93. Cooling equipment should be cleaned and disinfected on a regular basis in accordance with written procedures so as to minimize the potential for cross-contamination.

5.2.2.4 Cold storage

94. When appropriate, fresh fruits and vegetables should be maintained at appropriate temperatures after cooling to minimize microbial growth. The temperature of the cold storage should be controlled, monitored and recorded.

5.2.2.5 Cutting, slicing, peeling, shredding and similar pre-cutting processes

95. Refer to Annex I, on Ready-to-Eat, Fresh, Pre-Cut Fruits and Vegetables, which provides additional specific recommendations for the processing of ready-to-eat, fresh, pre-cut fruits and vegetables.

5.2.2.6 Germination

96. Refer to Annex II, on Sprouts, which provides additional specific recommendations for the germination process.

5.2.3 Microbiological and other specifications

97. Refer to the *Principles and Guidelines for the Establishment and Application of Microbiological Criteria Related to Foods* (CAC/GL 21-1997).

98. Microbiological testing can be a useful tool to evaluate and verify the safety and effectiveness of practices and to provide information about an environment, a process or even a specific product lot when sampling plans and methodology are properly designed and performed. The intended use of the information (e.g. evaluating the effectiveness of a sanitation practice or the risk posed by a particular hazard) can aid in determining which micro-organisms are most appropriate to test for. Test methods validated for the intended use should be selected. Consideration should be given to ensuring proper design of a microbiological testing programme. Trend analysis of testing data should be undertaken to evaluate the effectiveness of food safety control systems.

5.2.4 Microbiological cross-contamination

99. Refer to the *General Principles of Food Hygiene* (CAC/RCP 1-1969).

100. The traffic pattern of employees should prevent cross-contamination of fruits and vegetables. For example, the employees should avoid moving frequently among various areas of production or from a potentially contaminated area to the packaging area unless they have washed their hands, changed to clean protective clothing and washed or changed their shoes.

5.2.5 Physical and chemical contamination

101. Refer to the *General Principles of Food Hygiene* (CAC/RCP 1-1969).

5.3 Incoming material requirements

102. Refer to the *General Principles of Food Hygiene* (CAC/RCP 1-1969) and additionally:

103. Fruits and vegetables are perishable products that should be carefully handled. Damage will adversely affect the quality of the product and may increase the potential for microbial contamination.

104. During unloading of raw material, check the cleanliness of the food transportation unit and check raw materials for evidence of contamination and deterioration.

105. Physical hazards (such as the presence of animal and plant debris, metal and other foreign matter) should be removed through manual sorting or the use of equipment such as metal detectors. Raw materials should be culled or, if appropriate, trimmed to remove any damaged, rotten or mouldy material.

- The use products that have visible signs of decay or damaged structure (e.g. mechanical damage, cracked rinds, wilted leaves) should be avoided due to the increased risk for microbial contamination.

- Damaged or decayed fruits and vegetables should be discarded in a manner that does not attract pests.

5.4 Packing

106. Refer to the *General Principles of Food Hygiene* (CAC/RCP 1-1969).

5.5 Water

107. Refer to the *General Principles of Food Hygiene* (CAC/RCP 1-1969).

5.6 Management and supervision

108. Refer to the *General Principles of Food Hygiene* (CAC/RCP 1-1969).

5.7 Documentation and records

109. Where appropriate, processing, production and distribution records should be retained long enough to facilitate a recall and food-borne illness investigation if required. This period may significantly exceed the shelf-life of fresh fruits and vegetables. Documentation can enhance the credibility and effectiveness of the food safety control system.

110. Documentation and records can enhance the credibility and effectiveness of the food safety control system.

- Operators such as growers and contract harvesters should keep up to date all relevant information on agricultural activities such as the site of production; suppliers' information on agricultural inputs; lot numbers of agricultural inputs; irrigation practices; use of agricultural chemicals, including type and date used; harvest practices and harvest date; water quality data; pest control; and cleaning schedules for indoor establishments, premises, facilities, equipment and containers.
- Packers should maintain up-to-date information concerning each lot, including on incoming materials (e.g. information from growers, lot numbers), processing-water quality data, pest-control programmes, cooling and storage temperatures, chemicals used in post-harvest treatments, and cleaning schedules for premises, facilities, equipment and containers, etc.

111. Where practicable or appropriate, a written food safety control plan that includes a written description of each of the hazards identified in assessing environmental hygiene, as well as the steps that will be implemented to address each hazard, should be prepared by the business.

112. The following are examples of the types of records that should be retained:

- Supplier records
- Agricultural chemical use and storage records
- Compost purchase and use records
- Pest-control records
- Cleaning and disinfection reports
- Equipment monitoring and maintenance records
- Water monitoring and test results, including testing of wash-water chemical levels
- Product-processing records
- Storage-room temperatures
- Microbiological test results and, where possible, trend analyses
- Employee training records
- Personal illness reporting
- Distribution records
- Inspection/audit records

5.8 Recall procedures

113. A traceability/product tracing system should be designed and implemented according to the *Principles for Traceability/Products tracing as a tool within a Food Inspection and Certification System* (CAC/GL 60-2006), especially to enable the withdrawal of products where necessary.

114. In the event of a food-borne illness outbreak associated with fresh fruits and vegetables, maintaining appropriate records of production, processing, packaging and distribution may help to identify the source of contamination in the food chain and facilitate product recalls.

115. Detailed records should be kept to link each supplier with the immediately subsequent recipient of each product throughout the food chain. The information needed to link each supplier should include, if available and as appropriate to the point in the food chain, the grower's name, address and phone number; the packer's name, address, and phone number; the dates harvested, packed and released; the type of product (e.g. fruit or vegetable name and/or variety name), including brand name, lot identification and number of lots; and transporter.

6. ESTABLISHMENT: MAINTENANCE AND SANITATION

6.1 Maintenance and cleaning

6.1.1 General

116. Food contact surfaces should be cleaned and disinfected before the start of operations, at the beginning of the season, and throughout their use to ensure microbial pathogens do not become established in the facility or on the equipment.

6.2 Cleaning programmes

117. Refer to the *General Principles of Food Hygiene* (CAC/RCP 1-1969).

118. Where appropriate, written SOPs should be developed and implemented for the cleaning and disinfection of all equipment.

6.3 Pest-control systems

119. Fresh fruits and vegetable can be extremely attractive to flies and other insects, which may cross-contaminate the products. It is recommended that an efficient product cull disposal and waste removal programme should be implemented to reduce the potential for attracting insects and other pests. Pest-control systems should be implemented to minimize pest harbourage and access in the establishment and to ensure that pests do not become a source of contamination of fresh fruits and vegetables or food contact surfaces.

6.4 Waste management

120. Refer to the *General Principles of Food Hygiene* (CAC/RCP 1-1969).

6.5 Monitoring effectiveness

121. Refer to the *General Principles of Food Hygiene* (CAC/RCP 1-1969).

7. ESTABLISHMENT: PERSONAL HYGIENE

122. Refer to the *General Principles of Food Hygiene* (CAC/RCP 1-1969).

8. TRANSPORTATION

123. Refer to the *General Principles of Food Hygiene* (CAC/RCP 1-1969), the *Code of Hygienic Practice for the Transport of Food in Bulk and Semi-Packed Food* (CAC/RCP 47-2001) and the *Code of Practice for the Packaging and Transport of Fresh Fruits and Vegetables* (CAC/RCP44-1995).

9. PRODUCT INFORMATION AND CONSUMER AWARENESS

9.1 Lot identification

124. Refer to the *General Principles of Food Hygiene* (CAC/RCP 1-1969).

9.2 Product information

125. Refer to the *General Principles of Food Hygiene* (CAC/RCP 1-1969).

9.3 Labelling

126. Refer to the *General Standard for the Labelling of Pre-packaged Foods* (CODEX STAN 1-1985) in addition to the following:

127. Consumer handling information should provide specific directions for product storage and use, including regarding the 'use-by' date or other shelf-life indicators where appropriate/necessary. For example, consumers need clear guidance on keeping washed ready-to-eat (RTE) bagged fresh fruits and vegetables refrigerated until used. When necessary, instructions to wash the produce should be provided.

9.4 Consumer education

128. All stakeholders – government, industry, consumer organizations and the media – should work to communicate clear consistent messages on handling fresh fruits and vegetables safely. Consumer information on handling fresh fruits and vegetables safely should cover:

- avoiding the purchase of damaged or rotten products sold under unsanitary conditions, so as to minimize microbiological contamination;
- avoiding increased product temperature during transportation and minimizing the time in transit for fresh fruits and vegetables between retail/markets and the home;
- storing/refrigerating fresh fruits and vegetables– products should preferably be stored in a cool environment; some prepackaged products should be refrigerated as soon as possible;
- minimizing the time between removal from the refrigerator and consumption of processed prepackaged products;
- handling, preparing and storing produce safely to avoid cross-contamination with food-borne pathogens from various sources (e.g. hands, sinks, cutting boards, utensils, raw meats and other raw and/or unwashed fruits and vegetables); and
- the need to wash with potable water and/or peel fresh fruits and vegetables before consuming, if necessary.

10. TRAINING

129. Refer to the *General Principles of Food Hygiene* (CAC/RCP 1-1969).

10.1 Awareness and responsibilities

130. Education and training for all personnel should be a priority. There should be a documented training programme for growers and packers that is routinely reviewed and updated. Systems should be in place to ensure that food handlers remain aware of all procedures necessary to maintain the safety of fresh fruits and vegetables.

131. Personnel associated with growing and harvesting should be aware of GAPs, GHPs and their role and responsibility in protecting fresh fruits and vegetables from contamination or deterioration. Agricultural workers should have the necessary knowledge and skills to enable them to carry out agricultural activities and to handle fresh fruits and vegetables and agricultural inputs hygienically.

132. Personnel associated with packing should be aware of GHPs and their role and responsibility in protecting fresh fruits and vegetables from contamination or deterioration. Packers should have the necessary knowledge and skills to enable them to perform packing operations and to handle fresh fruits and vegetables in a way that minimizes the potential for microbial, chemical or physical contamination.

133. All personnel who handle cleaning chemicals or other potentially hazardous chemicals should be instructed in safe handling techniques. They should be aware of their role and responsibility in protecting fresh fruit and vegetables from contamination during cleaning and maintenance.

10.2 Training programmes

134. Personnel involved in primary production, packing, processing or transport operations of fresh fruits and vegetables should receive training appropriate to their tasks and should be periodically assessed while performing their duties to ensure tasks are being completed correctly. Training should be delivered in such a language and manner as to facilitate the recipients' understanding of what is expected of them and why, and should emphasize the importance of using hygienic practices.

135. A well-designed training programme takes into account any barriers to learning among the trainees and develops training methods and materials to overcome any such barriers. Factors to take into account in assessing the level of training required in growing, harvesting and packing activities include:

- longstanding or entrenched trainee behaviours, attitudes or personal beliefs;
- the transient nature of workforce with no prior training in food safety and hygiene;
- children/infants may accompany parents working in the production site, with the potential for transfer of pathogens with a human reservoir;
- diverse cultural, social and traditional practices;
- literacy and education level;

- language and dialect of trainees;
- the need to make food safety practices realistic and easy to implement (identify enabling factors, motivators and incentives);
- raising awareness among trainees of the symptoms and signs of disease and encouraging them to act on these (taking personal responsibility for health);
- the nature of the fruit or vegetable being produced, in particular its ability to sustain growth of pathogenic micro-organisms;
- the agricultural techniques and inputs used in the primary production, including the probability of microbial, chemical and physical contamination;
- the task the employee is likely to perform and the associated hazards and controls;
- the manner in which fresh fruits and vegetables are processed and packaged, including the probability of contamination or microbial growth;
- the conditions under which fresh fruits and vegetables will be stored; and
- the extent and nature of processing or further preparation by the consumer before final consumption.

136. Topics to be considered for inclusion in training programmes include the following:

- the importance of following SOPs;
- the importance of good health and hygiene for personal health and food safety;
- the importance of hand washing for food safety and of proper hand-washing techniques;
- the importance of using sanitary facilities to reduce the potential for contaminating fields, produce, other workers and water supplies; this may include toilet use, the proper disposal of toilet paper or equivalent, and proper hand-washing and -drying procedures;
- the importance of recognizing and recording field contamination indicators (e.g. broken fences, animal droppings, high incidence of insects) and taking appropriate risk-mitigation measures;
- the importance of separating fresh fruits and vegetables with visible defects, such as broken skin, decay, mould, soil and insect and/or bird damage;
- the importance of proper product-handling techniques to minimize or prevent product damage and microbial contamination;
- techniques for hygienic handling and storage of fresh fruits and vegetables by transporters, distributors, storage handlers and consumers; and
- sickness reporting and exclusion policy.

137. Training programmes should be repeated periodically, updated whenever there is a change in the product, process or staff, monitored for effectiveness and modified when necessary.

138. Increased emphasis on training in cold chain logistics and management is recommended, in line with advancing knowledge and technologies for both refrigeration and temperature monitoring and expanding international trade.

10.3 Instruction and supervision

139. Refer to the *General Principles of Food Hygiene* (CAC/RCP 1-1969).

10.4 Refresher training

140. Refer to the *General Principles of Food Hygiene* (CAC/RCP 1-1969).

ANNEX I

READY-TO-EAT, FRESH, PRE-CUT FRUITS AND VEGETABLES

INTRODUCTION

1. The health benefits associated with fresh fruits and vegetables combined with consumer interest in the availability of a variety of ready-to-eat (RTE) foods have contributed to a substantial increase in the popularity of pre-cut fruits and vegetables. Due to the increased convenience and consumption of pre-cut fruits and vegetables in and away from the home, the preparation of some of these products has moved from the point of consumption to the food processor or retailer. The processing of fresh produce without proper sanitation procedures in place in the manufacturing environment may enhance the potential for contamination by microbiological pathogens. The potential for pathogens to survive or grow may be enhanced by the high moisture and nutrient content of fresh-cut fruits and vegetables, the absence of a lethal process to eliminate them, and the potential for temperature abuse during processing, storage, transport and retail display.

2. Some of the microbiological pathogens associated with fresh fruits and vegetables include *Salmonella* spp., *Shigella* spp., pathogenic strains of *Escherichia coli*, *Listeria monocytogenes*, norovirus and hepatitis A virus and parasites such as *Cyclospora cayetanensis.* Some of these pathogens are associated with the agricultural environment, whereas others are associated with infected workers or contaminated water. Given the ability for pathogens to survive and grow on fresh produce, it is important for the pre-cut industry to follow good hygienic practices (GHPs) to ensure the microbiological safety of its products.

1. OBJECTIVE

3. Hygienic recommendations for the primary production of fresh fruits and vegetables are covered under the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003). This Annex recommends the application of Good Hygienic Practices (GHPs) for all stages involved in the production of ready-to-eat, fresh, pre-cut fruits and vegetables, from the receipt of raw materials to the distribution and consumption of finishedproducts.

4. The primary objective of this Annex is to identify GHPs that will help control biological, physical and chemical hazards associated with the processing of RTE, fresh, pre-cut fruits and vegetables. Particular attention is given to minimizing microbiological hazards.

2. SCOPE, USE AND DEFINITIONS

2.1 Scope

5. This Annex specifically applies to RTE fresh fruits and vegetables that have been peeled, cut or otherwise physically altered from their original form but remain in the fresh state, particularly those intended to be consumed raw. This Annex applies irrespective of where the operations take place (e.g. in the field or at the farm, retailer, wholesaler or processing establishment).

6. For some establishments that process fresh, pre-cut fruit and vegetables, this Annex will cover all operations, from the receipt of raw materials to the distribution of the final product. For other establishments (e.g. those using RTE, fresh, pre-cut fruits and vegetables in combination with other products, such as sauces, meat, cheese), only the specific sections relating to the processing of the RTE, fresh, pre-cut fruit and vegetable components will apply.

7. This Annex does not directly apply to fresh fruits and vegetables that have been minimally trimmed (e.g. cutting off the base of the stalk after harvest, as opposed to cutting into pieces) leaving the food otherwise intact. Nor does it apply to other fresh fruits and vegetables that are pre-cut before further processing that would be expected to eliminate any pathogen that may be present (e.g. cooking, juice processing, fermentation), nor to fresh fruit or vegetable juices. However, some of the basic principles of this Annex may nonetheless be applicable to such products.

8. Packaging includes single-serving containers (e.g. sealed pouches or plastic trays), larger consumer or institutional size packages and bulk containers. This Annex concentrates on microbial hazards, addressing physical and chemical hazards only in so far as they relate to GHPs.

2.2 Use

9. This document follows the format of the *General Principles of Food Hygiene* (CAC/RCP 1-1969) and should be used in conjunction with the *General Principles of Food Hygiene* and the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003).

2.3 Definitions

Processor – A person responsible for the management of the activities associated with the production of RTE, fresh, pre-cut fruits and vegetables.

3. PRIMARY PRODUCTION

10. Refer to Section 3 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003) in addition to the following:

3.2.3 Personnel health, hygiene and sanitary facilities

11. Personal hygiene is critically important in the production of manually harvested RTE fruits and vegetables due to the extent of human handling that could lead to the contamination of fresh fruits and vegetables. Whenever possible, harvesting, post-harvest activities, packing and inspection processes should be designed to reduce handling.

4. ESTABLISHMENT: DESIGN AND FACILITIES

12. Refer to Section 4 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003) in addition to the following:

4.4.2 Drainage and waste disposal

13. The processing of products covered by this Annex generates a large quantity of waste that can provide food and shelter to pests. It is therefore very important to plan an effective waste-disposal system. This system should always be maintained in good condition to ensure it does not become a source of product contamination.

5. CONTROL OF OPERATION

14. Refer to Section 5 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003) in addition to the following:

5.1 Control of food hazards

15. While processing may reduce the level of contamination initially present on raw materials, it cannot guarantee the elimination of such contamination. Consequently, processors should ensure that steps are taken by their suppliers (growers, harvesters, packers and distributors) to minimize the contamination of raw materials during primary production and subsequent handling. It is recommended that processors ensure that their suppliers have adopted the principles outlined in the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003).

16. There are certain pathogens, i.e. *Listeria monocytogenes* and *Clostridium botulinum*, which may present a concern in relation to RTE, fresh, pre-cut low-acid fruits and vegetables packaged in a vacuum or a modified atmosphere. Processors should ensure that they have addressed all relevant safety issues relating to the use of such packaging.

5.2.2.3 Cooling fresh fruits and vegetables

17. Refer to section 5.2.2.3 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003).

5.2.2.4 Cold storage

18. Refer to section 5.2.2.4 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003).

19. RTE, pre-cut fruits and vegetables should be kept under cold temperature that will minimize microbial growth at all stages, from cutting until distribution. Regular and effective monitoring should be carried out, and records maintained, of the temperature of storage areas and transport vehicles.

5.2.2.5 Cutting, slicing, peeling, shredding and similar pre-cutting processes

20. Procedures should be in place to minimize contamination with physical (e.g. metal) and microbiological contaminants during cutting, slicing, shredding or similar pre-cutting processes.

- Fresh fruits and vegetables should be washed with potable water before cutting or peeling.
- Before cutting or other processing, some fruits and/or vegetables may need to be scrubbed in the presence of a biocide or subjected to an alternative surface decontamination, such as hot water, steam or other treatment, in order to ensure a further reduction in microbial contamination.

- It is recommended that pre-cut products should be wrapped/packaged and refrigerated as soon as possible and distributed under refrigerated temperatures.
- The sharpness and condition of knives and cutting edges should be maintained to ensure product quality and safety.
- Cutting knives and other cutting blades or surfaces should be cleaned and disinfected on a regular basis in accordance with written procedures to reduce the potential for cross-contamination of fresh fruits and vegetables during the cutting process. Knife blade-disinfecting solutions should be monitored to ensure that the disinfectant is present at sufficient levels to achieve its intended purpose and does not promote the potential for cross-contamination.
- Cutting knifes and other cutting blades or surfaces should be kept in an appropriate state of repair and condition to facilitate cleaning and disinfection.

5.2.2.5.1 Washing after cutting, slicing, shredding and similar pre-cutting processes

21. Washing cut produce with potable water may reduce microbiological contamination. In addition, it removes some of the cellular fluids that released during the cutting process, thereby reducing the level of nutrients available for microbiological growth. The following should be taken into consideration:

- Water should be replaced at sufficient frequency to prevent the build-up of organic material and minimize cross-contamination.
- Biocides should be used to minimize cross-contamination during washing and where their use is in line with GHPs.
- Produce, except that to be packed in liquid, should be dried or drained to remove water after washing so as to minimize microbiological growth.

6. ESTABLISHMENT: MAINTENANCE AND SANITATION

22. Refer to Section 6 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003).

7. ESTABLISHMENT: PERSONAL HYGIENE

23. Refer to Section 7 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003).

8. TRANSPORTATION

24. Refer to Section 8 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003).

9. PRODUCT INFORMATION AND CONSUMER AWARENESS

25. Refer to Section 9 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003) in addition to the following:

26. Consumers should be instructed that pre-cut products labelled washed and RTE should be refrigerated as soon as possible and should not be rewashed due to the potential for contamination.

10. TRAINING

27. Refer to Section 10 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003) in addition to the following:

10.2 Training programmes

28. Training for persons responsible for the production of fresh, pre-cut fruits and vegetables should cover topics including:

- the packaging systems used for fresh pre-cut fruits and vegetables, and the risks of contamination or microbiological growth involved; and
- the importance of temperature control and GHPs.

ANNEX II

SPROUTS

INTRODUCTION

1. In recent years, the popularity of sprouted seeds has increased dramatically, favoured by many for their nutritional value. However, reports of food-borne illness associated with raw and lightly cooked sprouts have raised concerns among public health agencies and consumers about the safety of these products.

2. Microbial pathogens associated with sprouted seeds include *Salmonella* spp, pathogenic *Escherichia coli*, *Listeria monocytogenes* and *Shigella* spp. Outbreak investigations have indicated that micro-organisms found on sprouts most likely originate from the seeds. Most seeds supplied to sprout producers are produced primarily for planting for forage or animal grazing, where the Good Agricultural Practices (GAPs) necessary to prevent microbial contamination of seeds intended for sprouting are not followed, especially with regard to the use of natural fertilizers or contaminated irrigation water. As a result, the seeds may be contaminated in the field or during harvest, conditioning, storage or transportation. Typically, the germination process in sprout production involves keeping seeds warm and moist for between two and ten days. In these conditions, if low levels of microbial contaminants are present on seeds, they can quickly reach levels high enough to cause illness.

3. The scientific literature proposes a number of microbiological decontamination treatments of seeds, which can achieve various levels of pathogen reduction. There is currently no treatment available that can guarantee pathogen-free seeds. Research is under way to find effective microbiological decontamination treatments that provide sufficient pathogen reduction on seeds, especially if pathogens are internalized.

1. OBJECTIVE

4. This Annex recommends control measures during two stages: seed production and sprout production. During seed production, conditioning and storage, the application of GAPs and Good Hygienic Practices (GHPs) aims to prevent the contamination of seeds by microbial pathogens. During sprout production, the microbiological decontamination of seeds step is aimed at reducing potential contaminants and the GHPs at preventing the introduction of microbial pathogens and minimizing their potential growth. The degree of control in these two areas has a significant impact on the safety of sprouts.

2. SCOPE, USE AND DEFINITIONS

2.1 Scope

5. This Annex covers hygienic practices specific to the primary production of seeds for sprouting and the production of sprouts for human consumption in order to produce a safe and wholesome product.

2.2 Use

6. This Annex follows the format of the *General Principles of Food Hygiene* (CAC/RCP 1-1969) and should be used in conjunction with the *General Principles of Food Hygiene* and the *Code of Hygienic Practice for Fresh Fruit and Vegetables* (CAC/RCP 53-2003).

2.3 Definitions

Seed producer – A person responsible for the management of activities associated with the primary production of seeds, including post-harvest practices.

Seed distributor – A person responsible for the distribution (handling, storage and transportation) of seeds to sprout producers and who may deal with one or more seed producers or also be a seed producer.

Sprout producer – A person responsible for the management of activities associated with the production of sprouted seeds.

Spent irrigation water – Water that has been in contact with sprouts during the sprouting process.

3. PRIMARY PRODUCTION

7. Refer to Section 3 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003) in addition to the following:

3.1.2 Animal and human activity

8. Neither wild nor domestic animals should be allowed to graze (e.g. employing sheep for spring clip back of alfalfa) in the fields where seeds destined for the production of sprouts for human consumption are grown.

3.2.1.2 Manure, biosolids and other natural fertilizers

9. The prevention of contamination is particularly important during the production of seeds that will be used to produce sprouts for human consumption because of the potential for pathogens to grow during the sprouting process. Consequently, manure, biosolids and other natural fertilizers should only be used when they have undergone treatment to reduce pathogens to levels unlikely to result in contamination.

3.2.1.4 Agricultural chemicals

10. Seed producers should only use chemicals (e.g. pesticides, desiccants) acceptable for seeds intended for the production of sprouts for human consumption.

3.2.4 Equipment associated with growing and harvesting

11. Prior to harvest, harvesting equipment should be adjusted to minimize soil intake and seed damage, and cleaned of all debris or soil.

3.3 Handling, storage and transport

12. Diseased or damaged seeds, which could be susceptible to microbial contamination, should not be used for the production of sprouts for human consumption.

13. Seeds produced for the production of sprouts for human consumption should be segregated from product to be sowed or planted for animal feed (e.g. for forage or animal grazing) and clearly labelled.

14. Since seeds are vulnerable to microbial pathogens during threshing, drying and storage, adequate care should be taken to maintain sanitation in drying yards and prevent the exposure of seeds to mist, high humidity or fog that could provide sufficient moisture for pathogen growth.

4. ESTABLISHMENT: DESIGN AND FACILITIES

15. Refer to Section 4 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003) in addition to the following:

4.2.1 Design and layout

16. Storage, seed-rinsing, microbiological-decontamination, germination and packaging areas should be physically separated from each other.

5. CONTROL OF OPERATION

17. Refer to Section 5 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003) in addition to the following:

18. The seeds should be rinsed thoroughly before microbiological-decontamination treatment to remove dirt and increase the efficacy of the subsequent treatment. Seeds should be rinsed and thoroughly agitated in large volumes of clean water, in such a way as to maximize surface contact. The process should be repeated until most of the dirt is removed and the rinse water remains clear.

5.2.2.2 Chemical treatments

5.2.2.2.1 Microbiological decontamination of seeds

19. Due to the difficulty of obtaining seeds that can be guaranteed as pathogen free, the decontamination of seeds prior to the sprouting process is recommended, where appropriate, to reduce the risk of food-borne illness. Although there are other options, such as the use of lactic acid bacteria, liquid microbiological decontamination treatment is generally used. Alternative treatments, such as heating seeds, whether alone or in combination with other treatments, could greatly improve the efficacy of seed decontamination. Such decontamination should never replace good hygiene practices during seeds production and distribution as no method of decontamination is available to ensure elimination of pathogens. The use of biocides may be subject to approval by the competent authority. During this treatment, sprout producers should adhere to the following:

- Biocides should be used in accordance with the manufacturer’s instructions for their intended use.
- All containers used for the microbiological decontamination of seeds should be cleaned and disinfected prior to use.
- Seeds should be well-agitated in large volumes of biocide to maximize surface contact.
- The duration of treatment and the concentration of biocide used should be evaluated and determined for the type of seed.

- The duration of treatment and the concentration of biocides used should be accurately measured, controlled, monitored and recorded.
- Strict measures should be in place to prevent recontamination of seeds after the biocidal treatment.

5.2.2.2.2 Rinse after seed treatment

20. As appropriate, seeds should be thoroughly rinsed with potable water following microbiological decontamination treatment. Rinsing should be repeated sufficiently to reduce and/or eliminate the biocide.

5.2.2.6 Germination

21. During germination, the environment and equipment should be kept clean to avoid potential contamination. All equipment should be cleaned and disinfected before each new batch.

- Only potable water should be used.
- Where necessary and when used, soils or other matrices should be treated (e.g. pasteurized) to reduce pathogens to levels that are unlikely to result in contamination.

5.2.2.6.1 Pregermination soak

22. Soaking seeds before sprouting is often necessary to improve germination. When soaking, the sprout producer should adhere to the following:

- All containers used for soaking should be cleaned and disinfected prior to use.
- Seeds should be soaked in potable water and for the shortest possible time so as to minimize microbial growth.
- This step may also employ biocides.
- After soaking, seeds should be rinsed thoroughly with potable water.

5.2.2.6.2 Harvesting

23. All equipment should be cleaned and disinfected before each new batch. Harvesting should be carried out using dedicated tools, cleaned and disinfected prior to use.

5.2.2.6.3 Final rinse and cooling

24. Sprouts should undergo a final water rinse to remove hulls, cool the product and potentially further reduce microbial contamination. The following should be taken into consideration:

- As appropriate, sprouts should be rinsed in cold potable water to lower sprout temperature and slow down microbial growth.
- Water should be changed as needed (e.g. between batches) to prevent cross-contamination.
- Sprouts should be drained using appropriate equipment (e.g. food-grade centrifugal dryer) cleaned and disinfected prior to use.
- If additional cooling time is necessary, steps should be taken to facilitate rapid cooling (e.g. product placed in smaller containers with adequate air flow between containers).

5.2.2.4 Cold storage

25. Where appropriate, sprouts should be kept at cold temperature (e.g. 5°C) that will minimize microbial growth for the intended shelf-life of the product. The temperature of storage areas and transport vehicles should be monitored regularly and effectively.

5.2.3 Microbiological and other specifications

26. It is recommended that seed and sprouts or spent irrigation water be tested for the presence of pathogens.

27. Seed producers, distributors and sprout producers should test lots of seeds for microbial pathogens using internationally recognized analytical methods. Sprouting seeds before testing increases the possibility of finding pathogens that may be present. If seed lots are found to be contaminated, they should not be sold or used for the production of sprouts for human consumption. Due to the limitations associated with sampling methods and analytical tests, failure to find contamination does not guarantee that the seeds are pathogen free. However, if contamination is found at this stage, it allows seeds to be diverted or destroyed before entering sprout production for human consumption. Seed producers, distributors and sprout producers should refer to the *Principles and Guidelines for the Establishment and Application of Microbiological Criteria related to Foods* (CAC/GL 21-1977) for guidance on establishing a sampling plan.

5.2.3.1 Testing of seed lots before entering production

28. It is recommended that each new seed lot used for sprout production should be tested by the seed distributor and/or by the sprout producer before entering production (i.e. before the microbiological decontamination of seeds).

- The seed sample selected for testing should be sprouted prior to analysis to increase the likelihood of detecting pathogens if present. Analysis may be performed on the sprouted seeds or, preferably, the water used to sprout the sample.
- Seed samples for microbial analysis should not be subject to any microbiological decontamination treatment prior to testing.

5.2.3.2 Testing of sprouts and/or spent irrigation water

29. Current seed treatments cannot guarantee the total elimination of pathogens. Even if only a few pathogens survive the microbiological decontamination treatment, they can grow to high numbers during sprouting. Producers should therefore put in place a sampling/testing plan to regularly monitor for pathogens at one or more stages following initial germination.

- Analysis may be carried out during the germination process (e.g. of spent irrigation water or in-process sprouts) and/or after the harvest of finished product. Testing spent irrigation water is a good indicator of the microbial conditions of sprouts since it is homogeneous and simpler to analyse.
- Sampling spent irrigation water (or sprouts) during germination, as opposed to testing finished product, provides earlier results. Such sampling should be performed at a point early in the germination process after pathogens, if present, have had a chance to proliferate, usually as early as 24-48 hours into the germination process.
- Because of the sporadic nature of seed contamination, it is recommended that producers should test every production lot (e.g. each drum, bin or rack of trays).

5.3.1 Specifications for incoming seeds

30. Sprout producers should recommend that seed producers and seed distributors adopt GAPs, GHPs and provide evidence that the product was grown, handled, stored and transported according to this Annex and the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003).

31. Seed and sprout producers should obtain from seed producers or distributors: assurances that chemical residues in each incoming lot are within the limits established by the Codex Alimentarius Commission; and, where appropriate, certificates of analysis for microbial pathogens of concern.

5.3.2 Control of incoming seeds

32. Seed containers should be examined at their arrival to minimize the potential for introducing obvious and visible contaminants into the establishment.

33. Seed containers should be examined for physical damage (e.g. holes indicating rodents) and signs of contamination (e.g. stains, insects, rodent faeces, urine, foreign matter). If containers are found to be damaged, contaminated or potentially contaminated, the seeds should not be used for the production of sprouts for human consumption.

34. If seed lots are analysed for the presence of microbial pathogens of concern, the seeds should not be used until the results are available.

5.3.3 Seed storage

35. Seeds should be handled and stored in a manner that will prevent damage and contamination.

36. Seeds should be stored off the floor, away from walls and in proper storage conditions to prevent mould and bacterial growth and to facilitate pest-control inspection.

37. Open containers should be stored in such a way as to protect them from pests and other sources of contamination.

5.5.1. Water use during sprout production

38. Sprout producers should follow GHPs to minimize the potential for the introduction or spread of pathogens in processing water. The quality of water used should be dependent on the stage of the operation. Due to the potential for pathogen proliferation during the sprouting process, clean water could be used for initial washing stages, whereas water used later in the sprout production process (i.e. for the rinse following the microbiological decontamination of seed, and subsequent operations, other than seed germination) should be at least clean water and preferably of potable quality. Water used for seed germination should be potable.

5.8 Recall procedures

39. Refer to Section 5.8 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003) in addition to the following:

40. Sprout and seed producers in producing sprouts for human consumption should ensure that records and recall procedures are in place to effectively respond to health risk situations. Procedures should enable the complete and rapid recall of any implicated seed. The procedures should also assist in providing detailed information for the identification and investigation of any contaminated seeds and sprouts. The following provisions should be adopted:

- Such seed production and distribution practices should be in place as to minimize the quantity of seed identified as a single lot and avoid the mixing of multiple lots, which would complicate recalls and provide greater opportunity for cross-contamination. Seed producers and distributors and sprout producers should maintain records for each lot. The lot number, producer and country of origin should be indicated on each container.
- Seed and sprout producers should have a system to effectively identify lots, trace their associated production sites and agricultural inputs, and allow for the physical retrieval of the seeds in case of a suspected hazard.
- Where a lot has been recalled because of a health hazard, other lots produced under similar conditions (e.g. on the same production sites or with the same agricultural inputs) and which may present a similar hazard should be evaluated for safety. Any lot presenting a similar risk should be recalled. Blends containing potentially contaminated seeds should also be recalled.
- Seeds and sprouts which may present a hazard should be held and detained until they are disposed of properly.

6. ESTABLISHMENT: MAINTENANCE AND SANITATION

41. Refer to Section 6 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003).

7. ESTABLISHMENT: PERSONAL HYGIENE

42. Refer to Section 7 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003).

8. TRANSPORTATION

43. Refer to Section 8 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003).

9. PRODUCT INFORMATION AND CONSUMER AWARENESS

44. Refer to Section 9 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003).

10. TRAINING

45. Refer to Section 10 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003).

ANNEX III

FRESH LEAFY VEGETABLES

INTRODUCTION

1. Fresh leafy vegetables are grown, processed and consumed in multiple ways and in diverse conditions throughout the world. They are grown on farms of varying size, from very large to very small; marketed locally and globally, providing year-round availability to consumers; and sold as fresh, fresh-cut, pre-cut or other ready-to-eat (RTE) products such as prepackaged salads.

2. A broad range of microbial pathogens has been associated with fresh leafy vegetables, as reported in international outbreak data, including pathogenic *Escherichia coli*, *Salmonella enterica*, *Campylobacter* spp, *Shigella* spp, Hepatitis A virus, Norovirus, *Cyclospora cayetanensis*, *Cryptosporidium parvum*, *Giardia lamblia, Yersinia pseudotuberculosis* and *Listeria monocytogenes*. Epidemiological evidence, outbreak investigations and risk assessments have identified areas of risk for pathogen contamination of leafy vegetables, including key risks from water, animals, workers and manure-based soil amendments. Fresh leafy vegetables are grown and harvested in large volumes, often for export and increasingly in places where harvesting and distributing fresh leafy vegetables is new. The potential for human pathogens to spread has also, therefore, grown. Fresh leafy vegetables are packed in diverse ways, including: field packed direct for market; in packing houses; and as pre-cut products processed in sophisticated processing plants. As fresh RTE leafy vegetables move through the supply chain, there is also the potential for the introduction and growth of pathogens. There is no further processing treatment that would eliminate or inactivate the target micro-organisms. Examples of control measures are illustrative only and their use and approval may vary by country.

1. OBJECTIVE

3. The objective of this Annex is to provide specific guidance to reduce, during their production, harvesting, packing, processing, storage, distribution, marketing and consumer use, the microbial food safety risks associated with fresh leafy vegetables intended for human consumption without cooking. Due to the diversity of leafy vegetables, and of practices and conditions throughout the supply chain, recommendations to minimize microbial contamination will be most effective when adapted to specific operations.

2. SCOPE, USE AND DEFINITIONS

2.1 Scope

4. This Annex covers specific guidance related to fresh leafy vegetables that are intended to be consumed without further microbiocidal steps.

5. Fresh leafy vegetables for the purposes of this Annex include all vegetables of a leafy nature where the leaf is intended for consumption. Thus, leafy vegetables include, but are not limited to, all varieties of lettuce, spinach, cabbage, chicory, endive, radicchio, and fresh herbs such as coriander, cilantro, basil, betel leaf (Piper betle), curry leaf (Murrayakoenigii), fenugreek leaves, Colocasia leaves and parsley.

2.2 Use

6. This Annex follows the format of the *General Principles of Food Hygiene* (CAC/RCP 1-1969) and should be used in conjunction with the *General Principles of Food Hygiene* and the *Code of Hygienic Practices for Fresh Fruits and Vegetables* (CAC/RCP 53-2003) including the Annex for Ready-to-Eat, Fresh, Pre-Cut Fruits and Vegetables. This Annex provides additional guidance to the documents above.

3. PRIMARY PRODUCTION

7. Refer to Section 3 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003) in addition to the following:

3.2.1.1 Water for primary production

3.2.1.1.1 Water for irrigation and harvesting

8. Irrigation with clean water is particularly important for fresh leafy vegetables that have physical characteristics such as rough surfaces where water may accumulate, a vase-like growth characteristic, or high density seeding or transplant rates. Ideally, these products should be irrigated in such a way as to minimize wetting of the edible portion since the plant physical characteristics can provide niches for microbial attachment and survival.

9. Fresh leafy vegetables may be sprayed with small amounts of water during machine harvest or in the field container just after harvest to hydrate crops. Water may also be used to facilitate the handling of leafy vegetables in the field. Clean and preferably potable, water should be used in processes where there is direct contact between the water and edible portions of the leafy vegetables. It is understood that products at this point are not considered ready to eat and may be washed or further processed.

3.3.2 Storage and transport from the field to the packing facility

10. Maintaining optimum temperatures of leafy vegetables in the 1-5°C range throughout the supply chain or minimizing the time they are exposed to higher temperature will limit microbial proliferation and, depending on the type of the product, may optimize quality. Consideration should be given to the type of product, particularly certain fresh herbs (e.g. basil and shiso) that are chill-sensitive and may require higher storage temperatures to prevent quality deterioration that could leave the product vulnerable to food-borne pathogens. Minimizing the time such propoducts are exposed to higher temperatures may be preferable to maintaining the temperature below 5°C.

4. PACKING ESTABLISHMENT: DESIGN AND FACILITIES

11. Refer to Section 4 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003).

5. CONTROL OF OPERATION

12. Refer to Section 5 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003) in addition to the following:

5.2.2.3 Cooling of fresh leafy vegetables

13. The cooling of fresh leafy vegetables should take place as rapidly as possible and in a manner that does not contribute to contamination of product. For example, fresh leafy vegetables can be cooled immediately after harvest by using ice (for parsley), forced-air cooling, vacuum cooling (for iceberg lettuce), hydrocooling or spray-vacuum (hydrovac) cooling.

5.8 Recall procedures: traceability/product tracing

14. In fresh-cut, pre-cut or RTE salad operations, multiple ingredients from different sources may be combined in a single package. Such practices can complicate efforts to trace leafy vegetables to their source. Processors should consider establishing and maintaining records to identify the source of each ingredient in the product.

6. ESTABLISHMENT: MAINTENANCE AND SANITATION

15. Refer to Section 6 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003).

7. ESTABLISHMENT: PERSONAL HYGIENE

16. Refer to Section 7 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003).

8. TRANSPORTATION

17. Refer to Section 8 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003).

9. PRODUCT INFORMATION AND CONSUMER AWARENESS

18. Refer to Section 9 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003) in addition to the following:

9.4 Consumer education

19. Consumer information on handling fresh leafy vegetables safely should cover:

- Selecting produce in the marketplace (e.g. supermarkets, retailers). Many fresh leafy vegetables such as lettuce are fragile and should be handled with care to avoid mechanical damage and minimize microbiological contamination.

- Specific information for fresh-cut, pre-cut or RTE bagged salads. Consumers need clear specific guidance on how to safely handle fresh-cut, pre-cut or other RTE leafy vegetables. There is anecdotal evidence to suggest that some consumers find it difficult to distinguish between product that can be consumed without further washing and that which requires washing before consumption, particularly bagged produce such as herbs and spinach. Clear labelling is therefore important. If not labelled “washed and ready to eat” or similar wording, then it should be understood that a product needs to be washed.

10. TRAINING

20. Refer to Section 10 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003).

ANNEX IV

MELONS

INTRODUCTION

1. Melons, such as cantaloupe, watermelon and honeydew, are broadly consumed, whether alone, mixed with other foods in salads and other dishes, or as garnishes. They are popular in meals and as snacks, and constitute a regular part of the diet in a number of countries. The popularity of melons has remained high as they are readily available in many countries throughout the year. In recent years, there has been a focus on marketing not only whole melons, but pre-cut products, convenience products in packages and in salad bars, to appeal to consumers. The introduction of new varieties, including seedless and sweeter hybrids, has only added to the consumer appeal of melons.

2. Like other fresh fruits and vegetables that are eaten raw, the safety of melon products depends on maintaining good hygienic practices throughout the food chain during primary production, packing, processing, retail and at the point of consumption. International outbreak data and reported illnesses raise concerns regarding the safety of melon products. There have been a number of outbreaks associated with melon consumption, many caused by *Salmonella* spp., and others associated with such pathogens as *Listeria monocytogenes*. The major risk factors identified as contributing to melon-related outbreaks include contaminated irrigation water, infected food handlers, poor personal hygiene, poor temperature control (including extended holding at ambient temperature and poor cold storage), inappropriate food contact surfaces and inadequate building/equipment sanitation.

3. As fresh intact melons and pre-cut melon products move through the food chain, there is also the potential for the introduction, growth and survival of food-borne pathogens due to cross-contamination (arising from poor hygiene practices for personnel, transport, retail outlets, utensils or consumers). Moreover, the morphological characteristics of certain types of melon, such as those with netted rind, will be prone to attachment by microbial pathogens. Fresh melons are consumed without further processing treatment that would eliminate or inactivate pathogens if present.

1. OBJECTIVE

4. Hygienic recommendations for the primary production of fresh fruits are covered in general under the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003). The primary purpose of this Annex is to provide specific guidance on how to minimize microbiological hazards during primary production through packing and transport of fresh melons, including fresh melons processed for the pre-cut market and consumer use.

2. SCOPE, USE AND DEFINITIONS

2.1 Scope

5. This Annex covers specific guidance related to all areas, from primary production to consumption, of fresh melons that are intended to be consumed without further microbiocidal steps.

2.2 Use

6. This Annex follows the format of the *General Principles of Food Hygiene* (CAC/RCP 1-1969) and should be used in conjunction with it and other applicable codes such as the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003) and Annex I, on Ready-to-Eat, Fresh, Pre-cut Fruits and Vegetables.

2.3 Definitions

Ground spot – The point of direct contact between a melon and the soil or thin plastic mulch.

Melons – Whole and/or pre-cut cantaloupe (also known as muskmelons and rockmelons), honeydew, watermelon and other varieties of melons.

3. PRIMARY PRODUCTION

7. Refer to Section 3 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003) in addition to the following:

3.1 Environmental hygiene

8. Growing melons in warm, humid conditions may favour the growth and survival of food-borne pathogens. Growers should take steps to minimize the potential for contamination from any sources identified.

3.2 Hygienic primary production of melons

9. Special consideration should be given to practices specific to melon production because of the unique characteristics of melons and of the rind of some melons, and because melons frequently come into direct contact with soil as they grow and develop. Melons may have smooth or netted rind surfaces; microbial pathogens more easily adhere to the latter, survive and become more difficult to eliminate during post-harvest practices. It is recommended that growers use production practices that prevent or minimize contact between melons, particularly those with netted rinds, and soil, soil amendments (including natural fertilizers) and irrigation water.

10. Some growers place melons on cups (i.e. small plastic pads) or plastic mulch-covered beds (wider and more elevated during the wet season), or halved bamboo segments to minimize direct melon-to-soil contact and thereby reduce ground spot development. Melons may also be hand-turned multiple times during the growing season by agricultural workers to prevent sunburn or ground-spot development, or covered with biodegradable materials such as rice straw to prevent sunburn. Melon rind ground spots have been demonstrated to have significantly greater microbial populations than other areas of the rind, and may therefore be more susceptible to microbial contamination. If cups or biodegradable materials are used underneath melons, the following provisions are recommended:

- Plastic mulch should be used under cups to minimize cup and melon contact with the soil.
- It should be ensured that cups are clean and sanitary before setting them under the melons.
- Agricultural workers should follow good hygienic practices when turning melons on the cups or during harvesting operations.
- Biodegradable materials should be used only once to prevent cross-contamination.

3.2.1.1.1 Water for irrigation

11. Netted melon rind surfaces, in contrast to smooth rind surfaces, may foster greater attachment and survival of food-borne pathogens. For this reason, the quality of irrigation water and type of irrigation method used are important considerations. Growers should take the following into consideration:

- Overhead irrigation methods should be avoided, particularly for netted rind melons, because wetting the outer rind of melons increases the risk of pathogen contamination.
- Subsurface or drip irrigation presents the least risk of contaminating melon surfaces. For drip irrigation, care should be taken to avoid creating pools of water on the soil surface or in furrows that may come into contact with melon rinds.

3.3 Handling, storage and transport

12. Melons are harvested based on their stage of maturity as judged by the formation of an abscission zone between the vine and the melon. After the vine is separated from the melon, a stem scar is left on the fruit. Stem scars may provide a route for the entry of food-borne pathogens, if present, into the edible portion of the melon. Post-harvest handling practices should be implemented to minimize stem scar and rind infiltration of foodborne pathogens into the edible portions of melon flesh, such as during washing operations. Where appropriate, written standard operating procedures (SOPs) should be developed and implemented for the safe handling, storage and transport of melons. The recommended length and temperature of storage of melons at should be determined depending on the stage of maturity of the melons at harvest.

3.3.1 Prevention of cross-contamination

13. Equipment should be duly cleaned and disinfected since knives, if improperly used, can wound melon rinds and provide a point of entry for contaminants from soil or water.

14. Melons should not be set directly on soil after removal from the vine and before loading into the transport vehicle so as to avoid contamination from the soil.

4. ESTABLISHMENT: DESIGN AND FACILITIES

15. Refer to Section 4 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003).

5. CONTROL OF OPERATION

16. Refer to Section 5 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003) in addition to the following:

5.1 Control of food hazards

17. If melons pass over or under brushes during the operations, care should be taken to ensure that any brushes used in the operation do not damage or cross-contaminate the melons. Brushes should be routinely inspected, cleaned and adjusted as necessary.

5.2.2.2 Chemical treatments

18. If regulations allow, fungicides may be applied to melons, by aqueous spray or immersion, to extend the post-harvest life of the fruit.

5.5.1 Post-harvest water use

19. Water is often used in dump tanks to transport melons from field containers to the packing or processing establishment. If the temperature of the water in the dump tank is cold and the internal temperature of the melons is hot from field heat, a temperature differential is created that may aid in the infiltration of microbial pathogens into the rind and/or the edible portion of the fruit.

20. The following should be considered when using post-harvest water:

- Water temperatures should be higher than the internal temperatures of melons so as to minimize the risk of water infiltration.
- The full submersion of melons in colder dump tank water should be minimized or avoided so as to reduce the likelihood of water infiltration.
- It is recommended that the time melons remain in dump tank water should be minimized.
- If hot water treatments are used as an alternative to post-harvest chemical fungicide treatments, it is recommended that the water temperature and treatment duration should be controlled, monitored and recorded.
- If biocides are added to the water, concentrations should be appropriate for the temperature used.

5.2.2.3 Cooling melons

21. Forced-air cooling can avoid the risk of cooling water infiltrating into the melon, but may also spread contamination if equipment is not cleaned and disinfected regularly.

22. Water used in hydro-coolers should be potable, and preferably used only once, not recirculated.

23. Cooling and cold-storing melons as soon as possible after harvest is recommended to prevent the multiplication of food-borne pathogens, if present, on or from the rind surface of melons.

5.2.2.5 Cutting, slicing and peeling melons

24. It is recommended that pre-cut melons should be wrapped/packaged and refrigerated as soon as possible and distributed under refrigeration temperatures (i.e. 5 °C or less).

5.2.4 Microbiological cross-contamination

25. Where dry dump stations are used for unloading field containers (e.g. bins, gondolas, trailers or wagons), melon contact surfaces (including padding materials to protect melons from physical damage) should be constructed of material that can be cleaned and disinfected.

26. Where wet dump stations are used for unloading field containers, containers that have been in direct contact with the soil should not be directly immersed into dump tanks so as to reduce the potential for product cross-contamination with field or road debris.

6. ESTABLISHMENT: MAINTENANCE AND SANITATION

27. Refer to Section 6 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003).

7. ESTABLISHMENT: PERSONAL HYGIENE

28. Refer to Section 7 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003).

8. TRANSPORTATION

29. Refer to Section 8 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003).

9. PRODUCT INFORMATION AND CONSUMER AWARENESS

30. Refer to Section 9 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003).

10. TRAINING

31. Refer to Section 10 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003).

ANNEX V

BERRIES

INTRODUCTION

1. Berry crops are geographically diverse and represent a wide range of phenotypically unique fruits. They diverse not only in the size, shape and colours of their fruits, but also horticulturally, from low-growing berries (e.g. strawberries) to small bushes (e.g. blackberries, blueberries, raspberries) and tall shrubs (e.g. blackcurrants, gooseberries). All are perennial but some are cultivated as annuals (e.g. strawberries). Most are cultivated, while some are collected from the wild (e.g. wild blueberries).

2. These fruits are relevant to international trade as consumption of fresh produce increases along with globalization and changes and/or optimization in production and distribution. There is increasing awareness among public health officials of the risk factors associated with berry consumption. Berries have been associated with several foodborne illness outbreaks caused by a broad range of etiological agents, from viruses (hepatitis A, norovirus), to bacteria (*Escherichia coli* O26, O157:H7) and protozoa (*Cyclospora cayetanensis*, *Cryptosporidium parvum*).

3. Most berries are conveniently marketed as ready-to-eat (RTE) fruits. The handling of berries during production and harvesting and the broad range of etiological agents that have been associated with berry consumption suggest that the safety of berries for raw consumption depends significantly on the maintenance of good hygienic practices (GHPs) throughout the food chain, up to the point of consumption.

1. OBJECTIVE

4. Hygienic recommendations for the primary production of fresh fruits are covered in general under the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003). The primary purpose of this Annex is to provide specific guidance to minimize microbiological hazards during primary production until packing and distribution of fresh berries and consumer use, including fresh RTE berries and those processed without a microbiocidal step (e.g. frozen RTE berries).

2. SCOPE, USE AND DEFINITIONS

2.1 Scope

5. This Annex covers specific guidance related to all areas, from primary production to consumption, of berries that are intended to be consumed raw (e.g. fresh berries) and/or are processed without a microbiocidal step.

6. This Annex encompasses all edible varieties of berries, including, but not limited to: strawberries (i.e. *Fragaria* L.), raspberries (i.e*. Rubus idaeus* L.), blackberries (i.e. *Rubus* spp.), mulberries (i.e. *Morus* L.), blueberries (i.e. *Vaccinium* spp.), currants and gooseberries (i.e. *Ribes* L.) and groundcherries (i.e. *Physalis peruviana* L.).

7. For wild berries, only the measures for handling and post-harvest activities (i.e. from Section 3.3 onwards) apply.

2.2 Use

8. This Annex follows the format of the *General Principles of Food Hygiene* (CAC/RCP 1-1969) and should be used in conjunction with it and other applicable codes such as the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003) and Annex I, on Ready-to-Eat, Fresh, Pre-cut Fruits and Vegetables.

2.3 Definitions

9. Refer to definitions in the *General Principles of Food Hygiene* and the *Code of Hygienic Practice for Fresh Fruits and Vegetables.*

3. PRIMARY PRODUCTION

10. Refer to Section 3 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003) in addition to the following:

3.1 Environmental hygiene

11. Wet berries are very susceptible to spoilage and often resemble overripe berries leaking juice. Growers should allow a drying period, if possible, before harvesting berries to reduce the risk of contamination with food-borne pathogens.

3.2 Hygienic primary production of berries

12. Berries are pulpy fruits with high moisture content and a soft skin, which makes them susceptible to physical damage that accelerates their deterioration by increasing water loss and provides conditions for contamination during production, harvest and transport. Physical damage to berries may occur during harvesting from the use of sharp-edged storage containers, improper field packing or through careless or poor handling. Rodents, insects and birds may also damage berries, leading to increased microbial spoilage and the potential transmission of food-borne pathogens. Growers should take measures to reduce the extent of damage to fruit during production.

13. Some berries frequently contact soil directly during growth and/or harvesting. Bird droppings and airborne contaminants (from birds nesting around the packing area, nearby livestock, poultry areas or manure storage or treatment facilities, etc.) may also pose a risk of contamination to berries. Growers should use production practices (e.g. site selection, wind breaks) to minimize the contact of berries with airborne contaminants and limit contact with the soil, animal droppings, soil amendments (including natural fertilizers) or direct contact with irrigation water.

14. Where materials are used under the berries during growing to minimize contact with the soil (e.g. mulch or biodegradable materials such as straw) or during harvest (e.g. plastic or biodegradable materials such as leaves or papers as liners of biodegradable baskets) to collect harvested fruits, it is recommended that:

- Plastic should be clean and sanitary.
- If biodegradable materials and/or mulch are used, they should be applied only once, not reused, so as to prevent cross-contamination.

3.2.1.1 Water for primary production

15. Clean or potable water should be used for berry production.

3.3 Handling, storage and transport

16. Some berries may have high respiration rates, making them more perishable. Enzymes and biochemical reactions play an important role in the ripening process but also accelerate spoilage of damaged fruits and increase susceptibility of berries to microbial contamination. Growers should implement safe handling, transport and storage practices and immediately cool berries after harvesting. Precooling berries (i.e. the removal of field heat) after harvesting could be important to maintaining freshness and quality and contribute to the control of food-borne pathogens. When required, growers should use potable water for ice and hydro-coolers when precooling to minimize risks of contamination.

17. Manual harvest considerations:

- Appearance and firmness of berries are commonly associated with fruit quality and freshness. Overhandling berries may damage them and affect fruit quality. Moreover, excessive temperatures during harvesting in hot and/or humid weather also decrease quality and may affect food safety due to fruit damage and juice leakage, which may spread contamination over wholesome fruits.
- Growers should designate a responsible person to supervise harvesting at all times to ensure that harvesters use proper hand-washing and follow procedures not to harvest wet, bruised and/or damaged fruits. Additionally, berries that have fallen on the ground should be discarded unless they are processed with a microbiocidal step.
- Growers should take measures to train agricultural workers on safe handling, transport and storage practices to ensure that berries are immediately cooled after harvesting.

3.3.1 Prevention of cross-contamination

18. Specific control methods should be implemented to minimize the risk of cross-contamination from micro-organisms associated with harvesting methods. The following should be considered:

- The extent of soil and extraneous matter debris on the fruit during and after harvesting may pose a risk of food-borne contamination. Growers should take measures to minimize the contamination by sorting and selecting berries.
- Poor hygienic practices among agricultural workers in the field can significantly increase the risk of contamination to berries. In order to prevent microbial cross-contamination of berries, growers should continuously reinforce the importance of good hygienic practices during pre-harvest, harvest and post-harvest activities.

3.3.3 Field packing

19. Preference should be given to field packing berries into consumer-ready containers that will not be washed after harvest (e.g. strawberries) so as to minimize the possibility of microbial contamination through additional handling steps.

4. ESTABLISHMENT: DESIGN AND FACILITIES

20. Refer to Section 4 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003) in addition to the following:

4.2.1 Design and layout

21. For products that are not immediately wrapped or packed (i.e. the berries are exposed to contaminants from the environment), the rooms in which final products are packaged and stored should be designed and maintained to be as dry as possible. The use of water or having a wet environment enhances the growth and spread of food-borne pathogens.

5. CONTROL OF OPERATION

22. Refer to Section 5 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003) in addition to:

5.1 Control of food hazards

23. Care should be taken to ensure that berries are not damaged and do not become cross-contaminated during transport and handling. Prior to packing, berries that are soiled, damaged or come in with debris (e.g. insects) should be inspected and culled.

5.2.4 Microbiological cross-contamination

24. Berries that have undergone cleaning and/or chemical treatment should be effectively separated, either physically or by time, from raw material and environmental contaminants.

25. Cross-contamination should be prevented between raw and washed berries, which will be frozen, and from sources such as wash water, rinse water, equipment, utensils and fomites.

26. Only workers who have been trained on hygienic handling should be assigned to pick and pack berries.

5.3 Incoming material requirements

27. Berries should be cooled and stored as soon as possible under temperature controls within the processes.

5.5.1 Post-harvest water use

28. Most berries intended for direct consumption are generally not washed after harvest.

6. ESTABLISHMENT: MAINTENANCE AND SANITATION

29. Refer to Section 6 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003).

7. ESTABLISHMENT: PERSONAL HYGIENE

30. Refer to Section 7 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003).

8. TRANSPORTATION

31. Refer to Section 8 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003) and to the *Code of Practice for the Packaging and Transport of Fresh Fruits and Vegetables* (CAC/RCP 44-1995).

9. PRODUCT INFORMATION AND CONSUMER AWARENESS

32. Refer to Section 9 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003).

10. TRAINING

33. Refer to Section 10 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003) in addition to the following:

10.2 Training programmes

34. Since producing berries for direct consumption is labour intensive, which increases the risk of contamination from manipulation, special attention should be given to properly training all personnel involved in the primary production, packing, processing and transport of berries intended for consumption without a microbiocidal step.

35. Growers should train personnel to ensure that only experienced pickers harvest berries that are intended for direct consumption.

36. In addition to those listed in the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003), specific personnel training programmes should cover safe handling, transport and storage practices and ensure that berries are immediately cooled after harvesting.

Appendix IV

CCFH FORWARD WORKPLAN

Ranking	Title of Work	Last Revision	Currency of Information (Yes/No)[1]	Positive impact of new work on public health (Yes/No)	Project document/ discussion paper (Yes/No)	Public Health Risk (20/14/8)	Trade Impact (10/5/4/ 2/0)	Comments	FAO/WHO assistance needed? (Yes/No)	Total
	Code of Hygienic Practice for Meat (CAC/RCP 58-2005)	2005	No	Yes	No	20	10			30
	Control of Shiga toxin-producing *E. coli*	N/A	Yes	Yes	No	20	10			30
	Code of Hygienic Practice for Milk and Milk Products (CAC/RCP 57-2004)	2009	No			14	10			24
	Code of Hygienic Practice for Eggs and Egg Products (CAC/RCP 15-1976)	2007	No			14	5			19
	Code of Hygienic Practice for Precooked and Cooked Foods in Mass Catering (CAC/RCP 39-1993)	1993	No			14	5			19
	Code of Hygienic Practice for the Transport of Food in Bulk and Semi-packed Food (CAC/RCP 47-2001)	2001	No			8	10			18

[1] 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? If there is an existing code in place and a determination is made that the code is sufficient, no new work should proceed.

Ranking	Title of Work	Last Revision	Currency of Information (Yes/No)[1]	Positive impact of new work on public health (Yes/No)	Project document/ discussion paper (Yes/No)	Public Health Risk (20/14/8)	Trade Impact (10/5/4/ 2/0)	Comments	FAO/WHO assistance needed? (Yes/No)	Total
	Code of Hygienic Practice for Low-acid and Acidified Low-acid Canned Foods (CAC/RCP 23-1979) *Code of Hygienic Practice for Aseptically Processed and Packaged Low-acid Foods* (CAC/RCP 40-1993) *Guideline Procedures for the Visual Inspection of Lots of Canned Foods for Unacceptable Defects* (CAC/GL 17-1993) *Code of Hygienic Practice for Canned Fruit and Vegetable Products* (CAC/RCP 2-1969)	1993 1993 1993 1969	No			8	10			18
	Code of Hygienic Practice for the Storage of Cereals	N/A	Yes	No	Yes	8	5			13
	Code of Hygienic Practice for Bottled/Packaged Drinking Waters (other than natural mineral waters)(CAC/RCP 48-2001)	2001	No			8	5			13
	Code of Hygienic Practice for Refrigerated Packaged Foods with Extended Shelf-life (CAC/RCP 46-1999)	1999	No			8	5			13