

# codex alimentarius commission



FOOD AND AGRICULTURE  
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## JOINT FAO/WHO FOOD STANDARDS PROGRAMME

### CODEX COMMITTEE ON FOOD ADDITIVES AND CONTAMINANTS

Thirty-fifth Session

Arusha, Tanzania, 17 - 21 March 2003

#### PROPOSED DRAFT CODE OF PRACTICE FOR THE REDUCTION OF AFLATOXIN CONTAMINATION IN TREE NUTS

Governments and international organizations wishing to submit comments on the following subject matter are invited to do so **no later than 31 January 2003** as follows: Netherlands Codex Contact Point, Ministry of Agriculture, Nature Management and Fisheries, P.O. Box 20401, 2500 E.K., The Hague, The Netherlands (Telefax: +31.70.378.6141; E-mail: [info@codexalimentarius.nl](mailto:info@codexalimentarius.nl), with a copy to the Secretary, Codex Alimentarius Commission, Joint FAO/WHO Food Standards Programme, FAO, Viale delle Terme di Caracalla, 00100 Rome, Italy (Telefax: +39.06.5705.4593; E-mail: [Codex@fao.org](mailto:Codex@fao.org)).

#### Background

1. The 34<sup>th</sup> CCFAC agreed that a drafting group led by China, with the assistance of Brazil, Iran, Sweden, Thailand the UK, the USA and the INC, would elaborate a proposed draft Code of Practice for the Reduction of Aflatoxin Contamination in Tree Nuts for circulation, comment and further consideration at its next meeting, with the understanding that the proposal would be subject to approval as new work by the Executive Committee.<sup>1</sup> The 50<sup>th</sup> Session of the Executive Committee approved the proposal as new work.<sup>2</sup>

#### Preamble

2. The elaboration and acceptance of a Code of Practice for tree nuts by Codex will provide uniform guidance for all countries to consider in attempting to control and manage contamination by various mycotoxins, specifically aflatoxins. In order for this Code of Practice to be effective, it will be necessary for the producers and processors in each country to consider the general principles given in the Code, taking into account the agronomic practices associated with the tree nuts produced in their regions, before attempting to implement provisions enumerated in the Code. It is important for producers to realize that Good Agricultural Practices (GAP) represent the primary line of defense against contamination of nuts with aflatoxins, followed by the implementation of Good Manufacturing Practices (GMP) and Good Storage Practices (GSP) during the handling, processing, storage and distribution of nuts for human consumption. Only by effective control at all stages from the farm through to processing can excellent quality of the final product be assured. However, the complete elimination of mycotoxin contaminated commodities, including tree nuts, is not achievable at this time.

3. This Code of Practice applies to all varieties of tree nuts of commercial and international concern, including almonds (*Prunus amygdalus*), Brazil nuts (*Bertholletia excelsa*), cashews (*Anacardium*

<sup>1</sup> ALINORM 03/12, para. 128

<sup>2</sup> ALINORM 03/3A, Appendix III

*occidentale*), hazel nuts (*Corylus* spp.), macadamia nuts (*Macadamia* spp.), pecans (*Carya* spp.), pine nuts (*Pinus* spp.), chestnuts (*Castanea* spp.), pistachio nuts (*Pistacia* spp.) and walnuts (*Juglans* spp.). It contains general principles for the reduction of aflatoxins in tree nuts that should be sanctioned by national authorities. National authorities should educate producers regarding the environmental factors that promote infection and growth of fungi in tree nuts resulting in the production of aflatoxin in orchards. Emphasis should be placed on the fact that the planting, preharvest and postharvest strategies for a particular nut crop depends on the climatic conditions of a particular year, and traditional production, harvesting and processing practices followed in a particular country or region. National authorities should also support research on methods and techniques to prevent fungal contamination in the orchard and during the harvesting, processing and storage of tree nuts. An important part of this is the understanding of the ecology of *Aspergillus flavus/parasiticus* in connection with tree nuts.

## **PROPOSED DRAFT CODE OF PRACTICE FOR THE REDUCTION OF AFLATOXIN CONTAMINATION IN TREE NUTS**

1. This document is intended to provide guidance for all persons involved in producing tree nuts for entry into international trade for human consumption. All tree nuts should be prepared and handled in accordance with general hygienic principles and practices that are pointed out in appropriate sections of the Recommended International Code of Hygienic Practice for Tree Nuts<sup>1</sup>, and the Recommended International Code of Practice- General Principles of Food Hygiene<sup>2</sup>, which are relevant for all foods being prepared for human consumption. These codes of practice indicate the measures that should be implemented by all persons that have the responsibility for assuring that food is safe and suitable for consumption.

### **I. RECOMMENDED PRACTICES BASED ON GOOD AGRICULTURAL PRACTICES (GAP) GOOD MANUFACTURING PRACTICES (GMP) AND GOOD STORAGE PRACTICES (GSP)**

#### **Criteria for Orchard Sites**

2. Growers should obtain background information concerning the potential orchard site to determine if: (1) the soil composition is ideal to support the growth of the desired tree variety (2) there is adequate drainage of ground water (3) there are any environmental factors inherent to that location (such as wind-, soil- and dust-borne contaminants and pollutants) that might have a negative impact on safety concerns for human foods and (4) there is an available source of water suitable for irrigation and other purposes, viz. the water used would not constitute a public health hazard to the consumer through tree nuts.

3. Neighboring fields should not be used for plants which are known to be easily infected with *A. flavus/parasiticus* (e.g. maize) and consequently serve as a source of infection (spores spread by winds, insects, etc).

#### **Planting**

4. In designing the layout of the orchard, recommended adequate spacing for the variety of trees to be planted should be adhered to. Adequate spacing is necessary so that trucks and equipment needed for spraying trees can be accommodated and that ventilation of the orchard is maintained to reduce the growth of fungi. Information concerning plant spacing may be obtained from plant breeders or agricultural personnel.

5. Where possible and practical, the orchard surface area should be prepared before planting by destroying or removing all debris that may have served, or may potentially serve as substrates for the growth of mycotoxin-producing fungi. If there are areas vulnerable to soil erosion, no-till practices may be required in the interests of soil conservation.

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<sup>1</sup> CAC/RCP 6-1972. Recommended international code of hygienic practice for tree nuts. Codex Alimentarius Volume 5A.

<sup>2</sup> CAC/RCP 1-1969, Rev. 3 (1997), Amd. (1999). Recommended international code of practice- general principles of food hygiene. Codex Alimentarius Volume 1A.

6. Before planting, growers should consult with appropriate plant breeding authorities or tree nursery personnel to ascertain the variety of trees that have been adapted to their region, and the availability of species that are resistant to various factors (e.g., frost, microbial and fungal diseases) that can have an impact on the safety and quality of nuts produced in the orchard.

7. Growers should be familiar with GAPs associated with the use of formulated fertilizers, manure and other biosolids that may be used to enhance the nutritional state of the soil, without increasing the risks of introducing hazards originating from microbial or fungal sources in the orchard. If possible and practical, animal manure used should be followed the recommendation in GAPs.

8. The soil in the orchards should be disturbed as little as possible after planting.

9. Growers should consult with local or national authorities to determine insects and other pests that are commonly found in their region that might attack tree nuts causing them to be more susceptible to fungal infections that can lead to aflatoxin production.

10. Growers should take adequate precautions to ensure that human and animal wastes are disposed of in such a manner as not to constitute a public health or hygienic hazard, and take extreme care to protect the products from contamination with these wastes .

### **Preharvest**

11. During the growing seasons, roadways near the orchards should be watered or oiled periodically to minimize outbreaks of mites as a result of dusty conditions. Cultivation practices, in the vicinity of the orchard, that might disperse *Aspergillus flavus*/A. *parasiticus*, and other fungal spores in the soil to aerial parts of trees should be avoided.

12. Registered pesticides including insecticides, fungicides, herbicides, acaricides, and nematocides should be used to minimize damage that might be caused by insects, fungal infections, and other pests in the orchard and adjacent areas. Accurate records of all pesticide applications should be maintained.

13. Irrigation should be implemented in regions with high temperatures and very little rainfall during the growing season, however, irrigation water should be prevented from contacting the nuts and foliage.

14. Water used for irrigation and other purposes (e.g., preparation of pesticide sprays) should be of suitable quality for the intended use.

15. All equipment and machinery, which is to be used for harvesting, storage and transportation of crops, should not constitute a hazard to health. Before harvest time, all equipment and machinery should be inspected to ascertain that they are clean and in good working condition to avoid contamination of the nuts with soil and other potential hazards.

16. Trade Associations, as well as local and national authorities should take the lead in informing growers of the hazards associated with aflatoxin contamination of tree nuts and how they may practice safe harvesting procedures to reduce the risk of contamination by fungi, microbes and pests.

17. Personnel that will be involved in harvesting nuts should be trained in personal hygienic and sanitary practices that must be implemented in processing facilities throughout the harvesting season.

### **Harvest**

18. Harvesting of nuts should begin as soon as practicable after maturation to minimize problems involving fungal attack and insect infestation. Some varieties of nuts become contaminated with aflatoxins while still on the tree as a result of insect infestation and hull splitting, therefore, the earlier the harvest, the less chance there is for contamination to occur because there is a greater chance that the outer hull will remain intact to protect the underlying shell from insects and fungal spores.

19. Nuts, harvested by shaking the trees, should ideally be collected by mechanical harvesters with catching frames, or on some type of protective sheets or tarps under the trees to prevent nuts from falling to the ground. In regions where certain varieties of nuts are traditionally harvested by shaking the trees and/or allowing mature nuts to fall freely to the ground for collection by harvesting equipment or by hand, the orchard should not be used for grazing or holding cattle or other animals. If the land has been so used, the orchard should be worked immediately prior to harvesting (disced, rottilled, or soil turned in some manner) to lessen the hazard of fecal contamination of tree nuts. In addition, procedures should be in place to ensure their removal as soon as possible to decrease exposure to *Aspergillus flavus*/*A. parasiticus* spores that may be denser in the air near the ground and associated with plant debris.

20. The nuts, after collection, should be sorted to remove all foreign materials and transported as soon as possible to a processing facility for immediate processing (hull removal) in containers (e.g., trucks, conveyers) that are clean, dry, and free of insects and visible fungal growth. High humidities which are conducive to proliferation of mould and development of mycotoxins should be avoided to the greatest extent practical. Conveyances for transporting should be of such material and construction as will permit thorough cleaning and should be so cleaned and maintained as not to constitute a source of contamination to tree nuts .

### **Postharvest**

21. Nuts remaining on the trees after harvest should be removed during the winter months to reduce the overwintering of various insect populations, including the Navel Orangeworm (NOW) that is a problem in orchards containing almonds, pistachio nuts and walnuts in some regions of the world.

22. Trees should be pruned and treated with appropriate pesticides prior to each growing season.

23. The orchard floor should be cleared of litter and debris from the harvesting operations in order to decrease the colonization of *Aspergillus* fungi in the orchard.

24. Containers, equipment and machinery that have been used for harvesting operations should be stored in a clean location to minimize inadvertent contamination with fungi, chemicals, fertilizers or toxic substances.

25. Harvesting and storage procedures implemented each crop year 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 useful for explaining the cause(s) of fungal growth and mycotoxin formation during a particular crop year and help to avoid similar mistakes in the future.

### **Processing**

26. Personnel involved in all stages of tree nut processing should maintain a high degree of personal cleanliness, wear suitable protective clothing, be trained in food hygiene and general sanitation procedures to a level appropriate to the operations they are to perform in the processing facility. A system should be in place to ensure that all personnel remain aware of all precautions necessary to reduce the risk of aflatoxin contamination in the processing operations. In addition, precaution should also be made to protect the personnel from inhalation of fungal spores which may be released from infected nuts during the processing.

27. Areas where raw materials are received or stored should be separated from areas in which final product preparation or packaging is conducted as to preclude contamination of the finished product . The hulling of nuts should be carried out in a location that is separated by partitions from the main processing area of the facility. Care should be taken to ensure that dust-laden air is not introduced into other areas of the facility through a vent system or other openings.

28. Processors should establish good quality control procedures at every step in the processing sequence to avoid cross contamination of aflatoxins between various lots of nuts during processing.

29. Hulling of nuts should begin as soon as practicable after harvesting, preferably within 24 hours for those varieties of nuts that are susceptible to shell staining after long exposure to the undried hull.

30. If there is an expected short-term delay (less than 3 days) in hull removal, the nuts should be stored under a suitable type of covering that will protect them from insects, mites, vermin, domestic animals, fungi, chemical or microbiological contaminants, debris and dust.

31. If a long-term delay (more than 3 days) in hull removal is expected, the in-hull nuts should be stored in bulk storage containers and cooled to about 0°C with a relative humidity lower than 70% until hulled to prevent aflatoxin production. This temperature is below the minimal temperature needed for the growth of *Aspergillus* species and hence aflatoxin production. Appropriate fumigation should be used to control insects.

32. Dehulled nuts should be dried as soon as possible, preferably within 72 hours after harvesting; the drying rate and heat intensity should be determined by the intended end use of the final nut product(s). The nuts should be dried to a safe moisture level that corresponds to a water activity,  $A_w$ , of less than 0.70 at 25°C. *Aspergillus flavus*/*A. parasiticus* cannot grow and produce aflatoxin at water activities less than 0.80. Dehulled nuts that are allowed to sun-dry are at a greater risk of becoming contaminated during the drying process as a result of fungal growth and/or damage by pests.

33. Moisture levels should be checked after drying by taking samples as representative of the lot as possible. Make sure that the equipment needed for moisture measurements is calibrated.

34. Mechanical driers should be available and used to reduce the potential of further aflatoxin contamination in regions where steam or aqueous solutions are traditionally used to facilitate dehulling, and segregation of defective nuts; the water used should be of suitable quality for intended use and never recycled.

35. Personnel and equipment used in the hulling/ drying areas of a processing facility should not enter into other areas of the facility; this will reduce the risk of contaminating other areas of the facility. Waste materials should be frequently removed from the working area during operation and adequate waste receptacles should be provided.

36. Various visual and electronic sorting techniques should be to the fullest extent practicable used for separating nuts with various defects. Nuts should not be used for such processing unless they are free from obvious faecal contamination, infestations, decomposition and other defects. Special precautions must be taken to reject insect-damaged or early-split nuts because they are associated with a high risk of aflatoxin contamination.

37. For nut varieties that are traditionally preconditioned with moisture (steam or water of potable quality) to reduce kernel breakage during cracking, the moisture level of the kernels after cracking should be lowered immediately, to a level that will not support the growth of fungi by rapidly circulating dry air through the kernels.

38. The finished processed products (raw, shelled or in-shell, bulk or consumer ready) should be of the appropriate moisture and packaged so as to maintain their quality under normal transportation and storage conditions without significant deterioration by decay, mould, or enzymatic changes.

39. It is desirable that each plant in its own interest should have access to laboratory control of the sanitary quality of the nut product processed. The amount and type of such control will vary with the different nut products as well as the needs of management. Analytical procedures used should follow recognized or standard methods in order that the results may be readily interpreted. All outgoing lots of nuts should be analyzed for aflatoxins and preferably for moisture content before being released from the processing facility. Only the lots of nuts, whose levels of aflatoxins are below the maximum legal limit for direct human consumption and at safe moisture levels, should be released.

40. The apparently good quality nuts should be analyzed for aflatoxins according to specific and documented sampling and testing plans before being subjected to further processing (cracking to remove kernels) or transport to storage. Analyses should be conducted and/or confirmed by a reliable, independent and accredited laboratory.

## Transport of processed nuts to storage

41. Transport containers should be clean, dry, and free of visible fungal growth, insects and any contaminated material. The containers should be well constructed to withstand handling abuse without breaking or puncturing, and tightly sealed to prevent any access of dust, fungal spores, insects or other foreign material.
42. The nuts should be transferred from transport containers to the storage facility as soon as practicable. If different lots or sub-lots are transported together, they must be physically separated in a way that will ensure that lot identification is maintained. The lots must be indelibly marked with an identification number that can be traced back to the accompanying documentation.

## Storage

43. Storage facilities should be dry (i.e. relative humidity < 70%), well-vented structures that provide protection from rain, entry of rodents and birds, drainage of ground water and have minimum temperature and humidity fluctuations.
44. Good storage practices should be implemented to minimize the levels of insects and fungi in storage facilities. This may include the use of suitable, registered insecticides and fungicides or appropriate alternative methods. Nuts stored in sacks should be placed on pallets to allow good ventilation.
45. Water activity, which varies with moisture content and temperature, should be carefully controlled during storage. *Aspergillus flavus*/*A. parasiticus* cannot grow or produce aflatoxins at water activities less than 0.7; relative humidity should be kept below 70% and temperatures between 0°C and 10°C. These are optimal for minimizing deterioration and fungal growth during extended storage.
46. Consideration should be given to fumigating nuts as they are removed from storage for export to control any storage pests that may be present and to prevent infestation during shipment.

## II. A COMPLEMENTARY MANAGEMENT SYSTEM TO CONSIDER IN THE FUTURE

47. The Hazard Analysis Critical Control Point (HACCP) system is a food safety management system that is used to identify and control hazards within the production and processing system. The general principles of HACCP have been described in earlier documents.<sup>3,4</sup>
48. The HACCP concept is an all-encompassing integrated management system. When properly implemented in the tree nut industry, this system should result in a reduction in the levels of aflatoxins observed in tree nuts. The use of HACCP as a food safety management system has many benefits over other types of management control systems used in some segments of the food industry. In orchards, many factors that influence aflatoxin contamination of tree nuts are environmentally related, such as weather and insects; these are difficult or impossible to control. After harvesting, critical control points may be identified for aflatoxins produced by fungi during storage. For example, a critical control point could be at the end of the drying process and one critical limit would be the moisture content or water activity.
49. Good Agricultural Practices (GAPs), Good Manufacturing Practices (GMPs) and Good Storage Practices (GSPs) are programs that should be in place before attempts are made to establish and implement a HACCP system. A manual on the application of the HACCP system for mycotoxin prevention and control was recently published.<sup>5</sup> It is recommended that tree nut producers, processors,

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<sup>3</sup> FAO. 1995. The use of hazard analysis critical control points (HACCP) principles in food control. FAO Food and Nutrition Paper No. 58 Rome.

<sup>4</sup> ILSI. 1997. A simple guide to understanding and applying the hazard analysis critical control point concept, ILSI Europe Concise Monograph Series, 2<sup>nd</sup> edition, ILSI Europe, Brussels.

<sup>5</sup> FAO/IAEA training and reference center for food and pesticide control, 2002. Manual on the Application of the HACCP System in Mycotoxin Prevention and Control. FAO Food and Nutrition Paper No. 73, Rome.

and others involved in the tree nut industry review the example of a HACCP plan developed for controlling aflatoxins in pistachio nuts in S.W. Asia that is presented in this Manual. Although this example is for pistachio nuts, the concepts presented should be applicable to all tree nuts, with the understanding that each HACCP plan must be developed by following the 12 stages, and applying the seven principles of HACCP given in the Manual. It should be expected that HACCP plans will vary with tree nut varieties and traditional practices followed in various regions of the world.

50. At the Third International Conference on Mycotoxins, which was held in Tunisia in March 1999, one of the general recommendations was that integrated mycotoxin control programs should incorporate HACCP principles in the control of risks associated with mycotoxin contamination of foods and feeds.<sup>6</sup> The implementation of HACCP principles will minimize aflatoxin contamination through applications of preventive controls to the extent feasible in the production, handling, storage and processing of each tree nut crop. Since all countries may not have the required technical expertise and experience to establish effective integrated mycotoxin management systems, the Food and Agriculture Organization (FAO) has given high priority to the provision of training professionals in developing countries on the HACCP approach and its application.

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<sup>6</sup> FAO. Preventing mycotoxin contamination. Food, Nutrition and Agriculture No. 23, 1999. Food and Nutrition Division, FAO, Rome.