CODEX ALIMENTARIUS COMMISSION

Food and Agriculture Organization of the United Nations

World Health Organization

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Agenda Item 5.2

CX/FH 24/54/6
January 2024

JOINT FAO/WHO FOOD STANDARDS PROGRAMME

CODEX COMMITTEE ON FOOD HYGIENE

Fifty-fourth Session

Nairobi, Kenya

11 - 15 March 2024

GUIDELINES FOR THE CONTROL OF SHIGA TOXIN-PRODUCING ESCHERICHIA COLI (STEC) IN RAW BEEF, FRESH LEAFY VEGETABLES, RAW MILK AND RAW MILK CHEESES, AND SPROUTS (CXG 99-2023): PROPOSED DRAFT ANNEX IV ON SPROUTS

(Prepared by the electronic working group chaired by Chile, New Zealand, Kenya, and the United States of America)

Codex Members and Observers wishing to submit comments on the discussion paper should do so as instructed in CL 2024/22-FH available on the Codex webpage/Circular Letters 2024: https://www.fao.org/fao-who-codexalimentarius/resources/circular-letters/en/

BACKGROUND

1. The 50th Session of the Committee on Food Hygiene (CCFH50) agreed to start new work on Guidelines on the control of Shiga-toxin producing *Escherichia coli* (STEC) in raw beef, fresh leafy vegetables, raw milk and raw milk cheeses, and sprouts. An electronic working group (EWG) was established, co-chaired by Chile and the United States of America (USA), working via the Codex online Forum and open to participation by all Codex Members and Observers.

2. CCFH51 considered the report of the EWG on the guidelines for the control of STEC and focused on giving guidance on the terminology to be used for each of the commodities covered by the Guidelines, as well as the request to JEMRA for scientific advice. CCFH51 agreed to return the draft to step 2/3 for redrafting and to establish an EWG, chaired by Chile and co-chaired by the USA, France, and New Zealand.

3. Since CCFH52 was postponed due to the COVID19 pandemic, the revised texts were distributed in April 2021 by CL 2021/35/OCS-FH for comments by Members and Observers, further revised, and then distributed for comments in December 2021 via CL 2021/63/OCS-FH. A Virtual Working Group (VWG) met immediately prior to CCFH52 to get input on specific issues related to the three annexes.

4. CCFH52 considered the report of the EWG and the VWG (CCFH52/CRD5) and agreed with the proposals made in CRD5 and that these should be incorporated in the further elaboration of the Guidelines. CCFH52 agreed to return the proposed draft document to Step 2/3 for redrafting and circulation for comments and to establish an EWG, chaired by Chile and co-chaired by the United States of America, France, and New Zealand, and working in English.

5. CCFH 53 noting that there were no outstanding issues to be addressed in the general section and the annexes on raw beef and raw milk and raw milk cheeses, agreed to forward the proposed draft Guidelines and these two annexes for adoption at Step 5/8 by CAC46 (Appendix III); to return the annexes on fresh leafy vegetables and sprouts to Step 2/3 for redrafting and circulation for comments and to establish an EWG, chaired by Chile and co-chaired by New Zealand, Kenya, and USA, and working in English (noting that comments would also be accepted in Spanish). CAC46 adopted the general section and the annexes on raw beef and raw milk and raw milk cheeses (CXG 99-2023).

TERMS OF REFERENCE

6. The EWG was given the following terms of reference:

- further develop the annex on fresh leafy vegetables using CRD13 as a basis and taking into consideration the general section of the guidance as agreed at CCFH53 and the CRDs submitted at CCFH53;
- continue the development of the annex on sprouts describing interventions relevant to control STEC, taking into consideration the written comments that were submitted through the Online Commenting System (OCS) in response to the CL 2022/56-FH, and CRDs submitted at CCFH53, as well as the general section of the guidance as agreed at CCFH53; and
- prepare a report and revised text to be submitted to the Codex Secretarial three months before CCFH54 for circulation for comments at Step 3;

PARTICIPATION AND METHODOLOGY

7. An invitation was sent to all Codex Members and Observers to participate in the EWG; participants from 27 Codex Member countries and 1 Observer Organization registered for the EWG. The list of participants is attached as Appendix II to **CX/FH 24/54/5**. The EWG worked through the Codex Online Forum.

8. The EWG redrafted the Fresh Leafy Vegetables Annex and Sprout annex, based on written comments submitted to CCH53; and comments received through the Codex Forum in a round of consultation for each one of the Annexes (July – September 2023).

SUMMARY OF DISCUSSION OF THE ANNEX ON SPROUTS

9. The following changes were made to the Annex on sprouts after a round of consultation in the EWG

- Made changes suggested in comments received through the Codex online forum, including editorial changes.
- The objective and scope were aligned with the objective of the Fresh Leafy Vegetable Annex. In line with the decision of CCFH53 that microgreens would be considered as part of the fresh leafy vegetables annex rather than the sprouts annex a sentence clarifying that microgreens were outside of the sprouts scope was added.
- In the Objective section consumer use was replaced by consumer awareness to be consistent.
- The reference to < 7°C for cold storage was changed for *appropriate refrigerated temperatures* and the footnote for appropriate temperature deleted since there weren´t any scientific reference to support it according to JEMRA report (MRA 43).
- In the section of testing seed lots, considerations regarding the optimal time for sampling were introduced as a recommendation and as it was expressed in the majority of the comments the alternate paragraph was retained.
- The word sanitizing was changed for disinfecting through the document for consistency of language with CXC 1-1969.

10. References have been included in the text for the moment as a means of tracing the source of information provided while discussing the draft guidelines, but these will be removed from the final version.

11. Details of the discussions on the Annex on sprouts are available in CX/FH 24/54/6.

CONCLUSIONS

12. The EWG completed the tasks identified in its Terms of Reference; specifically, the EWG developed the Sprouts Annex (see Appendix 1) taking into consideration the comments received during the rounds of consultation.

RECOMMENDATIONS

13. The EWG recommends that CCFH54 consider the proposed draft Annex IV on Sprouts (see Appendix 1) and recommend whether it can be advanced in the Codex Step process.

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Appendix 1

PROPOSED DRAFT ANNEX IV ON SPROUTS

1. INTRODUCTION

1. Sprouts are commonly consumed raw and often without application of a kill step that would eliminate microbial pathogens, prior to consumption. Consequently, it is necessary to ensure safe production of sprouts by preventing or minimizing contamination of incoming seeds, in the production environment and in the finished products. While no single step will reliably eliminate all pathogenic microorganisms that may survive on sprouts, using a series of preventive and risk-reduction steps (i.e. a multi-hurdle approach) can greatly reduce the food safety risks that may be associated with sprouts.

2. Sprouts have different food safety concerns from other fresh fruits and vegetables because the conditions for seeds to sprout (e.g. time, temperature, water activity, pH, and available nutrients) also support the growth of foodborne bacterial pathogens if present.

3. Contaminated seeds have historically been identified as the likely source of most sprout-related outbreaks, particularly those attributed to Shiga toxin-producing *Escherichia coli* (STEC) contamination and continues to be the most common source of sprout contamination[1] (NACMCF, 1999; EFSA, 2011; Ferguson *et. al*., 2005, FAO/WHO, 2022). Bacterial pathogens that may be present at low levels on seeds can multiply to very high levels during the sprouting process. Sprout contamination could also be caused by poor hygienic practices and contamination in production environments.[1]

4. Figure 1 provides a flow diagram illustrating a generalized process flow to produce sprouts. This flow diagram is for illustrative purposes only. All steps may not occur in all operations or may not occur in the order presented in the flow diagram. Sprouts are grown in production environments that vary based in size and resources of the operation, seed type, available equipment, etc.

5. During seed production, conditioning, storage, and distribution for sprouting, the application of good agricultural practices (GAPs) and good hygienic practices (GHPs) should aim to prevent the contamination of seeds by microbial pathogens such as STEC. During sprout production, any step for the microbiological decontamination of seeds is aimed at reducing potential contaminants, while GHPs are aimed 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. OBJECTIVE

6. The objective of this Annex is to provide guidance to reduce the risk of foodborne illness from STEC associated with sprouts intended for human consumption without cooking, during production, harvesting, packing, processing, storage, distribution, and marketing as well as addressing consumer awareness.

3. SCOPE, USE, AND DEFINITIONS

3.1 Scope

7. This Annex covers specific guidance for the control of STEC related to sprouts that are intended for human consumption without cooking or other microbicidal treatment.

8. Home-sprouting, and shoots, cress, and microgreens[2] where the seed is not kept in the final product are outside the scope of this document.

3.2 Use

[1] FAO/WHO. 2022. Microbiological Risk Assessment Series 43: *Prevention and control of microbiological hazards in fresh fruits and vegetables – sprouts.*

[2] Shoots are grown hydroponically, and true leaves are developed. The shoots and the leaves are cut during harvest and the final product does not include the seed and roots. Cress is grown with substrate and true leaves are developed; as with shoots grown hydroponically, the cut shoots and leaves do not include the seed and roots. For microgreens, plants reach a later stage of growth than sprouts, typically associated with the emergence of “true” leaves. They can be grown in soil or substrate and are harvested above the soil or substrate line; they Include both shoots and cress (FAO/WHO, 2022).

9. This Annex should be used in conjunction with the *General Principles of Food Hygiene* (CXC 1-1969) and the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CXC 53-2003), including Annex II for Sprout Production.

3.3 Definitions

Sprouts - Sprouted seeds or beans harvested when the cotyledons (or seed leaves) are still un- or underdeveloped and true leaves have not begun to emerge. They can be grown in water, soil or substrate and can be harvested with or without the root (cut sprouts).[3]

NOTE TO CCFH54: Definition of Sprouts was agreed at CCFH53.

Seeds for sprouting – Seeds or beans used to produce sprouts for human consumption.[4]

4. PRIMARY PRODUCTION OF SEEDS FOR SPROUT PRODUCTION

4.1. Control measures for seed production and handling

10. Interventions aimed at reducing the risk from seed-borne contamination should focus on controlling contamination of seeds from animal and human activities and ensuring proper use and application of manure, biosolids, other natural fertilizers, and agricultural water.

4.1.1. Animal and human activities

11. Grazing of domestic animals should not occur in fields while crops are actively being grown for use in sprouted seed/bean production. History of the growing area regarding previous uses for grazing domestic animals should also be considered, as STEC have been shown to survive for several weeks in bovine feces.

12. In addition, nearby fields with livestock can increase the likelihood of STEC contamination. Livestock should be located as far as feasibly possible from fields growing seeds for sprout production, because the risk decreases as the distance to livestock increases (Berry *et al.*, 2015, 2019).

13. During the growing season the areas used for growing seeds for sprouting should be assessed for evidence of potential contamination of seeds from domesticated or wild animals (e.g. observation of animals or animal activity, animal excreta, crop destruction).

14. When evidence of potential contamination is found (e.g. the plant or seed is visibly contaminated with animal excreta), growers should evaluate whether the seed should not be harvested due to the potential for contamination with pathogens such as STEC. Growers should then take measures to identify contaminated seed and/or the contaminated area (e.g. mark the affected area) so that such seed will not subsequently be harvested in the event weather conditions, or other occurrences, make the evidence of potential contamination no longer visible.

15. Wild animals should be excluded from the production area to the extent possible. Possible methods include the use of physical barriers (e.g. fences) and active deterrents (e.g. noise makers, scarecrows, images of owls, foil strips).

16. The presence of nearby animal production facilities (e.g. animal feed operations, poultry farms, dairy farms) or other related factors such as slope of land, lack of runoff controls, and manure spreading that could lead to contamination of the seed or irrigation water with untreated manure should be assessed and appropriate actions taken to prevent contamination of growing areas and seed with STEC.

4.1.2 Water for seed production

17. Water for irrigation and other applications should be fit for purpose and used in a manner to avoid the introduction of pathogens onto seeds.

18. Growers should evaluate the sources of water used on the farm for the likelihood of contamination with STEC (e.g. from livestock, wildlife, sewage treatment, human habitation). The following actions may prevent contamination of water supplies with STEC:

[3] FAO/WHO. 2022. Microbiological Risk Assessment Series 43: *Prevention and control of microbiological hazards in fresh fruits and vegetables – sprouts.*

[4] References to “seeds” in this document include other things that are sprouted to produce sprouts for human consumption, such as beans.

- installation of fencing around surface water supplies to prevent large animal contact,
- proper maintenance of wells,
- water filtration or chemical water treatment,
- prevention of stirring of the sediment when drawing water, and
- construction of settling or holding ponds or water treatment facilities.

19. The effectiveness of these actions should be verified by periodic risk-based water testing. Where necessary, growers should test the water they use for appropriate indicator microorganisms and, where identified as necessary, STEC, according to the risk associated with the production. The frequency of testing will depend on the water source (e.g. lower for adequately maintained deep wells, higher for surface waters), the risks of environmental contamination, including intermittent or temporary contamination (e.g. heavy rain, flooding), or the implementation of a new water treatment process by growers.

20. Where possible, growers should be able to identify or have a contingency plan in place that identifies an alternative source of fit-for-purpose water if the primary water source is found to have unacceptable levels of indicator microorganisms or is contaminated with STEC.

4.1.3 Manure, biosolids and other natural fertilizers

21. Growers who use biological soil amendments of animal origin (e.g. manure) on fields producing seeds for sprouting should only use them in such a way that they do not contaminate the seeds for sprouting. Manure, biosolids, and other natural fertilizers are potential sources of bacterial pathogens. Only composted manure/biosolids treated to reduce or eliminate STEC should be used during seed production to reduce the risk of seed contamination.

22. Refer to Section 3.2.1.2 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CXC 53-2003) for practices to minimize microbial pathogens such as STEC in manure, biosolids and other natural fertilizers. If untreated or partially-treated natural fertilizers are used, the time period between the application and the planting and harvesting of seed should be maximized, as bacterial pathogens die off over time.

4.1.4 Personnel health, hygiene, and sanitary facilities

23. Worker hygiene and health requirements should be followed to ensure that personnel who have direct contact with seeds for sprouting prior to, during or after harvesting will not contaminate them with STEC.

24. Adequate access to, and use of, hygienic and sanitary facilities, including adequate means for hygienically washing and drying hands, are critical to minimize the potential for workers to contaminate seeds for sprouting.

25. People known or suspected to be suffering from diarrheal illness should not be allowed to enter any area handling seeds destined for sprouting, including the growing and harvest area.

26. Refer to the *General Principles of Food Hygiene* (CXC 1-1969), Section 3.2.3 and Section 6 for more recommendations that may apply.

4.1.5 Equipment associated with growing and harvesting of seeds for sprouting

27. Equipment should be designed for ease of cleaning and maintained to minimize soil intake and seed damage and prevent introduction of pathogens such as STEC onto seeds for sprouting.

28. Growers should avoid moving harvesting equipment across fields where manure or compost non – properly composted, has been applied.

29. To avoid contamination of seeds destined for sprouting, harvesting equipment should be cleaned and disinfected prior to harvesting. In addition, in the event of circumstances that may result in contamination, e.g., equipment runs over an area with animal intrusion and faecal deposits, harvesting should cease, and equipment should be cleaned and disinfected prior to using the equipment for harvesting again.

4.1.6 Handling, storage, and transport of seeds for sprouting

30. Good hygiene practices (GHPs) should be implemented to avoid possible contamination of seeds during storage and transportation. When possible, temperature and humidity should be controlled.

31. Equipment used to transport the seeds should be clean and, where necessary, disinfected prior use.

32. Packaging of seeds is recommended to minimize the potential for contamination. Growers should pack and hold seeds under sanitary conditions and pest controls should be implemented in storage facilities.

33. Seeds should be stored in closed or covered containers, in a clean, dry area dedicated only to seed storage.

34. Containers stored outdoors should be cleaned and, as appropriate, disinfected before being used to transport seeds for sprouting. Such containers should be positioned off the ground.

35. Use solid bags or other containers to hold or storage seeds for sprouting, open weave bags or other containers which includes holes on it, should not be used to protect the seeds from contamination.

36. The use of recycled bags should be avoided if there is a possibility of prior contamination.

37. Each container should be marked to identify the source and lot and if the seed has been treated. This should be clearly indicated on the label.

38. Containers should not be stored on the floor or placed against walls to reduce the possibility of contamination with STEC by rodents or other pests and to facilitate regular monitoring for pest problems.

5. SPROUT PRODUCTION

39. HACCP principles should be applied to sprout production, with all the steps well documented and potential critical control points (e.g. decontamination of the seeds) identified and controlled. If a problem is identified (e.g. STEC contamination of sprouts), corrective actions should be taken and a critical review of all the steps should be performed to determine whether changes are needed.

5.1 Sourcing and receiving seeds for sprouting

40. Seeds should be obtained from suppliers, (producers or distributors) that follow GAPs and GHPs during production, storage, distribution, and commercialization of the seeds. When possible, microbiological testing/certificates of analysis or a letter of guarantee should be obtained from the supplier.

41. When seeds arrive at a sprout operation, they should be inspected for physical damage and signs of contamination (e.g. rodent/bird droppings, dirt, and other visible contamination).

42. Keeping seeds and sprouts from different batches separated can facilitate the identification of contaminated batches and help trace seeds back to the supplier**.** Water used throughout sprouts production should be fit for purpose.

5.2 Storage of seeds for sprouting

42. Seeds should be stored and handled in conditions (e.g. temperature and relative humidity) that will prevent growth of microorganisms, such as STEC. Seeds should also be stored and handled in a manner that will avoid damage and keep them protected from pests and other sources of STEC contamination.

5.3 Initial Rinse

43. Seeds should be rinsed thoroughly to remove dirt or debris before any antimicrobial treatment is applied.

44. Seeds should be rinsed and agitated in large volumes of fit for purpose water. Repeat the process with fit for purpose water until the dirt or debris are removed and rinse water remains clear.

45. The rinsing process should be designed to maximize surface contact of seeds with water (e.g. use large buckets of water and sieves).

5.4 Treatment and pre-germination soak of seeds for sprouting

46. Treatment of seeds to reduce the presence of pathogens such as STEC may be determined to be a critical control point. However, seed treatment can be challenging due to the low water activity of the seeds, and the need to preserve the viability of the seeds, including their ability to germinate. Treating seeds used for sprouting reduces the level of potential contamination but does not reliably eliminate pathogens, such as STEC, therefore treating seeds does not replace the importance of measures to prevent contamination of seeds and sprouts. Known seed treatment methods include those that work by chemical methods (liquid or gas), physical methods, or a combination of these. The use of certain seed treatments may be subject to approval by competent authorities.

47. The following chemicals, when used at appropriate concentrations, may be able to achieve at least a 3-log reduction of pathogens: calcium hydroxide (Holliday *et al*., 2001), calcium hypochlorite (Ding *et al*., 2013),

sodium hypochlorite, (Ding *et al.*, 2013) caprylic acid (Chang *et al.*, 2010), gaseous acetic acid (Nei *et al.*, 2011; Nei *et al*., 2014), hydrogen peroxide (Holliday *et al*., 2001), lactic acid (Sikin *et al*., 2013), monocaprylin (Chang *et al.*, 2010), oxalic acid (Sikin *et al*., 2013), and phytic acid (Sikin *et al*., 2013). When using chemical treatments, the duration of treatment and the concentration of the chemical used should be accurately measured and recorded.

48. Physical treatments have been reported to achieve a 5-log or greater reduction in pathogens, including *E. coli* serotype O157:H7, on seeds (Bari *et al*., 2010, Ding *et al*., 2013, Neetoo *et al.*, 2013). Physical treatments, such as heat (dry heat or hot water), high pressure, and irradiation are reported to have better penetration characteristics for reaching bacteria on microscopically rough surfaces as well as the interior of the seed as compared to chemical treatments (Ding *et al*., 2013). Physical and chemical combination treatments have been reported to be the most effective for removing pathogens from seeds for sprouting. Combination methods applied sequentially or simultaneously may be more effective than using a single treatment alone.

49. Where feasible, sprout growers should treat the seeds used for sprouting with a method validated to reduce microorganisms of public health significance such as STEC.

50. All steps involved in antimicrobial treatment for seeds should be carried out in an area separated from the germination and packaging areas.

5.5 Rinse after seed treatment

51. Seeds may need to be rinsed after a seed treatment (e.g., seeds treated with chemicals). Time duration of the rinse step should be adequate to limit potential microbial growth.

5.6 Germination and growth of sprouts

52. Sprouts are grown hydroponically or in soil. Practices employed for germination, growth, harvest, and post-harvest washing vary depending on the operation and the type of sprout grown. Growing units include rotating drums, bins, beds, trays, and buckets.

53. Seeds for soil-grown sprouts are generally rinsed and soaked to allow for initial germination before sowing in soil in plastic trays. Water is sprayed over the trays daily. Sprouts such as alfalfa, broccoli, clover, and radish are grown hydroponically in rotating drums with frequent water sprays. If present at the growing stage, microbial pathogens such as STEC can multiply, significantly increasing the risk for illness.

5.7 Harvesting

54. Sprouts are harvested manually by removing them from growing units. Sprouts may be washed to remove hulls and/or to help lower the temperature of the sprouts and then spin-dried. Soil-grown sprouts are harvested by cutting them from the trays, prior to washing and packaging, or the sprout trays are sent to retailers and cut at the point of sale. GHPs should be applied to prevent these operations from being a source of contamination (e.g., if some of the sprouts are contaminated with STEC from the environment or from handlers).

5.8 Cold sprout storage

55. Sprouts should be maintained at appropriate refrigerated temperatures after cooling to minimize growth of any STEC that may be present. The temperature of cold storage should be controlled, monitored, and recorded.

5.9 Personal and environmental hygiene at sprout production

56. Proper storage, handling and disposal of waste, sanitation of equipment and tools, and effective pest control will minimize the risk of sprout contamination with pathogens such as STEC.

57. Facilities should be designed (e.g. differentiation between areas, hygienic zones, flow of operations and personnel) to prevent potential cross-contamination from raw materials to the finished sprouts.

5.10 Documentation and records

58. Documentation of key information for incoming seeds (e.g. supplier details, date of receipt, quantity etc.) should be maintained.

59. It is recommended that production, harvesting, packing, storage, and distribution records should be retained long enough to facilitate investigation of product recalls and any notified STEC illnesses, if needed. This period may significantly exceed the shelf-life of sprouts.

60. It may be appropriate to retain microbiological test results for a longer period since this data should be used for trend analyses. Increases, often small, in the population of indicator microorganisms over time may suggest that there is an emerging issue (or issues) in the production process which may require remediation.

61. Refer to Section 5.7 of the *Code of Hygienic Practice for Fresh Fruits and Vegetables* (CXC 53-2003) for the types of records that should be maintained by growers, harvesters and packers that may be important when investigating foodborne illness outbreaks due to STEC.

6. MICROBIOLOGICAL CRITERIA AND OTHER SPECIFICATIONS FOR LABORATORY TESTING

62. Where appropriate and when possible, sprouts or spent sprout irrigation water (SSIW), and possibly seeds, should be tested for the presence of pathogens such as STEC; in particular, strains demonstrated to be a country's highest priority due to their public health burden (e.g. those strains with virulence factors capable of causing severe illness or considered to cause significant illness in that country).

63. Testing spent sprout irrigation water or in-process sprouts collected during sprouting increases the likelihood of detecting the pathogens that may be present in seed. It also enables early detection of contamination in the production batch before products enter the marketplace. Testing spent sprout irrigation water is preferred over testing sprouts because water may pick up bacteria as it passes through the production batch, making it easier to collect a representative sample.

64. The volume of sample collected should be sufficient to be representative of the production batch and for testing target pathogens.

65. Testing for indicator microorganisms, can be a useful tool to evaluate and verify the safety of the product, the effectiveness of the control measures, and to provide information about an environment, a process or even a specific product lot when sampling plans and testing methodology are properly designed and performed. Measures to be undertaken in case of positive results for STEC (or when indicator microorganisms reach a pre-defined threshold) need to be established and defined. Refer to the *Principles and Guidelines for the Establishment and Application of Microbiological Criteria Related to Foods* (CXG 21-1997) and *Principles and Guidelines for the conduct of microbiological risk management (MRM)* (CXG 63-2007).

6.1 Testing of seed lots before entering production

66. Testing lots of sprout seeds for pathogens such as STEC can help identify contaminated lots. Thus, some seed producers may opt to test their seed for pathogens before distribution. However, the likelihood of detecting the presence of pathogens such as STEC in seeds is low, due to the heterogeneous distribution and low numbers of STEC contaminating the seeds. A negative test does not assure the absence of STEC on the seeds.

67. Testing of seed lots for indicator microorganisms may be used as an indicator of potential STEC contamination. If initial testing indicates the possible presence of STEC, additional testing for STEC is recommended.

6.2 Testing of sprouts and/or spent sprout irrigation water (SSIW).

68. Microbial testing of SSIW (or in-process sprouts) is an important part of a multi-hurdle approach to ensure contaminated sprouts do not enter the marketplace. Testing SSIW (or in-process sprouts) for STEC from each production batch of sprouts may be a much more reliable indicator than testing seed to determine whether the sprouts and potentially the seeds used to produce the batch, are contaminated with STEC.

69. Samples of SSIW can be collected as early as 48 hours after the start of sprouting, although the optimal time for sample collection may vary depending on the type of sprouts and sprouting practices. If the seeds are pre-soaked (e.g., soaked in water for a short time and then transferred to growing units for sprouting), include the pre-soak time. Early results will allow sprout growers to take corrective actions sooner, thus ensuring that sprouts grown from that (those) lot(s) of seeds do not enter commerce, and to report positive test findings to the seed grower, distributor, supplier, or other relevant entity.

70. If testing SSIW is not practicable (for example, soil-grown sprouts harvested with roots or for hydroponically grown sprouts that use very little water), each production batch of sprouts could be tested at the in-process stage (i.e. while sprouts are still growing).

71. The highly perishable nature of sprouted seeds generally makes routine microbiological testing of finished sprouts impractical. Testing spent sprout irrigation water of seed lots, or in-process sprouts is more practical. However, periodic testing of the finished sprouts for generic *E. coli* may be beneficial for evaluating the overall effectiveness of hygiene practices and post sprouting treatments (e.g. final rinse).

7. DISTRIBUTION AND POINT-OF-SALE

72. STEC growth and contamination can occur during transport, distribution and at point-of-sale due to improper handling and poor personal hygiene, and contamination through comingling with other raw food commodities and animals/animal products, and exposure to unsanitary surfaces and/or water**.** Control measures should be applied during distribution and at point of sale to prevent contamination with STEC.

7.1 Transportation

73. Transportation should be done in clean, enclosed, and refrigerated transport vehicles and the temperature in the refrigerated compartment of such transport vehicles, should be monitored.

8. PRODUCT INFORMATION AND CONSUMER AWARENESS

74. Producers should provide relevant information to the consumer to assure the safety of sprouted seeds during storage, handling, and preparation of the product. This information may include, but is not limited to: (1) recommended temperature of storage; (2) the date by which the sprouts should be consumed or discarded (e.g. use-by date); (3) cooking or washing instructions, which should be included on the label if the product is intended to be consumed as non-RTE or cooked before consumption.

75. Consumers should store sprouts at temperatures that will minimize the growth of pathogens such as STEC and adhere to any instructions provided on labeling (e.g. a use-by date or cooking instructions).

9. TRAINING

- All personnel involved in the production and handling of seeds for sprouting or sprouts across the supply chain should receive training on the principles of food hygiene and food safety, in particular the high risk of sprouts and the illness associated with them, as well as personal health and hygiene requirements.

76. Seed producers, handlers, distributors, and processors should be aware of GAPs, GHPs and their role and responsibility in protecting seeds intended for sprouting from STEC contamination.

77. Interventions designed to reduce microbiological hazards in sprouts can be highly technical and difficult to implement. Specific training related to seed sourcing and storage, seed treatment, cleaning and disinfecting, sampling and microbiological testing, and record keeping should be done to ensure successful implementation.

10. RETAIL AND FOODSERVICE

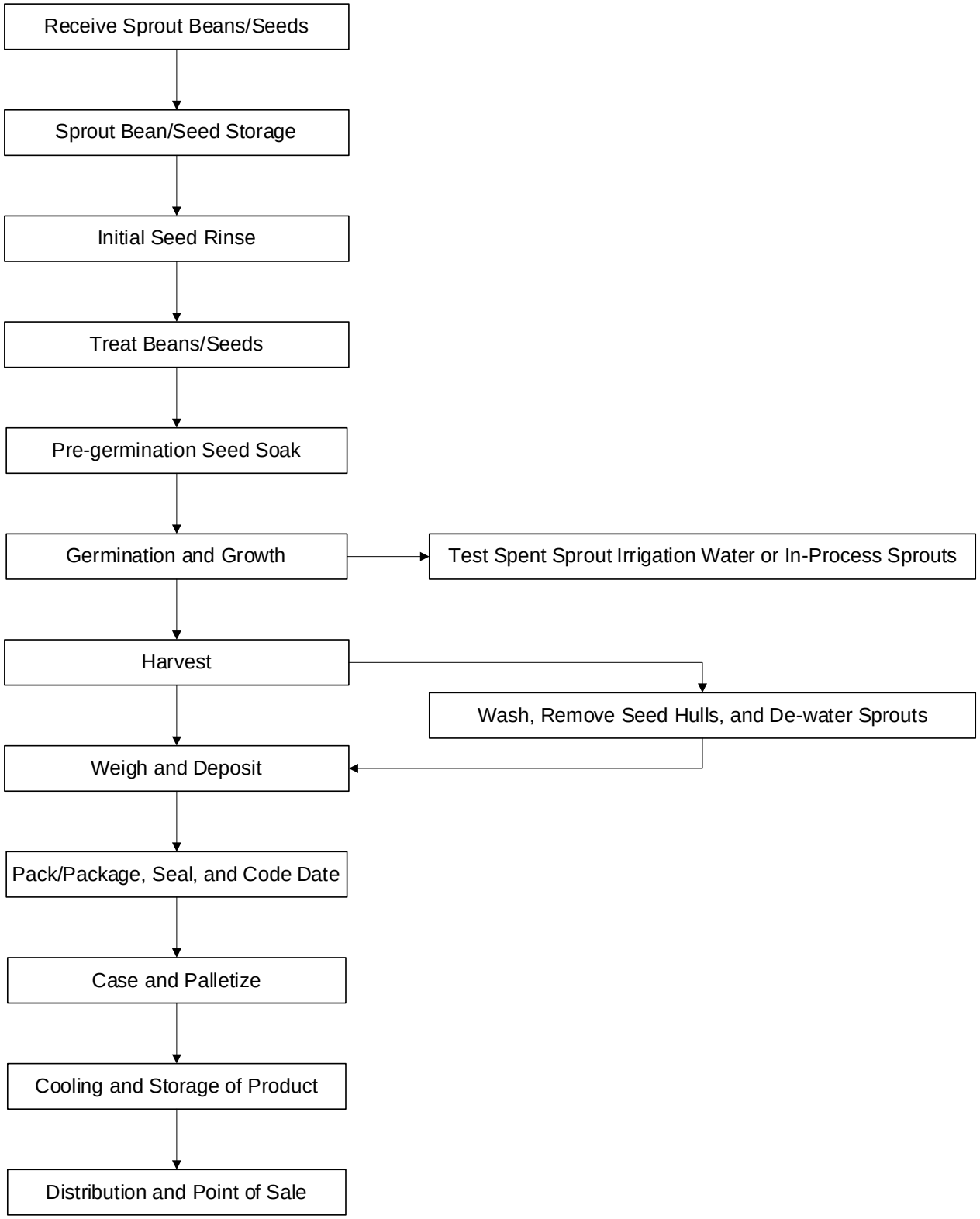
78. Sprouts for retail sale should be held at an appropriate refrigeration temperature to minimize growth of STEC. Temperatures should be monitored.

79. Food business operators serving sprouts for consumption without cooking to consumers should take appropriate measures to:

- prevent cross-contamination,
- discard any sprouts that are past the date on their label for which they can be consumed,
- maintain sprouts at an appropriate storage temperature to minimize growth of STEC that may be present, and
- ensure proper cleaning of tools and surfaces that may come in contact with these products.

80. For in-restaurant sprouting, interventions recommended for sprout operations to minimize the potential for STEC should be considered, including seed sourcing programs, seed treatment (if appropriate), prevention of cross-contamination, sampling, and testing of spent sprout irrigation water (samples to be tested by contract laboratories), as well as cleaning and disinfecting food contact surfaces.

Figure 1: Sprouts flow diagram[5]



[5] The diagram illustrates a generalised process flow to produce sprouts for illustrative purposes only. Steps may not occur in all operations and may not occur in the order presented in the flow diagram and the germination time may be different.