CODEX ALIMENTARIUS COMMISSION

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World Health Organization

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Agenda Item 7 **CX/FH 15/47/8**

JOINT FAO/WHO FOOD STANDARDS PROGRAMME

CODEX COMMITTEE ON FOOD HYGIENE

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DISCUSSION PAPER ON THE NEED TO REVISE THE CODE OF HYGIENIC PRACTICE FOR FRESH FRUITS AND VEGETABLES (CAC/RCP 53-2003)

Prepared by the Electronic Working Group led by Brazil and France

Background

1. The 45th Session of the Committee on Food Hygiene (CCFH45) started the discussion on the *Code of Hygienic Practice for Fresh Fruit and Vegetables* and its annexes (CAC/RCP 53-2003) in order to identify duplications, redundancies and provisions that could be missing.

2. The working document, CX/FH 13/45/9, presented to CCFH45, prioritised the comparison between the main Code and the Annexes for Fresh Leafy Vegetables, Melons and Berries. The comparison identified texts of the main Code that are repeated in the Annexes, texts repeated/identical in two or more annexes and some inconsistencies in section headings and numbering of the ANNEX II. The comparison with the Annexes for Ready-to-Eat Fresh Pre-Cut Fruits and Vegetables and for Sprout Production was not performed.

3. The working document, CX/FH 14/46/10, presented to CCFH46, contained a revised draft of the *Code of Hygienic Practice for Fresh Fruit and Vegetables* and its annexes with some changes, such as the inclusion of some definitions and references to other Codex documents, organization of the text in a more logical sequence, deletion of redundancies, merging paragraphs with the same subject and moving paragraphs from the annexes to the main document.

4.The Committee agreed to establish an electronic Working Group (eWG) led by Brazil and co-chaired by France and working in English and French only, to review the consolidated Code and identify any additional changes for consideration at its next session. It was understood that if substantial changes were to be made to the Code (e.g. additional sections and provisions), the eWG would also prepare a project document for new work.

5. Comments were received from Canada, Spain, Philippines, Thailand, United States, Japan, Mexico, Belgium, United Kingdom and India.

6. The complete list of participants is given in Appendix III to this discussion paper.

General Discussion

7. The draft text attached as Appendix II was a continuation of the work to remove redundancies and duplications between the main Code and its annexes. A version of the revised Code in track change mode and a table explaining the changes are available in English at ftp://ftp.fao.org/codex/meetings/ccfh/ccfh47/support_documents. During the eWG work the inclusions or modifications were also identified. Some of these were considered just "technical amendments", such as good manufacturing practices being replaced by Good Hygienic Practices.

8. There was a general agreement among the eWG members on the modifications made on the revised *Code of Hygienic Practice for Fresh Fruit and Vegetables* and its annexes. The revised text addressed editorial changes, deletion of redundancies, changing of paragraph order and some minor additions in the definitions and some specific provisions under environmental hygiene and cleaning programs. The scope was expanded to include provisions to the consumption stage. One member questioned whether the provisions in the document fully address the expanded scope (e.g. retail and foodservice).

9. Some eWG members asked to include some definitions such as greenhouse, flooding, hygiene, postharvest treatment, Standard Operating Practice (SOP). One eWG member was of the opinion that the definitions for greenhouse and flooding are not necessary, because they could be understood by common knowledge. Another member highlighted that the definition of Hygiene could be covered by the definition of "Food Hygiene" in the *General Principles of Food Hygiene* (CAC/RCP 1- 1969). Postharvest treatment was defined, because the term is very broad and the kind of treatment that applies to this document should be specified. There was also no consensus regarding the necessity to define SOP and ready-to-eat fruit and vegetables. One eWG member suggested the inclusion of the definition of Agricultural Chemical as no definition was provided, the definition was not included at this stage.

10. One eWG member suggested deleting the text "and from treatment applied to urban and industrial wastes (food industries or other types of industry)" in the biosolids definition because the member considers that biosolids result only from the treatment of sewage sludge and should not include industrial waste. The definition was retained but amended with the inclusion of "adequate sources of" urban and industrial wastes.

11. An eWG member also requested the deletion of "microorganism and/or microbial metabolites" from the definition of biological control. At this stage all the proposed definitions were kept to allow CCFH to decide on them, but in general, the inclusion of these definitions would also be considered "technical amendments".

12. The eWG discussed the most appropriate section to place many provisions. Many paragraphs were moved from the Annexes and placed in the Main Code or in Annex I. The provisions were slightly modified to become more flexible and general. Only provisions specific to the commodity were kept in the annexes. It was impossible to reach a consensus regarding all of these changes. This document reflects the opinion of the majority of the eWG members.

13. In the section on environmental hygiene it was stressed that monitoring animal activity in an open field could not be a realistic measure and it could also be difficult for small farmers. In order to address this concern the expression "as far as possible" was included in the text to allow more flexibility.

14. The issue that generated the most discussion was the quality of the water for the different uses and the meaning of suitable quality water. Some members have considered it very important to establish a parameter (or a list of parameters) in order to define what "clean water" is. WHO provides guidelines for the safe use of waste water, but a member considered that in developing countries for low and medium scale farmers it is not possible to adhere to WHO guidelines for safe water for irrigation and cleaning of fresh fruits and vegetables. Another member considers that the only way recycled water will not constitute a risk to the safety of fresh fruits and vegetables is to treat it with an antimicrobial. CCFH should decide the best way to address this issue, in this document or in a specific new work. This document just tried to keep the idea that the quality of the water is essential for the safety of fresh fruit and vegetables, but depending on the stage, operation and the intended use of the product, the quality of the water can vary.

15. The majority of the eWG members were of the opinion that it is necessary to obtain approval for new work, not only because the scope was expanded, but also due the text moved from the Annexes to the main Code and the several "technical amendments" that taken together could be sufficient to justify a new work proposal.

Recommendations

16. The CCFH is invited to consider:

- the necessity to start a new work to continue revising the Code (see Project Document attached at Appendix I);
- how to address the issue raised in the eWG regarding the parameters for clean water according to its use, and
- if the draft revised Code (Appendix II) could be circulated as a starting point for the revision.

Appendix I

PROJECT DOCUMENT

PROPOSAL FOR NEW WORK ON THE REVISION OF THE "*CODE OF HYGIENIC PRACTICE FOR FRESH FRUITS AND VEGETABLES* (CAC/RCP 53-2003)"

1. Purpose and Scope of the new work

The purpose of the proposed new work is to revise **"***CODE OF HYGIENIC PRACTICE FOR FRESH FRUITS AND VEGETABLES* (CAC/RCP 53-2003) and delete redundancies/duplication, revise the scope and make editorial changes, add definitions and specific provisions regarding hygiene in the environment and cleaning programs.

2. Relevance and timeliness

The *Code of Hygienic Practice for Fresh Fruit and Vegetables* was adopted by CAC in 2003. Since then, many Codes of Hygienic Practice for specific fruit and vegetables were adopted and added as Annexes to the Code. However, slightly different wording was used, text was sometimes duplicated and some of the provisions do not fit the scope of the main code. Continued outbreaks of foodborne illness attributed to fresh produce have led to the identification of new sources of contamination and additional control measures to minimize the potential for illness.

3. Main aspects to be covered

A number of changes will be considered. Some will be technical amendments, others will include new definitions. The objective and the scope need to be expanded to include provision throughout the food chain from "primary production to consumer" as well as to accommodate the inclusion of specific provisions from the Annexes.

4. Assessment against the criteria for the establishment of work priorities

The proposed work falls under the general criterion for establishment of work priorities, because the use of the Code will strengthen protection of consumers by ensuring food safety. This work also seeks to promote fair practices in food trade taking into account the identified needs of developing countries.

The proposed work is directed primarily at control of microbial hazards in fresh fruit and vegetables. Fresh fruits and vegetables are part of the basic diet worldwide, and therefore widely traded. Through updating the information and structure of the document, the revision of this Code aims to facilitate understanding of the guidance in matters of hygiene for fresh fruits and vegetables.

Other criteria applicable to general subjects for the establishment of work priorities of the Procedural Manual:

(a) Diversification of national legislations and apparent resultant or potential impediments to international trade - it is covered by the preceding paragraph.

(b) Scope of work and establishment of priorities between the various sections of the work- see above section on purpose and scope.

(c) Work already undertaken by other international organizations in this field and/or suggested by the relevant international intergovernmental body(ies) - no other similar work undertaken by other international organizations.

(d) Amenability of the subject of the proposal to standardization – it is amenable to standardization – the Code is already adopted, and the revisions will be simply to streamline the Code – there should be no problem with standardization.

(e) Consideration of the global magnitude of the problem or issue - it is covered by the preceding paragraph.

5. Relevance to Codex Strategic Goals[1]

The proposed work falls under 3 Codex Strategic Goals:

Strategic goal 1. *Establish international food standards that address current and emerging food issues*.

[1] ftp://ftp.fao.org/codex/Publications/StrategicFrame/Strategic_plan_2014_2019_EN.pdf

Strategic goal 2. *Ensure the application of risk analysis principles in the development of Codex standards*: this work will help in establishing of risk management options and strategies to prevent outbreaks from the consumption of fresh fruits and vegetables.

Strategic goal 4. *Implement effective and efficient work management system and practices*: reviewing and implementing the recommended practices from primary production to consumption can help the control of microbiological contamination in fresh fruits and vegetables.

6. Information on the relationship between the proposal and other existing Codex documents

The revised Code will build on the *General Principles of Food Hygiene* (CAC/RCP 1-1969), the *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 on "*Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003)".

7. Identification of any requirement for and availability of expert scientific advice

Additional scientific advice is not necessary at this moment.

8. Identification of any need for technical input to the standard from external bodies

There is no need for additional technical input from external bodies.

9. The proposed timeline for completion of the new work, including the starting date, proposed date for adoption at step 5 and the proposed date for the adoption by the Commission, the timeframe for developing a standard should not normally exceed 5 years.

2015 (November) - Consideration of the discussion paper and proposed new work at CCFH47.

2016 (July) - Approval of the work by the CAC39.

2016 (November) - Circulate for comments at Step 3, consideration of the draft proposed revision at CCFH48.

2017 (July) - Adoption at Step 5/8 by the CAC40.

Appendix II

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

INTRODUCTION

1. Scientific research over the last decades has shown that a diet rich in fruits and vegetables is protective against many cancers and lowers the occurrence of coronary heart disease. This recognition of the importance of routine consumption of fresh fruits and vegetables, together with a marked increase in the year-round availability of these products from a global market, has contributed to the substantial increase in their consumption over the past two decades. However, the recent increase in reports of food borne illness associated with fresh fruits and vegetables has raised concerns from public health agencies and consumers about the safety of these products.

1. OBJECTIVES OF THE CODE

2. This code addresses Good Agricultural Practices (GAPs) and Good Hygienic Practices (GHPs) that will 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 to allow uniform adoption by this sector rather than providing detailed recommendations for specific agricultural practices, operations or commodities. 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, in both developed and developing countries and also in areas where traditional farming is practiced. Therefore, the code is, of 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

3. This code of practice covers general hygienic practices for the primary production and packing of fresh fruits and vegetables cultivated for human consumption in order to produce a safe and wholesome product: particularly for those intended to be consumed raw. Specifically, this code is applicable to fresh fruits and vegetables grown in the open field 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 these relate to GAPs and GHPs.

4. 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, respectively, hygienic practice specific for these commodities.

5. The code excludes food products for which there is a specific Codex Alimentarius Code of Hygienic Practices.

2.2 Use

6. 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 Viruses in Food* (CAC/GL 79-2012), the *Code of Practice for Packaging and Transport of Fresh Fruits and Vegetables* (CAC/RCP 44-1995) and the *Code of Practice for the Processing and Handling of Quick Frozen Foods* (CAC/RCP 8-1976). Flexibility in application is an essential element of this code. Implementation of any hygienic practices is proportionate to the risk of foodborne illness or the characteristics of commodity.

7. The annexes provide additional information applicable to specific commodities.

2.3 Definitions

8. Definitions of general expressions are included in the *General Principles of Food Hygiene*. For the purpose of this code, the following terms have the definition stated:

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

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

11. Antimicrobial agents – any substance of natural, synthetic or semi-synthetic origin which at intended use concentrations kills or inhibits the growth of microorganisms but causes little or no host damage.

12. Biological control – the use of competing biologicals (such as insects, microorganism and/or microbial metabolites) for the control of mites, pests, plant pathogens and spoilage organisms.

13. Biosolids – Sludge and other residue deposits obtained from sewage treatment plants and from treatment applied to adequate sources of urban and industrial wastes (food industries or other types of industry).

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

15. Cull – removal of any product or part of product that is of inadequate quality, including physical damage (such as skin breaks or decay).

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

17. Farm – any premise or establishment in which fresh fruits and/or vegetables are grown and harvested.

18. Flooding - the flowing or overflowing of a field with water outside a grower's control. 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.

19. Grower – the person on the farm responsible for the management of the primary production of fresh fruits and vegetables.

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

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

22. Hazard – a biological, chemical or physical agent in, or condition of, food with the potential to cause an adverse health effect.

23. Hazardous material – any compound which, at reasonable use levels, has the potential to cause adverse health effects

24. Hydroponics – a general term for the production of plants without soil in a water medium.

25. Hygiene – Conditions or practices conducive to maintaining health and preventing disease, especially through cleanliness

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

27. Microorganisms – include yeasts, moulds, bacteria, viruses and parasites. When used as an adjective, the term "microbial" is used.

28. Packer – the person responsible for the management of postharvest processing and packing of fresh fruits and vegetables.

29. Packing or Packaging – the action of putting fresh fruits and vegetables in a package. This may take place in a field or in an establishment.

30. Packing establishment/Packaging establishment or Packhouse/Packing house – any establishment in which fresh fruits and vegetables receive postharvest treatment and are packaged.

31. Postharvest treatment – activities performed incidental to packing, such as washing, sorting, culling, grading and trimming.

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

33. Standard Operating Practice (SOP) - a detailed explanation of how a policy is to be implemented. The SOPs should contain full working instructions as well as information on applicability.

34. Types of water:

Clean water – water that does not compromise food safety in the circumstances of its use and, therefore, may have different microbiological criteria depending on the stage of production.

Potable water – water which meets the quality standards of drinking water such as described in the WHO Guidelines for Drinking Water Quality.

35. Ready-to-eat fruits and vegetables - fruit and vegetables that are edible without additional treatment or preparation to achieve food safety.

3. PRIMARY PRODUCTION

36. Fresh fruits and vegetables are grown and harvested under a wide range of climatic and diverse 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

37. 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.

38. 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 production site, measures should be implemented to minimize the contamination of the fresh fruits and vegetables primary production sites.

39. Where possible, growers should evaluate the previous uses of the sites (indoor and outdoor) as well as adjoining sites in order to identify potential microbial hazards. The potential for other types of contamination (e.g. from agricultural chemicals, hazardous wastes, etc.) should also be considered. The evaluation process should include the following:

• Previous and present usage of the primary production area and the adjoining sites (e.g. crop grown, feed lot, animal production, hazardous waste site, sewage treatment site, mining extraction site) to identify chemical and/or potential chemical and/or microbial hazards including faecal contamination and contamination by organic waste and potential environmental hazards that could be carried to the growing site.

• As far as possible, the access of wild and domestic animals to the site and to water sources used in primary production should be identified and minimized due to potential for faecal contamination of the soil and water, and the likelihood of contaminating the crop. As far as possible, domestic and wild animal should be excluded from the area. Wild animals represent a particularly difficult risk to manage because their presence is intermittent and hard to track. When appropriate, this may require 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). Fields should be monitored for animal activity (e.g. presence of tracks, faeces, crop damage from grazing, etc.), particularly near harvesting. If present, consideration should be given to the risks and whether affected crop areas should be harvested. Vehicles which may introduce faecal contamination to the production and handling areas include, but are not limited to, humans, contaminated water, insects, workers, or fomites such as dust, tools and equipment. Therefore efforts should be made to protect fresh produce growing areas from animals and vehicles.

• Potential for contaminating produce fields from leaking, leaching or overflowing manure storage sites, flooding from polluted surface waters, runoff from nearby fields and also from aerosols.

40. 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. Where the environmental assessment identifies a potential food safety risk, measures should be implemented to minimize contamination at the production site. When the risks are serious these production sites should not be used for fresh fruits and vegetables production.

41. 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 fruit and vegetable surfaces. 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 of contamination is greatest when heavy rains cause flooding and flood waters come in 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 the risk, they should not be used if they are to be eaten raw. This does not include flood irrigation, where the source of water is of known and appropriate quality.

3.1.1 Location of the Production Site

42. Consideration of land location should include evaluating the slope, potential for runoff, flood risk, as well as hydrological features of the nearby sites in relation to the primary production site.

43. 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 fresh fruits and vegetables production fields or the water sources used with microbial or other environmental hazards via, for example, run-off, faecal material, aerosols or organic waste.

44. Growers should take measures to mitigate the risks associated with runoff and flooding, e.g. mapping the production field, terracing, construction of a shallow ditch to prevent runoff from entering the fields, etc.

45. In the case of aerosols, the use of an effective wind-break (natural e.g. trees or constructed) or use of a protective covering are examples of measures that can be used to reduce pathogen and chemical contamination of the primary production site.

3.1.2 Wild and domestic animals and human activity

46. Humans and many wild and domestic animal species that may be present in the primary production environment are known to be potential carriers of foodborne pathogens. When the environmental hygiene step (Section 3.1) evaluates that the risks are serious and these activities can present a risk from direct contamination of the crop and soil as well as indirectly via contamination of surface water sources and other inputs, the following should be considered:

- Appropriate biological, cultivation, physical and chemical pest control methods should be used in order to exclude domestic and wild animals from the primary production and handling areas, to the extent practicable. Methods selected should comply with local, regional, and national environmental protection regulations.

- Primary production and handling areas should be properly maintained to reduce the likelihood of vector attraction. Activities to consider include efforts to minimize standing water in fields, restrict animal access to water sources (may be based on local ordinances for public irrigation systems), and keep production sites and handling areas free of waste and clutter.

- Fresh fruits and vegetables 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, or decomposing remains). Where such evidence exists, growers should evaluate the risks and whether or not the affected area of the production site should be harvested for direct consumption.

3.2 Hygienic primary production of fresh fruits and vegetables

3.2.1 Agricultural input requirements

47. Agricultural inputs should not contain microbial, physical or chemical 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 taking 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

48. An appropriate and adequate supply of water of a suitable quality for use in different operations in the primary production of fresh fruits and vegetables should be available. 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.

49. The quality of water may vary. Several parameters may influence the risk of microbial contamination: the type of irrigation (drip, sprinkler irrigation, etc.), 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 pathogenic organisms in the irrigation water. Water for primary production, including for irrigation, frost protection, protection against sun scald, etc., that has substantial contact with the edible portion of fresh fruits and vegetables should not compromise their safety. When these risks are serious, the following should be considered:

• Growers should identify the sources of water used on the farm (e.g. municipality, re-used irrigation water, reclaimed wastewater, discharge water from aquaculture, well, open canal, reservoir, rivers, lakes, farm ponds). Examples of water sources that present the lowest risk of contamination are:

- Water in deep wells, provided they are maintained, monitored and capped,
- Water in shallow wells provided they are not influenced by surface waters and are maintained, monitored and capped.
- Rain water, provided the integrity of the water capture and distribution system is maintained,

Water sources that pose a higher risk of contamination may need further treatment such as:

- Reclaimed or wastewater: Before using reclaimed or wastewater for crop irrigation, consult with an expert 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 WHO guidelines[2] for safe use of wastewater, excreta and grey water for irrigation of vegetables marketed to consumers as fresh, fresh-cut, pre-cut or ready-to-eat.
- Surface water: 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 considered for use, and its suitability for intended use, and identify corrective actions to prevent or minimize contamination (e.g. from livestock, sewage treatment, human habitation, manure and composting operations or other environmental intermittent or temporary contamination such as heavy rain or flooding).

• Where necessary, growers should have the water they use tested for microbial and chemical contaminants, according with the risk associated with the production. The frequency of testing will depend on the water source (e.g. less for adequately maintained deep wells, more for surface waters) and the risks of environmental contamination including intermittent or temporary contamination (e.g. heavy rain, flooding).

• 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 should 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 needed, water safety experts in order to determine and document the following:

• What tests need to be performed, (e.g. which pathogens and/or sanitary indicators)

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[2] Guidelines for the safe use of wastewater, excreta and greywater (4 volumes) http://www.who.int/water_sanitation_health/wastewater/gsuww/en/

• Which parameters should be noted (e.g. temperature of water sample, water source location, and/or weather description),

• How often tests should be conducted,

• What the test outcomes indicate, and

• How tests will be used to define corrective actions.

50. If the water source is found to have unacceptable levels of indicator organisms or is contaminated with foodborne 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 fencing to prevent large animal contact, proper maintenance of wells, filtering water, not stirring the sediment when drawing water, building settling or holding ponds, and water treatment facilities. Verify whether the corrective actions are effective by performing regular testing

3.2.1.1.1 Water for irrigation and harvesting

51. 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 for 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 this method can still experience localized problems. 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 the edible portion of the crop.

Water used for agricultural purposes should be of suitable quality for its intended use. Special attention to water quality should be considered for 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 which can trap water.

• Irrigation of fruits and vegetables that will receive little or no postharvest wash treatments prior to packing, such as field-packed produce.

Additionally, growers should:

• Evaluate the water distribution system to determine if a contamination source is evident and can be eliminated.

• Establish no-harvest zones if irrigation source water is known to 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

52. 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

53. 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 survival or growth of pathogens.

54. Thus, it is especially critical in hydroponic operations to maintain the water quality to reduce the risk of contamination and survival of pathogens. Because of this:

• Water used in hydroponic culture should be changed frequently, or if recycled, should be treated to minimize microbial and chemical contamination.

• Water delivery systems should be maintained and cleaned, as appropriate, to prevent microbial contamination of water.

3.2.1.1.4 Water for other agricultural uses

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

3.2.1.2 Manure, biosolids and other natural fertilizers

56. 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.

57. Pathogens may be present in manure, biosolids and other natural fertilizers and may persist for weeks or even months, particularly if treatment of these materials is inadequate. Manure, biosolids and other natural fertilizers contaminated with heavy metals or other 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 considered:

- Adopt proper physical, chemical or biological treatment methods (e.g. composting, pasteurization, heat drying, UV irradiation, alkali digestion, sun drying or combinations of these) 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 foodborne pathogens in manure. In general, only fully composted animal waste or plant material should be applied to production fields.
- 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 determine the length of time needed to inactivate pathogens that may be present.
- 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 using a time between application and harvest of fresh fruits and vegetables that will reduce pathogens remaining in the amended soil to levels that are unlikely to result in contamination of the product.
- 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 the results thereof.
- Growers should not use biosolids and other natural fertilizers close to harvest unless properly composted or used in a manner not reasonably likely to contact the edible portion.
- Minimize contamination by manure, biosolids and other natural fertilizers from adjoining fields. If the potential for contamination from the adjoining fields is identified, preventative actions (e.g. care during application and run-off controls) should be implemented to minimize the risk.
- Avoid locating treatment or storage sites in proximity to fresh fruit and vegetable production areas.
- Prevent cross-contamination from runoff or leaching by securing areas where manure, biosolids and other natural fertilizers are treated and stored.

3.2.1.3 Soil

58. Soils should be evaluated for hazards. If the evaluation concludes that such hazards are at levels that may compromise the safety of crops, control measures 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.

3.2.1.4 Agricultural chemicals

59. Growers should use only agricultural chemicals which are authorized for the cultivation of the specific fruit or vegetable and should use them according to the manufacturer’s instructions for the intended purpose.

Residues should not exceed levels as established by the Codex Alimentarius Commission. In order to minimize and contain the emergence of microbial resistance:

- The use of antimicrobial agents significant to human and animal therapy should be avoided.
- Antimicrobial agents not significant to human and animal therapy should be used only when unavoidable and in accordance with good agricultural practices and in a manner that achieves this objective.

60. Agricultural workers who apply agricultural chemicals should be trained in proper application procedures.

61. Growers should keep records of agricultural chemical applications. Records should include information on the date of application, the chemical used, the crop sprayed, the pest or disease against which it was used, the concentration, method and frequency of application, and 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.

62. 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 and to protect employees involved in this activity from potential hazards.

63. 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.

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

65. 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

66. Environmental and 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.

67. Growers should use only biological controls which are authorized for the cultivation of the specific fruit or vegetable and should use them according to the manufacturer's instructions for the intended purpose.

3.2.2 Indoor facilities associated with growing and harvesting

68. For operations where fresh fruits and vegetables are grown indoors (greenhouses, hydroponic culture, etc.) suitable premises should be used.

69. Some protective agricultural structures are located in the field (hoop houses, high tunnels, etc.) Factors that influence the magnitude and frequency of the transfer of pathogenic microorganisms in the field, such as the climate, weather, topology, hydrology and other geographic characteristics in or nearby the field may pose a similar risk for these protective structures. The methods for adequate maintenance of the environment around the structures include, but are not limited to:

- Properly storing equipment, removing litter and waste, and cutting weeds or grass within the immediate vicinity of the buildings or structures that may constitute an attractant, breeding place, or harborage for pests.
- Adequately draining areas that may contribute contamination to food by
    - providing a breeding place for pests
    - runoff, leakage, or pooled/settled water flowing into food growing areas,
    - transfer of contaminants via equipment or foot traffic
- The land nearby certain protective structures (high tunnel, hoop house, etc.) should not be a significant source of contamination. Appropriate measures should be taken to minimize any relative risks from surrounding land use or environment.

3.2.2.1 Location, design and layout

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

71. 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

72. Refer to 3.2.1.1.1 (Water for Irrigation) 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 potable and clean water supplies by exposure to agricultural inputs used for growing fresh produce.
- Clean and disinfect potable and clean water storage facilities on a regular basis.
- Control the quality of the water supply.

3.2.2.3 Drainage and waste disposal

73. Adequate drainage and waste disposal systems and facilities should be provided. These systems should be designed and constructed so that the potential for contamination of fresh fruits and vegetables, agricultural inputs or the potable water supply is avoided

74. 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 harborage 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

75. Hygiene and health requirements should be followed to ensure that personnel who come directly into 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.

76. Personal hygiene is critical to produce ready-to-eat fruits and vegetables with manual harvesting due to the amount of human handling that could lead to contamination of fresh fruits and vegetables. Whenever possible, harvesting, packing and inspection processes should be designed to reduce handling.

77. Hand washing is especially important for those agricultural workers who handle ready-to-eat fruits and vegetables. They should properly use soap and clean running water to wash their hands and dry them before handling fresh fruits and vegetables or food contact surfaces, particularly during harvesting and postharvest handling.

78. If gloves are used, a procedure for glove use in the field should be documented and followed. 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.

79. Where appropriate, each business operating primary production should have written Standard Operating Procedures (SOPs) that relate 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.

80. The entrance of non-essential persons, casual visitors and, to the extent possible, children, should be controlled in the harvest area as they may present an increased risk of contamination.

3.2.3.1 Personnel hygiene and sanitary facilities

81. Hygienic and sanitary facilities should be available to ensure that an appropriate degree of personal hygiene can be maintained. As far as possible, the hygienic and sanitary facilities should:

- Be located in close proximity to the fields and indoor premises in a manner to encourage their use and reduce the likelihood that agricultural workers will relieve themselves in the field, and in sufficient number to accommodate personnel (e.g. 1 per 10 people) and be appropriate for both genders if the workforce contains males and females.
- Be of appropriate design to ensure hygienic removal of wastes and avoid contamination of growing sites, fresh fruits and vegetables or agricultural inputs.
- Have adequate means of hygienically washing and drying hands.
- Be maintained under sanitary conditions and 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.
- If clean running water is not available, an acceptable alternative hand washing method should be recommended by the relevant competent authority
- Portable facilities should 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.
- Growers should consider providing areas away from the field and packing lines for agricultural workers to take breaks and eat. For worker convenience, these areas should provide access to toilet and hand-washing facilities so that agricultural workers can practice proper hygiene.

3.2.3.2 Health status

82. People known, or suspected, to be suffering from, or to be a carrier of a disease or illness likely to be transmitted through fresh fruits and vegetables, should not be allowed to enter any food handling area if there is a likelihood of their contaminating fresh fruits and vegetables. Any person so affected should immediately report illness or symptoms of illness to the management.

83. The following should be considered:

- Growers should be encouraged to recognize symptoms of diarrheal or food-transmissible communicable diseases, and reassign agricultural workers as appropriate.
- Agricultural workers should be encouraged and, where feasible, be motivated with appropriate incentives to 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

84. 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. Workers should wear clean clothes. Cuts and wounds should be covered by suitable waterproof dressings when personnel are permitted to continue working. When personnel are permitted to continue working with hand cuts and hand wounds 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, otherwise they should be reassigned to another working area where they do not handle fresh fruits and vegetables or food contact surfaces directly.

85. 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

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

87. Personal effects such as jewellery, watches, or other items (e.g. purses, backpacks, clothes, etc) 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

88. Growers and harvesters should follow the technical specifications recommended by the equipment manufacturers for their proper usage and maintenance. 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). Standard operating practices should be developed for the maintenance, cleaning and disinfecting operations of growing and harvesting equipment. In addition:

- Equipment and tools should function according to the use for which they are designed without damaging the produce.
- Proper cleaning and sanitation of equipment is important for manual and mechanical harvesting, since knives and other equipment used can damage fruits and vegetables, lead to cross contamination, and provide entry for contaminants that may be in soil and water.
- Equipment and containers coming into contact with fresh fruits and vegetables should be made of materials that are non-toxic. 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. Specific hygienic and maintenance requirements should be identified for each piece of equipment that is used and the type of fruit or vegetable associated with it.
- Policies should be established for the control of equipment when it is not in use, including policies for the removal of equipment from the work area or site and for the use of scabbards, sheathes or other storage equipment.
- Containers by-products (including liners of containers made from biodegradable materials) that are no longer cleanable should be disposed of since they may increase the risk of microbial contamination.
- If the containers are stored outside, they 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. such as from pests, birds, rodents, dust, water, etc.).
- Damaged containers or transport trailers should be repaired or replaced.
- Maintain sharpness and condition of knives and cutting edges to maintain product quality and safety.

3.3 Handling, storage and transport

3.3.1 Prevention of cross-contamination

89. During the primary production and postharvest activities, effective measures should be taken to prevent cross-contamination of fresh fruits and vegetables from agricultural inputs or personnel who come directly or indirectly into contact with fresh fruits and vegetables. To prevent the potential of cross-contaminating fresh fruits and vegetables, growers, harvesters and their employees should adhere to the recommendations presented elsewhere in section 3 of this code and the following:

- 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.
- Care must be taken when packing fresh fruits and vegetables in the field to avoid contaminating containers or bins by exposure to, manure or animal/human faeces.
- Over-filling of totes and bins should be avoided to prevent 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.

- Avoid setting harvested fresh fruits and vegetables directly on soil after harvest and before loading into transport vehicle to avoid contamination.
- Containers used repeatedly during harvest should be cleaned after each load.
- Harvesting containers that come into direct contact with fresh fruit and vegetables should not be utilized for purposes other than holding product (e.g. should not hold personal items, lunch, tools, fuel, waste, etc.).
- If 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 to avoid it from 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 methods vary depending upon the characteristics of the product. Specific control measures should be implemented to minimize the risk of contamination from microorganisms associated with the method of harvesting.
- Mechanical harvest is a common practice for some fresh fruits and vegetables and may create food safety hazards if the equipment breaks down during the harvest, if it has received poor maintenance and cleaning or if it damages the harvested plant.
- Growers should avoid moving harvesting equipment across fields where manure or compost was applied.
- 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 container and directly or indirectly contaminating product in the other container.

3.3.2 Storage and transport from the field to the packing facility

90. Refer to the *Code of Hygienic Practice for the Transport of Food in Bulk and Semi-Packed Food* (CAC/RCP 47-2001).

91. 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 SOP for shipping containers/trailers to assure that they are clean, sanitary and in good structural condition.
- Storage facilities and vehicles for transporting the harvested crops should be built in a manner to minimize damage to fresh fruits and vegetables and to avoid access by pests. They should be made of non-toxic materials that permit easy and thorough cleaning. They should be constructed in a manner to reduce the opportunity for potential contamination from physical objects such as glass, wood, plastic, etc.
- 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 crop during this process.
- Fresh fruits and vegetables should not be transported in vehicles used previously to carry animal manure or biosolids and pesticides unless they are adequately cleaned and disinfected. Receptacles in vehicles and/or containers, when being used to transport fresh fruits and vegetables, are not to be used for transporting anything which may result in 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, there should, be effective separation of products.

• Cover product to maintain integrity of the load as needed.

3.4 CLEANING, MAINTENANCE AND SANITATION

92. 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 and kept or stored separately in secure storage facilities. Cleaning materials should be used according to manufacturer's instructions for their intended purpose.

3.4.1 Cleaning programmes

93. 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 should be regularly reviewed and adapted to reflect changing circumstances. Specific recommendations are as follows:

• Harvesting equipment, such as knives, pruners, and machetes, that come into direct contact with fresh fruits and vegetables should be cleaned and disinfected at least daily or as the situation warrants.

• Clean water should be used to clean all equipment directly contacting fresh fruits and vegetables, including farm machinery, harvesting and transportation equipment, containers and knives.

• Some cleaning chemicals are considered food or processing aids and should not exceed levels as established by the Codex Alimentarius Commission.

3.4.2 Cleaning procedures and methods

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

• Cleaning procedures should include the removal of debris from equipment surfaces, 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 sanitizing procedures should be verified to ensure their effectiveness.

• Cleaning chemicals should be handled and used carefully and in accordance with manufacturers' instructions.

3.4.3 Pest control systems

95. When primary production is carried out in indoor establishments (e.g. greenhouses), the recommendations of the General Principles of Food Hygiene, section 6.3 should be followed with respect to pest control.

96. When fresh fruit and vegetable packing and/or processing establishments are not used during the year, measures should be taken to minimize pest infestations or to correct pest infestations and their risk of contamination prior to use.

3.4.4 Waste management

97. Suitable provision must be made for the storage and removal of waste. Waste must 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. PACKING ESTABLISHMENT: DESIGN AND FACILITIES

98. Refer 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.

99. Packing activities can occur in the field or in facilities. Field pack operations should implement the same sanitary practices where practical or be modified as needed to minimize risks.

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

4.1 Premises and rooms

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

4.1.1 Design and layout

102. Refer to the *General Principles of Food Hygiene*.

103. 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 between equipment and utensils used in each operation.

4.2 Facilities

4.2.1 Drainage and waste disposal

104. Adequate drainage is critical to packing, cooling and processing facilities to avoid the risk of contaminating fresh fruits and vegetables. To ensure adequate drainage of standing water, consider the following:

- 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 build-up of biofilms that may contain organisms of concern (e.g. *Listeria monocytogenes*).
- Areas for garbage recyclables and compostable waste should be identified and all waste should be stored and disposed of in a manner to minimize contamination.
- Waste should be disposed of on a frequent basis to avoid attracting pests (e.g. flies, rodents).

4.2.2. Internal structures and fittings

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

4.3 Equipment

106. Care should be taken to ensure that equipment used in handling fruits and vegetables do not damage the fruit or vegetable and can be cleaned and disinfected such that it does not serve as a source of contamination

5. CONTROL OF OPERATION

5.1 Control of food hazards

107. Refer to the *General Principles of Food Hygiene*.

108. Prevention of contamination is a key control point for all fresh fruits and vegetables operations.

5.2 Key aspects of hygiene control systems

5.2.1 Time and temperature control

109. Refer to the General Principles of Food Hygiene.

5.2.2 Specific process steps

5.2.2.1 Receipt and inspection of raw materials

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

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

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

5.2.2.

2 Postharvest water use

113. 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 be dependent 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 and force pathogens into plant cells.
- It is recommended that the quality of the water used in packing establishments be controlled and monitored, i.e. recording testing for indicator organisms and/or foodborne pathogens.
- If water is used in pre-washing and washing tanks, additional controls (e.g. changing water whenever necessary and controlling of product throughput capacity) should be adopted.
- Postharvest systems that use water should be designed in a manner to minimize places where product lodges and dirt builds up.
- Antimicrobial agents should be used where necessary to minimize cross-contamination during postharvest and where their use is in line with good hygienic practices. The antimicrobial agents levels should be monitored and controlled to ensure that they are maintained at effective concentrations. Application of antimicrobial agents, followed by a rinse as necessary, should be done to ensure that chemical residues do not exceed levels as recommended by the Codex Alimentarius Commission.
- Where appropriate, the temperature, as well as additional factors of postharvest water (e.g. the pH, turbidity, and water hardness) that may impact the efficacy of the antimicrobial treatments, 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 and controlled. For example the following may be used to maintain the suitability of the water: primary screening, secondary filtration, and antimicrobial 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. Ice should be produced, handled and stored to protect it from contamination.

5.2.2.3 Chemical treatments

114. Packers should only use chemicals for postharvest treatments (e.g. sanitizers, antimicrobial treatments, waxes and fungicides) in accordance with the *General Standard for Food Additives* (CODEX STAN 192-1995) or according to the Good Agricultural Practices. These treatments should be carried out in accordance with the manufacturer's instructions for the intended purpose.

115. Sprayers for postharvest treatments should be calibrated regularly to control the accuracy of the rate of application. They should be thoroughly washed in safe areas when used with different chemicals and on different fruits or vegetables to avoid contaminating the produce.

5.2.2.4 Cooling of fresh fruits and vegetables

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

117. 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 these systems should be controlled and maintained.

118. 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, e.g. cleaned and disinfected regularly, to avoid contaminating fresh produce.

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

120. Cooling equipment should be cleaned and sanitized on a regular basis according to written procedures to ensure that the potential for cross contamination is minimized.

5.2.2.5 Cold storage

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

5.2.2.6 Cutting, slicing, peeling, shredding and similar pre-cut processes

122. Refer to The *Annex for 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.

5.2.3 Microbiological and other specifications

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

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

5.2.4 Microbial, Physical and Chemical contamination

125. Refer to the General Principles of Food Hygiene.

126. The traffic pattern of employees should prevent cross-contamination of fruits and vegetables. For example: the employees should avoid going back and forth to various areas of production. The employees should not go from a potentially contaminated area to the packaging area unless they have washed their hands, changed to clean protective clothing and wash or change shoes.

5.3 Incoming material requirements

127. Refer to the general principles of food hygiene. The following are recommended:

- Avoid using products that have visible signs of decay or damaged structure (e.g. mechanical damage or cracking rinds, wilted leaves etc) due to the increased risk for microbial contamination.
- Damaged or decayed fruits and vegetables should be discarded in a manner that does not serve to attract pests.

5.4 Packing

128. Refer to the *General Principles of Food Hygiene*.

5.5 Water used in the packing establishment

129. Refer to the *General Principles of Food Hygiene.*

5.6 Management and supervision

130. Refer to the *General Principles of Food Hygiene*.

5.7 Documentation and records

131. Where appropriate, records of processing, production and distribution should be kept long enough to facilitate a recall and food borne illness investigation, if required. This period could be much longer than the shelf life of fresh fruits and vegetables. Documentation can enhance the credibility and effectiveness of the food safety control system.

- Growers should keep current 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, water quality data, pest control and cleaning schedules for indoor establishments, premises, facilities, equipment and containers.

• Packers should keep current all information concerning each lot such as information on incoming materials (e.g. information from growers, lot numbers), data on the quality of processing water, pest control programmes, cooling and storage temperatures, chemicals used in postharvest treatments, and cleaning schedules for premises, facilities, equipment and containers, etc.

132. 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. The description should include, but is not limited to, the following: an evaluation of the production site, water and distribution system, use of sprays, manure use and composting procedures, animal monitoring, personnel illness reporting policy, sanitation procedures and training programs.

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

- Supplier records
- Pest control records
- Cleaning and disinfection reports
- Equipment monitoring and maintenance records
- Water monitoring and test results
- Product processing records
- Storage room temperature levels
- Microbiological test results and, where possible, trend analyses
- Employee training records
- Distribution records
- Inspection/audit records

5.8 RECALL PROCEDURES

134. 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 the products, where necessary.

135. Records should be kept long enough to facilitate recalls and foodborne illness investigations, if required. This period will likely be much longer than the shelf life of the product.

136. In the event of a foodborne 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.

137. Detailed records should be kept that link each supplier of the product with the immediate subsequent recipient of each product throughout the food chain. The information needed to link each supplier should include, if available, the packer name, address, and phone number, date packed, date released, type of product (e.g. fruit or vegetable name and/or variety name, etc.) including brand name, lot identification and number of lots, and transporter.

138. Operators such as growers and producers and, in cases where contract harvesters are used, harvesters should keep current all relevant information on agricultural activities such as information concerning each lot, sprays used, date harvested, grower contact information, harvest practices, if water used in harvesting, water quality.

6. PACKING ESTABLISHMENT: MAINTENANCE AND SANITATION

6.1 Maintenance and Cleaning

6.1.1 General

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

6.1.2 Cleaning procedures and methods

140. Written SOPs should be developed and implemented for the cleaning and disinfection of equipment used for postharvest treatment.

6.2 Pest control systems

141. Fresh fruits and vegetable can be extremely attractive to flies and other insects that may cross-contaminate the products. It is recommended that an aggressive product cull disposal and waste removal program be implemented to reduce the potential for attracting insects and other pests. Pest control systems should be implemented to ensure that pest harborage and access is minimized in the establishment to the extent practical, and that pests are not permitted to become a source of contamination of fresh fruits and vegetables or food contact surfaces.

7. PACKING ESTABLISHMENT: PERSONAL HYGIENE

142. Refer to the General Principles of Food Hygiene.

8. TRANSPORTATION

143. Refer to the *General Principles of Food Hygiene* and to the *Code of Hygienic Practice for the Transport of Food in Bulk and Semi-Packed Food* and the *Code of Practice for the Packaging and Transport of Fresh Fruits and Vegetables* (CAC/RCP44-1995).

9. PRODUCT INFORMATION AND CONSUMER AWARENESS

144. Refer to the *General Principles of Food Hygiene*.

9.1 LABELLING

145. Refer to the *General Standard for the Labelling of Pre-packaged Foods* (CODEX STAN 1-1985). In addition, the following should be considered:

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

9.2 CONSUMER EDUCATION

147. 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 to minimize microbiological contamination.
- Transporting to home of RTE processed produce. Increase in product temperature during transportation can be considerable. Time in transit for fresh fruits and vegetables between retail/markets and the home should be kept as short as possible
- Storage/ refrigeration of fresh fruits and vegetables. Products should preferably be stored in a cool environment. Some prepackaged products should be refrigerated as soon as possible.
- Once removed from the refrigerator, processed prepackaged products should be consumed as soon as possible. This is a quality issue, not a food safety issue for produce unless the produce is processed pre-packaged produce (ready-to-eat).
- Cross-contamination. Consumers need to handle, prepare, and store produce safely to avoid cross-contamination with foodborne pathogens from various sources (e.g. hands, sinks, cutting boards, utensils, raw meats).
- The need to wash with potable water and/or peel fresh fruits and vegetables before consuming.
- Products labelled washed and ready-to-eat (e.g. pre-cut) should be refrigerated as soon as possible and should not be rewashed due to the potential for contamination.

10. TRAINING

148. Refer to the *General Principles of Food Hygiene* except for section 10.1 and 10.2.

10.1 Awareness and responsibilities

149. Education and training should be a priority for all personnel. The producer should have a written training programme 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 fruit and vegetables.

150. Personnel associated with growing and harvesting should be aware of GAPs, good hygienic practices 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.

151. 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.

152. 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

153. 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 a language and manner to facilitate understanding of what is expected of them and why, and should emphasize the importance of using hygienic practices.

154. A well-designed training program considers the barriers to learning of the trainees and develops training methods and materials to overcome those barriers. Factors to take into account in assessing the level of training required in growing, harvesting and packing activities include:

- Longstanding entrenched trainee behaviours, attitudes or personal beliefs
- Transient nature of workforce with no prior training in food safety and hygiene
- Concerns about children/infants who 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
- 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 encourage them to act upon it (taking personal responsibility for health)
- The nature of the fruit or vegetable, in particular its ability to sustain growth of pathogenic microorganisms.
- The agricultural techniques and the agricultural 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 hazards and controls associated with those tasks.
- 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.
- The extent and nature of processing or further preparation by the consumer before final consumption.

155. Topics to be considered for training programmes include, but are not limited to, 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 the importance of proper hand washing techniques.
- The importance of using sanitary facilities to reduce the potential for contaminating fields, produce, other workers, and water supplies. Training could include, for example, toilet use, 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 measures to mitigate the risks.

• The importance of sorting out fresh fruits and vegetables with visible defects, such as broken skin, decay, mould, soiled and insect and/or bird damage.

• The importance of proper product handling techniques to minimize or prevent damage to the fruit and microbial contamination.

• Techniques for hygienic handling and storage of fresh fruits and vegetables by transporters, distributors, storage handlers and consumer.

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

157. 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.

ANNEX I

ANNEX FOR FRESH CUT AND PRE-CUT READY-TO-EAT FRUITS AND VEGETABLES

INTRODUCTION

1. The health benefits associated with fresh fruits and vegetables combined with the on–going consumer interest in the availability of a variety of ready-to-eat foods have contributed to a substantial increase in the popularity of pre-cut fruits and vegetables. Because of 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.* Some of these pathogens are associated with the agricultural environment, whereas others are associated with infected workers or contaminated water. Because of the ability for pathogens to survive and grow on fresh produce, it is important for the pre-cut industry to follow good hygienic practices 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 receipt of raw materials to distribution of finished products.

4. The primary objective of this Annex is to identify GHPs that will help control microbiological, physical, and chemical hazards associated with the processing of fresh pre-cut fruits and vegetables. Particular attention is given to minimizing microbiological hazards. This Annex provides elements that should be taken into account in the production, processing and distribution of these foods.

2.1 Scope

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

6. For some establishments that process fresh pre-cut fruit and vegetables, this Annex will cover all operations from receipt of raw material to the distribution of the final product. For other establishments, (e.g. those that use ready-to-eat pre-cut fresh fruit and vegetables in combination with other products, such

as sauces, meat, cheese, etc.) only the specific sections that relate to the processing of the fresh pre-cut fruit and vegetable components will apply.

7. This Annex does not directly apply to fresh fruit and vegetables that have been trimmed leaving the food intact. Nor does it apply to other fresh fruit and vegetables that are pre-cut but are destined for 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 the Annex could still 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 and addresses physical and chemical hazards only in so far as these 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*

2.3 Definitions

10. *Processor* – the person responsible for the management of the activities associated with the production of ready-to-eat fresh pre-cut fruits and vegetables.

3. Primary production

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

4. Establishment: design and facilities

12. Refer to the *General Principles of Food Hygiene*. In addition:

4.4 Facilities

4.4.2 Drainage and waste disposal

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

5. CONTROL OF OPERATION

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

5.1 CONTROL OF FOOD HAZARDS

15. While processing may reduce the level of contamination initially present on the raw materials, it will not be able to guarantee elimination of such contamination. Consequently, the processor should ensure that steps are taken by their suppliers (growers, harvesters, packers and distributors) to minimize contamination of the 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 ready-to-eat fresh pre-cut vegetables packaged in a modified atmosphere. Processors should ensure that they have addressed all relevant safety issues relating to the use of such packaging.

5.2.2.4 Pre-cooling fresh fruits and vegetables

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

5.2.2.5 Cutting, slicing, shredding, and similar pre-cut processes

18. Procedures should be in place to minimize contamination with physical (e.g. metal) and microbiological contaminants during cutting, slicing, shredding or similar pre-cut 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 sanitizer or subjected to an alternative surface decontamination process such as hot water, steam or other treatments 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 refrigeration temperatures.

• Maintain sharpness and condition of knives and cutting edges to maintain product quality and safety.

• Cutting knifes and other cutting blades should be cleaned and disinfected on a regular basis according to written procedures to reduce the potential for cross-contamination of fresh fruits and vegetables during 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.

5.2.2.6 Washing after cutting, slicing, shredding, and similar pre-cut processes

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

• Water should be replaced at sufficient frequency to prevent the build-up of organic material and minimize cross-contamination.

• Antimicrobial agents should be used to minimize cross-contamination during washing and where their use is in line with good hygienic practices.

• Except for produce to be packed in liquid, drying or draining to remove water after washing is important to minimize microbiological growth.

5.2.2.7 Cold storage

20. Refer to section 5.2.2.4 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (see Main Document).

5.2.2.8 Storage of finished product

21. Ready-to-eat, pre-cut fruits and vegetables should be kept under cold temperature that will minimize microbial growth at all stages, from cutting through distribution. Regular and effective monitoring and maintenance records of temperature of storage areas and transport vehicles should be carried out.

10.2 TRAINING PROGRAMMES

22. In addition to those listed in the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003), factors to be taken into account in assessing the level of training required of persons responsible for the production of fresh pre-cut fruits and vegetables, include the following:

• the packaging systems used for fresh pre-cut fruits and vegetables, including the risks of contamination or microbiological growth involved in the method;

• the importance of temperature control and GHPs.

ANNEX II
ANNEX FOR SPROUT PRODUCTION

INTRODUCTION

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

2. The microbial pathogens associated with sprouted seeds are for example *Salmonella* spp, pathogenic *Escherichia coli*, *Listeria monocytogenes*, and *Shigella* spp. Outbreak investigations have indicated that microorganisms found on sprouts most likely originate from the seeds. Most seeds supplied to sprout producers are produced primarily 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 through the use of natural fertilizers or contaminated irrigation water. As a result, the seeds may be contaminated in the field or during harvesting, conditioning, storage or transportation. Typically, the germination process in sprout production involves keeping seeds warm and moist for two to 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 microbiological decontamination of seeds treatments which can achieve different levels of pathogen reduction. There is currently no treatment available that can guarantee pathogen-free seeds. Research is in progress to find efficient microbiological decontamination treatments which would provide sufficient pathogen reduction on seeds, especially if pathogens are internalized.

1. OBJECTIVE

4. This annex recommends control measures to occur in two areas: during seed production and during sprout production. During seed production, conditioning and storage, the application of Good Agricultural Practices (GAPs) and Good Hygienic Practices (GHPs) are aimed at preventing microbial pathogen contamination of seeds. During sprout production, the microbiological decontamination of seeds step is aimed at reducing potential contaminants and the good hygienic practices 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.

2.1 Scope

5. This annex covers the hygienic practices that are specific for 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

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

8. Seed distributor – any person responsible for the distribution of seeds (handling, storage and transportation) to sprout producers. Seed distributors may deal with single or multiple seed producers and can be producers themselves.

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

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

3. PRIMARY PRODUCTION

3.1.2 Wild and domestic animals and human activity

11. When seeds are destined for the production of sprouts for human consumption, wild or domestic animals should not be allowed to graze in the fields where seeds are grown (e.g. employing sheep for spring clip back of alfalfa).

3.2.1.2 Manure, biosolids and other natural fertilizers

12. Prevention of contamination is particularly important during the production of seeds which 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 treatments which will reduce pathogens to levels that are unlikely to result in contamination.

3.2.1.3 Agricultural chemicals

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

3.2.4 Equipment associated with growing and harvesting

14. Prior to harvest, harvesting equipment should be adjusted to minimize soil intake and seed damage and should be cleaned from any debris or soil.

3.3 Handling, Storage and Transport

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

16. 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.

17. Because seeds are vulnerable to microbial pathogens during threshing, drying, and storage, adequate care is needed to maintain sanitation in drying yards, and exposure of seeds to mist, high humidity and fog that could provide sufficient moisture for pathogen growth should be avoided.

4. PACKING ESTABLISHMENT: DESIGN AND FACILITIES

4.2.1 Design and layout

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

5. CONTROL OF OPERATION

5.2.2.1 Water use during sprout production

19. 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. Because of 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, including seed germination) should be preferably of potable quality or at least clean water.

5.2.2.2 Initial rinse

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

5.2.2.3 Microbiological decontamination of seeds

21. Due to the difficulty of obtaining seeds which can be guaranteed as pathogen free, it is recommended that seeds be treated prior to the sprouting process. Although there are other options like the use of lactic acid bacteria, liquid microbiological decontamination treatment is generally used. The use of chemical decontaminants may be subject to approval by the competent authority. During this treatment sprout producers should adhere to the following:

- Antimicrobial agent should be used according to manufacturer’s instructions for their intended use.
- All containers used for microbiological decontamination of seeds should be cleaned and disinfected prior to use.
- Seeds should be well agitated in large volumes of antimicrobial agent to maximize surface contact.
- The duration of treatment and the concentration of antimicrobial agent used should be accurately measured and recorded.

• Strict measures should be in place to prevent re-contamination of seeds after the microbiological decontamination treatment.

5.2.2.4 Rinse after seed treatment

22. As appropriate, seeds should be thoroughly rinsed after the microbiological decontamination treatment with potable water. Rinsing should be repeated sufficiently to eliminate the antimicrobial agent.

5.2.2.5 Pre-germination soak

23. 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 clean (preferably potable) water for the shortest possible time to minimize microbial growth.

• This step may also employ antimicrobial agents.

• After soaking, seeds should be rinsed thoroughly with potable water or at least clean water.

5.2.2.6 Germination

24. During germination, keep the environment and equipment 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.

5.2.2.7 Harvesting

25. All equipment should be cleaned and disinfected before each new batch. Harvesting should be done with cleaned and disinfected tools dedicated for this use.

5.2.2.8 Final rinse and cooling

26. A final water rinse will remove hulls, cool product, and may reduce microbial contamination on sprouts. The following should be adopted:

• 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) that is cleaned and disinfected prior to use.

• If additional cooling time is necessary, steps should be taken to facilitate rapid cooling (e.g. placed in smaller containers with adequate air flow between containers).

5.2.2.9 Storage of finished product

25. Where appropriate, sprouts should be kept under cold temperature (e.g. 5°C) that will minimize microbial growth for the intended shelf life of the product. Regular and effective monitoring of temperature of storage areas and transport vehicles should be carried out.

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 accepted analytical methods. Sprouting seeds before testing increases the possibility of finding pathogens that may be present. If lots of seeds are found to be contaminated, they should not be sold or used for the production of sprouts for human consumption. Because of 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 lot of seeds received at the sprouting facility is tested by the seed distributor and/or by the sprouter 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 potential to detect 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 at the sprouting facility.

5.2.3.2 Testing of sprouts and/or spent irrigation water

29. Current seed treatments cannot guarantee total elimination of pathogens. Further, if even a few pathogens survive the microbiological decontamination treatment, they can grow to high numbers during sprouting. Therefore, producers should have in place a sampling/testing plan to regularly monitor for pathogens at one or more stages after the start of germination.

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

5.3 Incoming material requirements

5.3.1 Specifications for incoming seeds

30. Sprout producers should recommend that seed producers adopt good agricultural practices and provide evidence that the product was grown and handled according to section 3 of this Annex and the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CAC/RCP 53-2003).

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

5.3.2 Control of incoming seeds

33. Seed containers should be examined at their arrival to minimize the potential for introducing obvious contaminants in the establishment.

34. Seed containers should be examined for physical damage (e.g. holes from rodents) and signs of contamination (e.g. stains, insects, rodent faeces, urine, foreign material, etc.). 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.

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

5.3.3 Seed storage

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

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

38. Open containers should be stored in such a way that they are protected from pests and other sources of contamination.

5.8 RECALL PROCEDURES

39. Seed producers for the production of 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 should be adopted:

- Seed production and distribution practices should be in place to minimize the quantity of seed identified as a single lot and avoid the mixing of multiple lots that 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 producers should have a system to: effectively identify lots, trace the production sites and agricultural inputs associated with the lots, and allow physical retrieval of the seeds in case of a suspected hazard.
- Where a lot has been recalled because of a health hazard, other lots that were 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 which may present a hazard should be held and detained until they are disposed of properly.

ANNEX III

ANNEX FOR 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 that vary from very large to very small. Fresh leafy vegetables are marketed both locally and globally to provide year round availability to consumers and are sold as fresh, fresh-cut, pre-cut or ready-to-eat products such as pre-packaged salads.

2. International and national concerns have grown in response to recent outbreaks and reported illnesses linked to fresh leafy vegetables. A broad array of microbial pathogens have been associated with fresh leafy vegetables as reported in international outbreak data, including Enterohemorrhagic *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 volume, often for export and increasingly in places that are new to harvesting and distributing fresh leafy vegetables, therefore the potential for human pathogens to spread has also grown. Fresh leafy vegetables are marketed as diverse products including whole, unprocessed heads, loose leaves, mixed cut leaves and fresh herbs, and pre-cut packaged products. Fresh leafy vegetables are packed in diverse ways, including field packed direct for market, in packing houses and pre-cut products processed in sophisticated processing plants. As fresh, ready-to-eat 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 microorganisms. Examples of control measures are illustrative only and their use and approval may vary between member countries.

1. OBJECTIVE

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

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 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 and radicchio and fresh herbs such as coriander/cilantro, basil, 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

3.2.1.1 Water for primary production

3.2.1.1.1 Water for irrigation

7. 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, irrigation of these products should be applied in a way to minimize wetting of the edible portion because the plant characteristics can provide niches for microbial attachment and survival.

3.2.1.1.4 Water for harvesting and other agricultural uses

8. 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

9. Refer to the *Code of Hygienic Practice for the Transport of Food in Bulk and Semi-packed Food* (CAC/RCP 47-2001). In addition, the following should be considered:

10. Maintaining optimum temperatures of leafy vegetables between 1-5°C 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 be optimum for 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 foodborne pathogens. For this type of product, minimizing the time it is exposed to a higher temperature might be preferable to maintaining the temperature below 5°C.

5.2.2.4 Cooling of fresh leafy vegetables

11. 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

can be cooled immediately after harvest by either, using ice (parsley), forced-air cooling, vacuum cooling (iceberg lettuce), hydrocooling, or spray-vacuum (hydrovac) cooling.

5.8 TRACEABILITY/PRODUCT TRACING AND RECALL PROCEDURES

12. In fresh-cut, pre-cut or ready-to-eat salad operations, multiple ingredients from different sources may be combined in a single package. This practice can complicate efforts to trace leafy vegetables to their source. The processors should consider establishing and maintaining records to identify the source of each ingredient in the product.

9.2CONSUMER EDUCATION

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

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

- Specific information for fresh-cut, pre-cut or ready-to-eat bagged salads. Consumers need specific and clear guidance on how to safely handle fresh-cut, pre-cut or ready-to-eat (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 labeling is therefore important. If not labeled as "washed and ready to eat" (or similar wording), then it needs to be washed.

ANNEX IV

ANNEX FOR MELONS

INTRODUCTION

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

2. Like other fresh fruits and vegetables that are eaten raw, the safety of melon products depends on maintaining good hygienic practices along 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 with a large number being caused by *Salmonella* spp[1]. Additionally other pathogens, such as *Listeria monocytogenes* have been associated with foodborne outbreaks from melons. The major risk factors that have been identified as contributing to melon outbreaks include: 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 and pre-cut melon products move through the food chain, there is also the potential for the introduction, growth and survival of foodborne pathogens due to cross contamination (arising from poor hygiene practices for personnel, transport, retail outlets, utensils or consumers). Moreover, morphological characteristics of certain types of melons, for instance netted rind, will be prone to attachments 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.

2.1 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, the Annex for Ready-to-Eat Fresh Pre-cut Fruits and Vegetables.

2.3 Definitions

7. *Ground spot* - means the point of direct contact where melons sit directly on the soil or on top of thin plastic mulch.

8. *Melons* - refers to whole and/or pre-cut cantaloupe (also known as muskmelons and rockmelons), honeydew, watermelon and other varieties of melons.

3. PRIMARY PRODUCTION

3.1 ENVIRONMENTAL HYGIENE

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

3.2 HYGIENIC PRIMARY PRODUCTION OF MELONS

10. Special consideration should be given to production practices specific to melon production because of the unique characteristics of the melons and the rind of some melons and because melons frequently contact soil directly during growth and development. Melons may have smooth or netted rind surfaces. Netted rind surfaces, in contrast to smooth rind surfaces, provide an environment where microbial pathogens may more easily adhere to, survive on, and become more difficult to eliminate during post-harvest practices. It is recommended that growers use production practices that prevent or minimize contact of melons, particularly those with netted rinds, with soil, soil amendments (including natural fertilizers) and irrigation water.

11. 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 also may be hand-turned multiple times by agricultural workers during the growing season 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 non-ground spot areas and, therefore, may be more susceptible to microbial contamination. If cups or biodegradable materials are used underneath melons, the following are recommended:

- •Use plastic mulch under cups to minimize cup and melon contact with the soil.
- •Ensure cups are clean and sanitary before setting them under the melons.
- •Ensure that employees follow good hygienic practices when turning melons on the cups or during harvesting operations.
- •Use biodegradable materials only once to prevent cross-contamination.

3.2.1.1.1 Water for irrigation

12. Netted melon rind surfaces, in contrast to smooth rind surfaces, may foster greater attachment and survival of foodborne pathogens. For this reason, the quality of irrigation water and type of irrigation method used is an important consideration. Growers should consider the following:

- •Avoid overhead irrigation methods, particularly with 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

13. Melons such as cantaloupe are harvested based on the melon's 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. Melon stem scars may provide a potential route for entry of foodborne pathogens, if present, to the edible portion of the melons. It is recommended that post-harvest handling practices be implemented to minimize stem scar and rind infiltration, such as during washing operations, of foodborne pathogens into the edible portions of melon flesh. Where appropriate, written SOPs should be developed and implemented for safe handling, storage and transport of melons. It should be considered that the length of storage for melons at a recommended temperature depends on the stage of maturity when melons are harvested.

3.3.1 Prevention of cross-contamination

14. Proper cleaning and disinfection of equipment should be done since knives, if improperly used, can wound melon rinds and provide a point of entry for contaminants that may be in soil and water.

15. Avoid setting melons directly on soil after removal from the vine and before loading into transport vehicle to avoid contaminating the melon with contaminants in the soil.

5. CONTROL OF OPERATION

5.1 Control of food hazards

16. If melons pass over brushes during the operations, care should be taken to ensure they do not damage or cross-contaminate the melons. They should be routinely inspected, cleaned and adjusted as needed.

5.2.2.1 Post-harvest water use

17. Water is often used in dump tanks to transport melons from field containers into 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.

18. 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.
- Minimize or avoid fully submerging melons in colder dump tank water. When submerged, water is more likely to infiltrate into the melons.
- It is recommended that the time melons remain in dump tank water 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 time be evaluated and monitored to ensure that the water temperature and time is maintained and that antimicrobial agents are present in the water at sufficient levels for the temperature used.

5.2.2.2 Chemical treatments

19. If regulation allows, fungicides may be applied to melons by use of an aqueous spray or immersion to extend the post-harvest life of the fruit.

5.2.2.3 Cooling melons

20. Forced air cooling can avoid the risk of melon infiltration with cooling water, but it also may spread product contamination if forced-air cooling equipment is not cleaned and disinfected regularly.

21. Water that is used in hydro-coolers should be potable. Water that is used only once and not recirculated is preferable.

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

5.2.2.5 Cutting, slicing and peeling melons

23. 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

24. 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.

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

ANNEX V

ANNEX ON BERRIES

INTRODUCTION

1. Berry crops are geographically diverse and represent a wide range of phenotypically unique fruits. Not only are they diverse in the size, shape and colours of their fruits, they are also diverse horticulturally, from low growing berries (e.g. strawberries), to small bushes (e.g. blackberries, blueberries, raspberries) and tall shrubs (e.g. blackcurrant and gooseberry). All are perennial but some are cultivated as annuals (e.g. strawberry); most are cultivated while others are collected from the wild (e.g. wild blueberries).

2. These fruits are relevant to international trade due to increasing consumption of fresh produce and globalization as a result of changes and/or optimization in production and distribution. There is increasing awareness on the risk factors associated with berry consumption on the part of public health officials. 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 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 those fruits that are consumed raw is highly dependent on maintaining good hygienic practices along the food chain, including 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 through packing and distribution of fresh berries and consumer use, including fresh berries and consumer use, including fresh ready-to-eat berries and those processed without a microbiocidal step–(e.g. frozen ready-to-eat 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 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 postharvest activities (i.e. from Section 3.3.3 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), Annex I, the Annex for Fresh Cut and Pre-cut Ready-to-eat Fruits and Vegetables, Annex II of the *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) and the *Code of Practice for the Processing and Handling of Quick Frozen Foods* (CAC/RCP 8-1976).

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

3.1 ENVIRONMENTAL HYGIENE

10. 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 foodborne pathogen.

3.2 HYGIENIC PRIMARY PRODUCTION OF BERRIES

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

12. 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 .

13. 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 and not reused in order to prevent cross contamination.

3.2.1.1 Water for primary production

14. Only clean water should be used for berry production.

3.3 HANDLING, STORAGE AND TRANSPORT

15. 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. removal of field heat) after harvesting could be important to maintain freshness and quality and contributes to the control of foodborne pathogens. When required, growers should use potable water for ice and hydrocoolers when precooling to minimize risks of contamination.

16. Manual harvest considerations:

- Appearance and firmness of berries are commonly associated with fruit quality and freshness. Over-handling the berries may damage them and affect fruit quality. Moreover, adverse temperatures during harvesting in hot and/or humid weather also decreases quality and may affect food safety due to fruit damage and juice leakage, which may spread contamination over healthy fruits.
- Growers should have a responsible person to supervise harvesting at all times to assure 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

17. Specific control methods should be implemented to minimize the risk of cross-contamination from microorganisms 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 foodborne contamination. Growers should take measures to minimise the contamination by sorting and selection of berries.

• Poor hygienic practices of agricultural workers in the field can significantly increase the risk of contaminating berries. In order to prevent microbial cross-contamination of berries, growers should continually reinforce the importance of good hygienic practices during pre-harvest, harvest and postharvest activities.

3.3.3 Field Packing

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

4. PACKING ESTABLISHMENT: DESIGN AND FACILITIES

4.2.1 Design and layout

19. For products that are not immediately wrapped or packed (i.e. the berries are exposed to contaminants from the environment), the rooms where 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 foodborne pathogens.

5. CONTROL OF OPERATION

5.1 Control of food hazards

20. 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, come in with debris (e.g. insects), or that are damaged, should be inspected and culled.

5.2.2.1 Post-harvest water use

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

5.2.4 Microbiological cross-contamination

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

23. Prevent cross-contamination between raw and washed berries, which will be frozen, from sources such as wash water, rinse water, equipment, utensils and vehicles.

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

5.3 Incoming material requirements

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

8. TRANSPORTATION

26. Refer to the *Code of Practice for the Packaging and Transport of Fresh Fruits and Vegetables* (CAC/RCP 44-1995).

10. TRAINING

10.2 Training programs

27. Since producing berries for direct consumption is labour intensive, which increases the risk of contamination from manipulation, special attention is needed to properly select and train all personnel involved in primary production, packing, processing or transport operations of berries that are intended to be consumed without a microbiocidal step.

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

29. Specific employee training programmes should include the following:

• Agricultural workers should be trained on safe handling, transport and storage practices and to ensure that berries are immediately cooled after harvesting.

Appendix III

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