



**JOINT FAO/WHO FOOD STANDARDS PROGRAMME
CODEX COMMITTEE ON CONTAMINANTS IN FOODS**

**Tenth Session
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**PROPOSED DRAFT CODE OF PRACTICE FOR THE PREVENTION AND REDUCTION OF
MYCOTOXIN CONTAMINATION IN SPICES**

**(Prepared by the Electronic Working Group chaired by Spain
and co-chaired by India and the Netherlands)**

Codex Members and Observers wishing to submit comments at Step 3 on the proposed draft Code of Practice for the Prevention and Reduction of Mycotoxin Contamination in Spices (general provisions), including possible implications for their economic interests, should do so in conformity with the *Uniform Procedure for the Elaboration of Codex Standards and Related Texts* (Codex Alimentarius Commission Procedural Manual) (see Appendix I).

Codex Members and Observers are also invited to provide their views on the recommendations of the EWG on:

- general aspects related to the development of the Code as indicated in paragraph 6 while taking into account the conclusions put forward in paragraph 5.
- specific aspects related to the Annexes to the Code as indicated in paragraph 11 while taking into account the conclusions put forward in paragraph 10. Supportive information is provided in Appendix II, Part I.

Appendix II, Part II is an example of an Annex to the Code. Technical provisions contained therein are not subject to comments at this time.

Comments on the above must be submitted by no later than **15 March 2016**.

Comments should be directed:

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BACKGROUND

GENERAL PROVISIONS TO PREVENT AND REDUCE MYCOTOXIN CONTAMINATION IN SPICES - CODE OF PRACTICE FOR THE PREVENTION AND REDUCTION OF MYCOTOXIN CONTAMINATION IN SPICES AND DRIED AROMATIC HERBS (APPENDIX I)

1. The 9th Session of the Committee on Contaminants in Foods (March 2015) agreed to establish an Electronic Working Group chaired by Spain and co-chaired by India and The Netherlands to prepare a proposed draft Code of Practice for the Prevention and Reduction of Mycotoxin Contamination in Spices for circulation for comments at Step 3 and consideration at its next session at Step 4.¹

¹ REP 15/CF para 143

2. This new work was approved by the 38th Session of the Codex Alimentarius Commission (July 2015).²
3. A proposed draft was prepared following the CCCF9 directions for its content. The draft COP was elaborated on the basis of the discussion paper³ presented for discussion at CCCF9 and is attached as Appendix I. An example of a specific annex to the code of practice for mycotoxins in spices is attached in Appendix II, Part II.
4. The work plan of the EWG was to revise the text in Annex I of CX/CF 15/9/16 in order to prepare the final draft COP that will be presented for consideration by CCCF10.
5. The EWG came to the following conclusions:
 - a. Regarding the scope of the COP: According to the current definition and scope of the Code of Hygienic Practice for Spices and Dried Aromatic Herbs in CCFH⁴ (CAC/RCP 42-1995), the EWG considers that the COP should cover the term “spices and dried aromatic herbs”. Nevertheless, other definitions of “spices” are in discussion within different Codex committees (grouping of spices⁵ or the revision⁶ of the Classification of Food and Feed (CAC/MISC 4-1993)).
 - b. Regarding the reference to packaging technologies that ensure the maintenance of moisture (vacuum or modified atmosphere): The EWG has come to the conclusion that packaging material may be incorporated in the COP since it can affect the intrinsic quality of spices. For aromatic and other spices, the quality of the packing material can invariably affect the quality of the spices packed. Although these are expensive options, these technologies could be included in the COP to provide a better understanding of what is possible, even if it is not practical in all situations.
 - c. Regarding the smoke-drying process: Since in some countries, certain spices are dried by this method traditionally for centuries, the EWG considers that this type of drying process should be included in the COP.
6. The EWG makes the following recommendations to CCCF:
 - a. In order to be in line with other Codex documents (grouping of spices⁵ or the revision⁶ of the Classification of Food and Feed), the EWG recommends the CCCF to revise other definitions that could affect the scope of this COP.
 - b. Regarding the reference to packaging technologies that ensure the maintenance of moisture (vacuum or modified atmosphere), the EWG recommends the CCCF to agree on the inclusion of the reference to these types of packaging materials in the COP.
 - c. Regarding the smoke-drying process, the EWG recommends the CCCF to agree on the inclusion of this type of drying process. In case it is accepted, the EWG will work on the description of the process along with any considerations or drawbacks, as well as its scope of use.
 - d. The EWG recommends the CCCF to take into account the outcome of the discussions of other EWGs within the CCCF (prioritization of work on MLs for mycotoxins in spices, revision of the COP on mycotoxins in cereals) and other Codex Committees (recently amended Code of Hygienic Practice for Spices and Dried Aromatic Herbs in CCFH⁷, grouping of spices in CCSC⁸ and the Revision of the Classification of Food and Feed in CCPR⁹).
 - e. The EWG recommends the CCCF that, once the COP has been approved, the preventive measures for mycotoxin-producing fungi included in the Code of Hygienic Practice for Spices and Dried Aromatic Herbs should be moved into the COP for the prevention and reduction of mycotoxins contamination in spices.

² REP 15/CAC, Appendix VI

³ CX/CF 15/9/16

⁴ Committee on Food Hygiene

⁵ CX/SCH 15/02/8

⁶ CX/PR 11/43/5

⁷ Committee on Food Hygiene

⁸ Committee on Spices and Culinary Herbs

⁹ Committee on Pesticide Residues

SPECIFIC PROVISIONS TO PREVENT AND REDUCE MYCOTOXIN CONTAMINATION IN SPICES: ANNEXES TO THE CODE OF PRACTICE FOR THE PREVENTION AND REDUCTION OF MYCOTOXIN CONTAMINATION IN SPICES AND DRIED AROMATIC HERBS (APPENDIX II)

7. The 9th session of the Committee on Contaminants in Foods (March 2015) also agreed that the same EWG would further develop possible annexes for mycotoxin / individual spices or groups of spices combinations to the Code of practice for mycotoxins in spices¹⁰.
8. The example in Appendix II, Part II was elaborated on the basis of the information contained in the discussion paper³ presented at CCCF9.
9. The work plan of the EWG in this regard was:
 - a. To discuss different outlines for specific Annexes for mycotoxin/individual spices or groups of spices combinations.
 - b. To develop proposals for Annexes for consideration by CCCF10.
10. The EWG came to the following conclusions:
 - a. Regarding the organization of Annexes, the EWG has decided, according to the revision of the work of other Codex EGWs and the discussion paper³, to add different annexes for each group of spices containing the specifications to reduce or avoid both aflatoxins and Ochratoxin A.
11. The EWG makes the following recommendations to CCCF:
 - a. To agree on the general structure proposed by the EWG to be followed to draft the annexes for the general COP on mycotoxins in spices.

¹⁰ REP 15/CF para 144

APPENDIX I: PROPOSED DRAFT CODE OF PRACTICE FOR THE PREVENTION AND REDUCTION OF MYCOTOXINS IN SPICES AND DRIED AROMATIC HERBS

1. INTRODUCTION

1. The production, processing, packing and distribution of spices and dried aromatic herbs can be very complex. These processes can span long periods of time and possibly include a wide range of establishments. Dried product processing generally involves cleaning (e.g. culling, sorting to remove debris), grading, sometimes soaking, slicing, drying, and on occasion grinding/cracking. Some spices and dried aromatic herbs are also treated to mitigate microbial contamination. Processing and packing/repacking may also take place in multiple locations over long periods of time, since spices and dried aromatic herbs are prepared for different purposes.

A. Objectives

2. The objective of this document is to establish a general code of practice for the prevention and reduction of mycotoxins in spices *and dried aromatic herbs* in order to attain the lowest achievable level of these toxins by applying good practices throughout all the steps in the food chain, thus reducing consumers' exposure through preventive measures.
3. This code of practice addresses specific Good Agricultural Practices (GAPs), Good Manufacturing Practices (GMPs) and Good Storage Practices (GSPs) that would help minimize mycotoxin contamination throughout all stages of the production of spices *and dried aromatic herbs* from primary production to consumer use. A HACCP system should be built on sound GAPs, GMPs and GSPs.
4. Good Agricultural Practices (GAPs), GMPs and GSPs are applied at the pre-harvest stage, during processing and storage, respectively.

B. Scope, use and definitions

Scope

5. This Code applies to spices *and dried aromatic herbs* - whole, broken, ground or blended. Spices *and dried aromatic herbs* may include the dried aril (e.g. the mace of nutmeg), bark (e.g. cinnamon), berries (e.g. black pepper), buds (e.g. clove), bulbs (e.g. dried garlic), leaves/flowers (e.g. dried basil/dried thyme), rhizomes (e.g. ginger, turmeric), seeds (e.g. mustard), stigmas (e.g. saffron), pods (e.g. vanilla), resins (e.g. asafoetida), fruits (e.g. dried chilli) or plant tops (e.g. dried chives).

Use

6. This Code is a recommendation to which producers in different countries should adhere as far as possible taking into account the local conditions while ensuring the safety of their products in all circumstances. Flexibility in the application of certain requirements of the primary production of spices *and dried aromatic herbs* can be exercised, where necessary, provided that the product will be subjected to control measures sufficient to obtain a safe product.

Definitions

7. **Spices *and Dried Aromatic Herbs*:** Dried components or mixtures of dried plants used in foods for flavouring, colouring, and imparting aroma. The term applies equally to spices in the whole, broken, ground and blended forms.

Spices *and dried aromatic herbs* may include many parts of the plant, such as aril, bark, berries, buds, bulbs, leaves, flowers, rhizomes, roots, seeds, stigmas, pods, resins, fruits, or plant tops.

8. **Spice Blends:** Spice blends are obtained by mixing and grinding, cleaned, dried and sound selected spices.
9. **Source Plant:** plant (non-dried) from which the spice is derived.

2. RECOMMENDED PRACTICES BASED ON GOOD AGRICULTURAL PRACTICES (GAP) AND GOOD MANUFACTURING PRACTICES (GMP)

2.1 Pre-harvest agricultural conditions

10. Spices and herbs are susceptible to contamination by toxigenic fungi in the field. The use of appropriate good agricultural practices (GAP) to reduce the spore of mycotoxin producing fungi is recommended.
11. It is also recommended to develop a control system for the OTA and aflatoxin contamination in the production areas, as well as research studies on the factors affecting the formation of those mycotoxins.

12. A proper crop rotation or sequence should be applied in order to regenerate the soil fertility and reduce the inoculum load of the relevant mycotoxigenic fungi, to minimize the carry-over of moulds from one year to the next.
13. Reduction of plant stress and keep them healthy, using irrigation, fertilization, pruning and pest and disease control.
14. Insect damage which contributes to fungal infection in the vicinity of the crop can be minimized by proper use of registered insecticides and other appropriate practices within an integrated pest management program.
15. Recommended insecticides may be necessary to use, when conditions require, minimizing damage to fruits, which may later favour entry and development of fungi; for example, through open galleries made by caterpillars. It may also be useful to establish an appropriate planting density and prevent weed proliferation during plant development.
16. Weeds around the crop should be controlled by use of mechanical methods or by use of registered herbicides or other safe and suitable weed eradication practices.
17. The use of recommended soil fungicides in the process of farm soil preparation may be beneficial to reduce the spore load of mycotoxin-producing fungi. At sowing, use disinfected seeds to prevent mold and insects and carefully choose the planting season so that the collection of fruits takes place in the driest season. This good practice is essential in areas with warm and humid climate.
18. The use of chemical compounds is a very effective strategy to prevent mycotoxin production. However, fungicides must be applied with special care since some of them, such as carbendazim, have been found to reduce fungal flora but also to stimulate Ochratoxin A production.
19. Spray irrigation should be avoided during the flowering period. This could increase both the rate of normal dispersion of spores and the chances of fruit infection with mycotoxin-producing fungi.
20. Soil with good drainage must be chosen in order to avoid the water logging.
21. It is recommended to remove diseased and injured plants or part of the plants from the field in order to reduce inoculum load of the relevant mycotoxigenic fungi.
22. It is recommended that untreated organic waste not be applied to soil surrounding the crop in the field as it could allow the proliferation of mycotoxin-producing fungi.

2.2 Post-harvest agricultural conditions

2.2.1 Harvest

23. During the harvesting operation, the moisture content should be determined in each load of the harvested commodity since it affects drying times. As far as possible, avoid harvesting crop with high moisture contents (for instance, due to precipitation or morning dew and/or during late afternoon) as it takes a longer time to dry thus mycotoxin formation may occur.
24. Chances of mechanical damage, a type of stress that occurs during the post-harvest manipulation of crops and which is accompanied by physiological and morphological changes that affect the commodity, may be avoided so that subsequent contamination can be significantly reduced.
25. Fruits and leaves and other spice components that have fallen to the ground are known to be exposed to mould growth. Crops that are affected by mould or infected should be removed. Alternatively, the raw spice that has fallen to the ground can be collected separately, if it is washed, cleaned, dried and evaluated prior to any inclusion within the main lot.
26. The soil under the plant should be covered with a clean sheet of plastic during picking to avoid commodities from getting contaminated by dirt or mixed up with mouldy fruits that have fallen prior to harvesting.
27. Wherever possible a system for differential harvesting should be applied, so that once products are ripe they are harvested. This ensures good quality and helps prevent mould growth and mycotoxins production from overripe crops.

2.2.2 Transport

28. Containers and transportation devices (e.g. wagons, trucks) to be used for collecting and transporting the harvested commodity from the field to drying and storage facilities after drying, should be clean, dry and free of crop residues, old plants, plant dust, insects and visible fungal growth before use and re-use.

29. Harvested commodities that have not been dried to a safe storage moisture level should not be stored or transported in closed bins, wagons or trucks until the crop reaches acceptable storage moisture levels. When necessary, it is recommended that the trucks and containers be opened, in order to increase aeration and minimise the condensation effects.

2.2.3 Storage (fresh product)

30. Gunny bags should be stored off the floor (on pallets) and away from the walls (at least 30 cm) so that any potential condensation does not cause the product to become wet and to avoid the chance of moisture entering through the wall. Internal walls, floor surfaces, the junctions of the floor with the walls and the junctions between two walls should be made with a smooth, water-proof, non-absorbent, washable and non-toxic material.
31. Control of insect and rodent activity and maintenance of appropriate moisture levels and temperature in the storage room is essential. Insects and rodents can spread contamination and spoil the crop. If possible, only the amount that can be processed in a timely manner should be picked in order to minimize growth of mycotoxin-producing moulds prior to processing.
32. Proper storage is necessary to prevent biological activity through adequate drying to less than 10 % moisture. Storage facilities should include dry, well-vented structures that provide protection from rain, drainage of ground water, protection from entry of rodents and birds, and minimum temperature fluctuations.
33. The storage facilities should be cleaned and disinfected with appropriate substances (which should not cause off-odours, flavours or contaminate the crop). The use of registered fumigants or insecticides within the permissible level may be useful.
34. The use of chemical compounds is a very effective strategy to prevent fungal growth and mycotoxin production. If allowed, treatments with approved chemicals including sodium bisulfite, ozone, or acids and bases represent an opportunity to control fungal growth and mycotoxin biosynthesis in stored grains. The use of bases like ammonia can affect the aroma of spices. Hence it should not be recommended.

2.3 Industrial processing conditions

2.3.1 Sorting

35. It is necessary to separate the raw material upon receipt, to prevent any cross-contamination during the cleaning, washing, and processing stages.
36. Raw materials should be inspected and sorted prior to introduction into the processing line. The inspection may include visual inspection and removal of foreign material, organoleptic evaluation and analytical tests for mycotoxin contamination.
37. When necessary, prior to drying, the harvested products should be washed to remove organic debris and dust, for which potable water can be used. During this phase there should be a selection process to eliminate any fresh spice showing symptoms of fungal infection, and small portions of any contaminated fruit should be removed, because they can contaminate a whole batch. This procedure can be carried out on the farm. The discarded materials should be properly disposed of in order to avoid the recontamination of the clean material. However, washing is not appropriate for dried aromatic herbs (e.g. oregano, thyme).

2.3.2 Processing

38. The time between harvesting and drying should be as short as possible, including transport from the field to post-harvest facilities.
39. Growth of mould prior to, during and after drying may result in mycotoxin production. Inappropriate handling of raw materials may support the growth of several spoilage and toxigenic moulds prior to drying. Proper drying of spices to achieve a water activity below 0.60 is adequate to prevent mycotoxin production.
40. The drying area should be elevated to prevent pest ingress and potential flooding, and should be constructed of a material that will not contaminate the stored spices.
41. A concrete pad can serve this purpose and in this case it should have a slightly sloping surface to allow water runoff from the product and should have a perimeter fence to prevent farm animals, pets, pests, etc. from accessing the crop as it is drying.
42. It is important to ensure that the drying yard is cleaned prior to use.
43. Fresh spices should be processed as quickly as possible. Avoid storage of spices as any period of storage (in a bag or in a pile) increases the likelihood of mould growth. Wherever possible, start drying on the day of harvesting.

44. Drying methods:

1. Sun drying

- a. Drying should not occur on bare soil. Use trays, tarpaulins, bamboo mats or drying yards and make sure that these are clean as it is known that mould spores from previous use could re-contaminate product during drying. Techniques for cleaning all of the above should be taught to farmers. Never use cow dung paste in bamboo mats to fill the holes.
- b. The availability of additional tarpaulins should be ensured to cover the crop in case of any unexpected rain.
- c. The layer of drying fruits or leaves should not be more than 4 cm thick.
- d. Drying fruits or leaves must be regularly raked (5-10 times per day).
- e. Fruits should be protected during drying from rain and night dew. Fruits should not be allowed to get re-wet during storage or any other time.
- f. Drying areas should be raised from the ground to prevent water or pests from entering.
- g. Pathways should be made in the drying area to prevent anyone walking on the crop, as this can damage the crops and allow mould growth to occur.

2. Controlled drying

- i. A controlled drying system can be employed to give better quality, reduced bacterial loads and ensure less risk of mycotoxin growth.
- ii. Solar drying is one method, where crops are protected in polythene tunnels and the temperature is controlled through the use of air circulation. Such tunnels should be designed so that the risk of condensation falling onto the drying crop is eliminated.
- iii. Hot air drying can also be employed and care should be taken to ensure that there is no risk of fumes from the fuel coming into contact with the product. This can be best achieved through the use of a heat exchanger so that only clean air comes into contact with the product.
- iv. A solar heat exchanger can also be used where hot air is generated from the sun's rays.
- v. It is recommended that an optimum drying temperature increases to 50-60 Celsius degrees (optimum temperature) and ambient humidity in the drying chamber be reduce to 12 % moisture level.

3. Smoke drying

- a. This type of controlled drying is carried out in drying houses. Drying houses have a variable size, but the plant is either rounded or squared, around five meters high. The material used is terracotta or bricks.
- b. This system is conducive to slow, gentle, non-aggressive drying so that within 10 to 15 days the water content of the fruit falls from 80 % to under 15 %. The final product obtained has a smoky taste and aroma and a very stable color.

45. Drying of source plants may be performed mechanically (for rapid drying) or naturally (e.g. slower drying under the sun for several days). Both processes are detailed in the Code of Hygienic Practice for spices *and dried aromatic herbs* as well as in the IOSTA Guidelines for Good Agricultural Practices for Spices.

46. In the case of dried aromatic herbs (e.g. oregano, thyme), the removal of dust from herbs is performed after drying using a sieve of a small pore size and light oscillation or alternatively an inclined perforated cylinder drum which is rotated and the dust is removed as a result of the centrifuge force (washing damages the glands of the plants where the oils are stored and the colour of the leaves/flowers, which become darker or black).

47. Sterilization processes are effective in reducing the mould load in spices. These mould-reducing processes should be considered once the spice is dry (final processing). There is at least one mycotoxin-reducing process authorized for spices (gamma irradiation) in some countries/regions. It has been proved to be efficient in eliminating fungi in chilli, coriander, cumin, turmeric and Ashanti pepper. Moreover, other treatments utilized to reduce or eliminate toxigenic fungal spores in spices include UV as well as fumigation with ethylene oxide.

2.3.3 Storage after Drying and Cleaning

48. Fungal growth on stored spices is mainly influenced by temperature and relative humidity.

49. Temperature levels within large warehouses can be ideal for mould growth, particularly towards the roof, thus suitable ventilation should be provided in order to ensure proper management/control of both temperature and humidity.
50. Specific conditions to be utilized include the use of local ventilation systems that force the production of currents of cold, dry air to assure good ventilation, storage in a clean, dry place, and protection from dust, debris, insects and rodents. Product should be stored in well maintained warehouses that do not allow the ingress of water whether through leaks in the roof or walls or under doors, through open windows, etc. Besides, products which affect the storage of spices should not be stored in the same warehouse or compartment where spices are stored. For example, such items as fruits, vegetables, fish, fertilizers, kerosene or petrol, lubricating oils, etc.
51. Spices and dried aromatic herbs should be kept in areas where contact with water or moisture is minimized.
52. It is also important to ensure that product is stored off the floor and away from the walls so that any potential condensation does not cause the product to become wet. In addition there should be good air circulation through the warehouse to prevent sweating and mould formation.
53. The storage location should prevent access, to the extent practicable, by rodents or other animals and birds and should be isolated from areas of excessive human or equipment traffic.
54. Practices should be in place to minimize insect infestation in the spices at all stages of production, particularly during storage. Increased insect populations raise both the temperature and moisture content of the spices allowing for the subsequent growth of moulds and mycotoxins. The movement of insects through the spices facilitates the distribution of the moulds and mycotoxins throughout the product.
55. The harvesting and storage procedures implemented each season should be documented by making notes of measurements (e.g., temperature, moisture, and humidity) and any deviation or changes from traditional practices. This information may be very useful for explaining the cause(s) of fungal growth and mycotoxin formation during a particular crop year and may help to avoid similar mistakes in the future.

2.3.4 Transport from Storage

56. It is important that the operator select reliable transport service-providers that adopt this code of practice and ensure appropriate transport conditions.

2.3.4.1 Preventing moisture contamination

57. When the commodity is moved into or out of the warehouse, ensure that it is protected from the rain.
58. During transportation, due attention should be given to avoid re-entering of water/moisture into the commodity and to ensure that pests or debris cannot penetrate to the commodity.
59. Regular checks should be made to ensure that the truck is covered and that there are no rips in the covers and no leaks on the undersides of trucks which could allow water from the road to get into the truck. Check from the inside by closing all doors and looking for holes where daylight is visible.
60. Trucks must be clean, dry and odour-free. This also prevents cross contamination from previously transported products.
61. Trucks should not be loaded and unloaded if the product has the potential to be exposed to rain. Shelter should be provided so that the spice does not get wet during this operation.
62. The pallets or wooden floors of transport containers should be dry. Temperature and humidity sensors should be used inside the containers in order to detect fluctuations that might cause mold growth during transportation. Spices absorb moisture quickly if the bags get wet and as a result the moisture content increases considerably.

2.3.4.2 Hygiene practices during transportation

63. The containers and conveyances for transporting the source plant material or spices and dried aromatic herbs from the place of production to storage for processing should be cleaned and disinfected, as appropriate, before loading. Products should be protected, where practicable, against outdoor conditions during transportation. Covering should be provided to prevent rain, pests or debris from getting onto the commodity.
64. Field debris should be prevented from entering packing and storage facilities by cleaning the outside of harvest bins and requiring workers to wear clean clothes in those areas.

65. It should be verified that containers have not been previously used for dangerous and hazardous cargoes according to the criteria set by IMCO (International Maritime Organization), such as solid or liquid chemicals, oil refinery industry products, and waste chemicals.
66. Transit times should be made as short as possible. Avoid long stops and do not load container too early ahead of shipment in order to avoid excessive heat build-up within the container.
67. Containers should be shaded or covered to help to minimise the temperature increase within the container. The roof of an unprotected container can reach temperatures of over 80°C. The subsequent cooling off during the night results in condensation on the internal walls.
68. Containers lined with cardboard (single-side corrugated and waxed on the inside) have proven to be the best protection against condensation for bags in containers.
69. Kraft paper has also been used successfully to line containers. Ensure that the lining is properly fastened, particularly in the ceiling so that the lining will not fall down and settle on the top bags.
70. Bags should preferably be placed on a layer of pallets to avoid contact with the floor where condensation from the ceiling and walls may gather. If available, fully ventilated containers are preferable for spices in bags, especially if shipped from a high humidity origin. Alternatively the standard dry container with added paper / cardboard protection (top, sides and doors) is fully acceptable.
71. Ventilation holes in the container are to be kept clear. Do not cover with tape.
72. Desiccant boxes filled with calcium chloride can absorb around 100 % of their own weight in moisture and may be used for added protection.
73. It is important that care is taken not to damage these dry-bags and any spillages should be cleaned up immediately.
74. Ample top space between bags and the roof is important to maintain. Use the saddle stow method, which minimises side contact and maximises airflow between the bags.

2.3.5 Packaging

75. Use of appropriate packaging can help to avoid insect contact with the commodity and therefore, limits mould growth. Packaged commodities should be kept free of moisture or humidity. The possible use of packaging with intelligent materials which absorb humidity should be explored.
76. Packing activities can occur in the growing/harvest area. Such packing operations should include the same sanitary practices, where practical, as packing spices *and dried aromatic herbs* in establishments or should be modified as needed to minimize risks. To prevent germination and growth of spores, the products must be dried to a safe moisture level prior to packing.
77. New bags should be used when packing spices *and dried aromatic herbs* in the growing/harvest area for transport, storage, or for further sale, to prevent the potential for microbial, physical and chemical contamination.
78. When bags of spices have an open structure, such as jute bags, the bag should not be marked with liquid ink in order to prevent liquid intrusion. It is recommended that marked paper tags should be used as bag labels instead of liquid ink marking.
79. Containers should be inspected immediately before use to ensure that they are in a satisfactory condition, as defined by the manufacturer, and where necessary, cleaned and/or disinfected; when washed, they should be well drained and dried before filling.
80. Removal of discarded plant material should be done on a regular basis in order to avoid accumulation that could promote the presence of pests.
81. Two recommendations that could affect this step:
 - A) The use of packaging impervious to water in order to maintain moisture below 12 %.
 - B) The use of packaging technologies that ensure the maintenance of moisture as vacuum or modified atmosphere with the use of the appropriate packaging material, where feasible.

2.3.6 Labeling and distribution/information to consumers

82. The manufacturer should indicate the expiration date of the commodity. This date will be justified by completing appropriate studies that take into account the characteristics of the packaging, examining unfavorable conditions that may promote mould growth and verifying the quality of the final product in order to give assurance that no mycotoxins contamination will occur until the end of the viability indicated for consumption of that commodity.
83. The manufacturer should indicate specific storage instructions to include but not be limited to storage in a cool, dry, well-ventilated area away from heat sources such as ovens and areas with high humidity; avoid storing in a refrigerator to prevent condensation, etc.
84. The manufacturer should specify tips for good use by the consumer to minimize the risk of mycotoxins contamination which include avoiding contact with wet utensils and wooden spoons, closing containers tightly immediately after use, avoiding unnecessary stockpiling and checking dates of preferred consumption.

APPENDIX II: SPECIFIC ANNEXES TO THE CODE OF PRACTICE FOR MYCOTOXINS IN SPICES

PART I: Discussion on organization of annexes

There are several possibilities to organize the annexes taking into account different mycotoxins and different spices or group of spices.

1. Background for “mycotoxins”

As it was agreed upon at the CCCF9 when considering the discussion paper³, the main mycotoxins identified in spices are ochratoxin A (OTA) and aflatoxins (AFT). These mycotoxins are produced by *Aspergillus* and *Penicillium* species. However, the same management practices can be applied in order to reduce their presence in spices.

This information has been confirmed by the EWG on “mycotoxin contamination in spices for possible prioritization of the work” (within CCCF). The discussion paper includes a list of spices that are affected by the two mycotoxins mentioned (OTA and AFT). There is no data/information on contamination of spices by other mycotoxins:

Mycotoxins	Fungi	Spices affected by mycotoxins
Aflatoxin (B ₁ , B ₂ , G ₁ , G ₂)	<i>Aspergillus flavus</i> , <i>A. parasiticus</i> , <i>A. nomius</i>	Chilli, Clove, Ginger, Nutmeg, Paprika, Pepper, Turmeric
Ochratoxin (Ochratoxin A)	<i>Aspergillus ochraceus</i> , <i>A. carbonarius</i> , <i>Penicillium verrucosum</i>	Cayenne pepper, Celery seed, Chilli, Garlic, Mace, Nutmeg, Paprika, Pepper, Poppy seed, Turmeric

The EWG on prioritization of work on spices has provided a list of spices to be considered by the CCCF for the establishment of MLs. The method of prioritization described in the discussion paper is based on several aspects, such as the concentration of mycotoxins found in those spices worldwide, their importance with respect to the international trade and their per capita daily consumption. The top 5 spices on the priority list are: Turmeric, chilli/paprika, nutmeg, ginger and pepper (in this order).

2. Background for “spices”

According to the discussion paper⁵ on grouping of spices and culinary herbs, the grouping of spices is based on their morphology and the parts of plants used, as well as on their major utility and the terminology used in global commerce. The proposed groups for spices are listed below:

- 1) Dried Fruits and Berries
- 2) Dried Roots, Rhizomes, Bulbs
- 3) Dried Seeds
- 4) Dried Floral parts
- 5) Dried Leaves
- 6) Dried Bark
- 7) Others

We could use the same approach for grouping since the risk of mycotoxin contamination is presumed to be very similar within the group (similar fungi affecting the part of the plant used).

3. Discussion on the organization of annexes

According to the revision of the work of other Codex EGWs and the discussion paper³ presented at CCCF9, the proposal of this EWG is to add different annexes for each group of spices, possibly following the grouping mentioned above, where the spice production could be approached together with specific management practices (if applicable) to avoid the most common mycotoxins affecting those spices. In cases without information on specific management practices, reference to the main body of the COP should be made (similar to the COP for mycotoxins in cereals). The document would be amended and updated as new evidence become available.

The proposal for the Annex in Part II is added as an example. It is mainly focused on OTA in chilli/paprika (second spice in priority). However, if this approach is accepted, the Annex would be revised to make it applicable to the rest of spices of the group “dried fruits and berries”. Evaluation also should be made to see if aflatoxins are reduced by means of these good practices as well.

PART II: Proposals for an Annex to the general COP**PREVENTION AND REDUCTION OF CONTAMINATION BY OCHRATOXIN A AND AFLATOXINS IN SPICES OF “DRIED FRUITS AND BERRIES”****1. INTRODUCTION**

Good hygiene practices may help prevent and reduce the OTA and aflatoxins contamination of spices during the stages of production, drying, transport, processing and storage.

Following good agricultural practices during both pre-harvest and post-harvest stages should result in a minimization of the problem of contamination by mycotoxins such as aflatoxins and ochratoxin A.

2. RECOMMENDED PRACTICES**2.1. BEFORE HARVEST**

Refer to paragraphs XXX of the general Code of Practice.

2.1.1. Variety choice

Varieties of chilli and peppers that have a thin pulp and with high dry solid content should be selected; these traits make the drying easier and faster.

2.1.2. Fungicides

In geographic areas where climatic conditions are favorable for contamination by mycotoxin-producing fungi (warm temperatures and high humidity), authorized fungicides should be applied, especially during fruit ripening, taking into account the maximum residue limits (MRLs) for the country and the corresponding processing factor due to desiccation, which is 5-6 for this group of spices, but it is estimated that it can reach a value of 10.

2.2. HARVESTING

Refer to paragraphs XXX of the general Code of Practice

It is important to harvest the peppers at the optimum point of ripeness and most intense color, which indicates a higher content of natural pigments and lower water content.

2.3. POST-HARVEST**2.3.1. Storage (fresh product)**

Refer to paragraphs XXX of the general Code of Practice.

Fresh fruits should be stored under a relative humidity below 80% and a temperature between 7-12 °C to prevent the proliferation of OTA producing fungi.

2.3.2. Drying

Refer to paragraphs XXX of the general Code of Practice.

In the case of paprika, the drying process produces a dried product whose composition on a dry base is approximately 33% of seed, 8% of stalk and 58.5% of pod.

The fruits can be dried either using direct sun (taking 3 or 4 days during periods of high temperatures and 7 or 8 in colder seasons) or in hot-air mechanical driers using air of low relative humidity (RH) and temperature of 45-65 °C (from 10-12 hours). In areas with climatic conditions of high humidity and mild temperatures, it is preferable to use hot air dryers, since the sun drying process can be extended up to 20-25 days, which favors the growth of OTA producing fungi. Smoke drying is also used in some parts of the world, reducing the possibility of mycotoxin formation.

The OTA-producing fungi require favorable conditions to grow and produce the toxin. The level of available water content is the most important factor to be considered. At high water activity ($a_w > 0.95$) OTA-producing fungi is unlikely to grow as fast-growing hydrophilic fungi and yeasts grow first. At lower water activity ($a_w < 0.60$) the OTA-producing fungi can be present but do not produce the toxin, and at a_w below 0.76-0.78 they cannot grow.

Therefore the most important point is to control the period of time in which the pepper stays in the drying yard with the aim of avoiding the range of water activity where OTA-producing fungi can grow ($a_w = 0.76-0.95$).

2.3.3.Sorting

Refer to paragraphs XXX of the general Code of Practice.

Once the peppers are dried, remove and discard all stained, immature, discolored and damaged fruits. The elimination of a single piece of a contaminated fruit is not a preventive measure for the OTA contamination, but if left with the rest of the fruit, it may contaminate the entire batch or even other consignments that may be in the mix.

2.3.4.Packaging

Refer to paragraphs XXX of the general Code of Practice.

After removing the stalk (optional), and in case the peppers that are not processed immediately, the product is eventually compacted into bales.

The presses used must be clean and in good condition. Breathable and suitable for food contact raffia bags must be used and should be tightly closed to prevent insects or other pests infestation. The dry pepper packed into bales should be stored in a closed, clean and ventilated warehouse, and always protected from moisture.

2.4. TRANSPORTATION

Refer to paragraphs XXX of the general Code of Practice.

Bags of dried peppers should be well stacked and crossed over for mutual support in order to avoid the formation of empty vertical columns (chimneys). The top layer and sides of bags should be covered with materials that can absorb condensed water, such as silica gel or cardboard for protection against condition that favors fungi growth that could result in OTA production.

During transportation, containers that are resistant to insect and rodent, or authorized chemical repellent treatments in order to prevent infestation. As an effective option, the pepper can be fumigated with magnesium or aluminum phosphide for transportation in containers.

2.5. PROCESSING

Refer to paragraphs XXX of the general Code of Practice.

Because pepper is hygroscopic, it must be packaged quickly after processing using a material that serves as a barrier to moisture.

The modified atmosphere packaging conditions may be used to inhibit growth and reduce aflatoxin production of *A. flavus*. Sealed or vacuum conditions can prevent mycotoxin occurrence of red chili pepper during storage.

The moisture content of the final product should range between 5 % and 12 % to prevent the proliferation of fungi.

2.6. STORAGE

Refer to paragraphs XXX of the general Code of Practice.

The layout, design, construction, location and size of pepper storage areas should permit adequate maintenance, cleaning and/or disinfection.

When necessary, these areas should provide suitable conditions for handling and storage at controlled temperature and a sufficient capacity for maintaining foodstuffs at appropriate temperatures that can be monitored and, if necessary, recorded. The atmosphere should be maintained at a relative humidity of 55 to 60 percent to protect the quality and prevent mold growth.

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