CODEX ALIMENTARIUS COMMISSION

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World Health Organization

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Agenda Item 8 **CX/CF 13/7/8**
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JOINT FAO/WHO FOOD STANDARDS PROGRAMME

CODEX COMMITTEE ON CONTAMINANTS IN FOODS

Seventh Session
Moscow, Russian Federation, 8 – 12 April 2013

PROPOSED DRAFT ANNEX FOR THE PREVENTION AND REDUCTION OF AFLATOXINS AND OCHRATOXIN A CONTAMINATION IN SORGHUM (CODE OF PRACTICE FOR THE PREVENTION AND REDUCTION OF MYCOTOXIN CONTAMINATION IN CEREALS (CAC/RCP 51-2003))

(AT STEP 3)

Codex Members and Observers wishing to submit comments at Step 3 on the proposed draft Annex for the Prevention and Reduction of Aflatoxins and Ochratoxin A Contamination in Sorghum, 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) before **25 March 2013**. Comments should be directed:

to:	with a copy to:
Mrs Tanja Åkesson Codex Contact Point Ministry of Economic Affairs P.O. Box 20401 2500 EK The Hague The Netherlands E-mail: info@codexalimentarius.nl	Secretariat, Codex Alimentarius Commission, Joint FAO/WHO Food Standards Programme, Viale delle Terme di Caracalla, 00153 Rome, Italy E-mail: codex@fao.org

BACKGROUND

1. The Committee on Contaminants in Food at its 6th session in 2012 agreed to initiate new work on the development of an annex for the management of AFs and OTA in sorghum to the Code of Practice for the Prevention and Reduction of Mycotoxin Contamination in Cereals (CAC/RCP 51-2003), subject to approval by the 35th Session of the Codex Alimentarius Commission.[1] The new work was subsequently approved by the 35th session of the Commission.[2] The Committee also agreed to establish an electronic Working Group led by Nigeria and co-chaired by Sudan, to prepare the proposed draft annex for comments and consideration at the next session.

2. The proposed draft Annex is attached to this document as Appendix 1 while the list of participants in this working group is provided in Appendix 2.

1 REP12/CF, para. 136.
2 REP12/CAC, Appendix VI.

APPENDIX 1

Scope

This document is intended to provide member countries and the sorghum industry, guidance to prevent and reduce aflatoxins (AFs) and ochratoxin A (OTA) contamination in sorghum during production, storage and distribution to the point of usage of the cereal. Sorghum should be cultivated, prepared and handled in accordance with the General Code of Practice for the Prevention and Reduction of Mycotoxin Contamination in Cereals (CAC/RCP 51-2003) and Code of Practice – General Principles of Food Hygiene (CAC/RCP 1-1969), 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.

ANNEX 5

PREVENTION AND REDUCTION OF AFs AND OTA IN SORGHUM AND SORGHUM PRODUCTS

Introduction

1. This Annex is in two parts. The first part (paragraphs 2-33) applies to both AFs and OTA whereas the second part (paragraphs 53 – 60) specifically refers to practices that are applicable only to OTA reduction.

2. Good Practices include methods to reduce development of contamination by AF- and OTA- producing fungi and the consequent toxins contamination of sorghum in the field during planting, harvest, storage and transport; and processing. The following practices are recommended for different segments of sorghum production.

Planting

Refer to paragraphs 4-9 of General Code of Practice for Prevention and Reduction of Mycotoxin Contamination in Cereals (CAC/RCP 51-2003)

3. Avoid planting sorghum under environmental and agronomic conditions that influence seed infection by aflatoxin–producing fungi and AFs production. These conditions vary from one location to another and between seasons in same location.

4. Before planting, growers should consult with appropriate plant breeding authorities to ascertain sorghum cultivars that are resistant to various factors (e.g., fungal diseases).

5. Avoid planting sorghum on the land where groundnut or other highly susceptible crop was cultivated the previous year because such soils are likely contaminated with *Aspergillus flavus* and *Aspergillus parasiticus.*

6. As far as practical, crop planting should be timed to avoid high humidity during the period of pollination, flowering and/or fertilization. Fungi tend to produce mycotoxins (particularly ergot alkaloids) in such climate condition[1].

7. Avoid cultivating on light sandy soil, particularly under dry conditions, as these factors may introduce drought stress causing proliferation of fungi and toxin production.

8. Use good agricultural practices including measures which will reduce plant stress. Such measures may include: nutrient management, pest control and irrigation, if necessary to combat heat and drought stress.

9. Perform soil tests and apply lime following extension recommendations if needed.

10. If available and cost effective, Extension officers should assist the farmers in procuring and releasing atoxigenic *A.flavus* and *A.parasiticus* into the agricultural environment to suppress the natural occurrence of the aflatoxigenic fungi following labelling directions.

Harvest

11. Harvest crops at full maturity unless allowing the crop to continue to full maturity would subject it to extreme heat, rainfall or drought conditions.

12. Harvest when the relative humidity of the ambient air is conducive for storage. This is particularly important during the rainy season which is usually referred to as “off season” harvesting.

13. Plants damaged and/or infected by pests and pathogens should be harvested separately.

Avoid stacking the harvested produce including the panicle for unduly long periods to prevent fungal growth as spore from panicle will serve as inoculums.

14. Threshing should be carried out on clean surfaces or in a cleaned thresher, and the process should be done with care to ensure that minimal mechanical damage is inflicted on the grains.

15. After prompt harvesting, the grains should be dried to safe moisture levels (less than 13%) before storage to stop fungal growth.

16. Sun drying should be done on clean surfaces or in mechanical dryers. Grains should be protected from rain and dew during this process. Flat bed and re-circulating batch driers are adequate for small scale operations while and large drying system using continuous flow-dryer will suffice for large scale drying for long storage period.

Transport

Refer to paragraphs 32-34 in the General Code of Practice for transport to and from storage

Storage

17. Post-harvest storage is the stage that contributes most to AFs load in sorghum. The basic principle of maintaining the quality of crop during storage is to keep the grains safe from favourable conditions for fungal growth and mycotoxin development as well as avoiding loss of produce to pests and predators such as birds and rodents[11].

Refer to paragraphs 26 and 31 of the General Code of Practice for type of storage facility to use and documentation of harvesting and storage procedure.

18. Start with high quality, mature grains which are free from mechanical, insect or mould damage.

19. Use of metal or cement bin or hermetic bags as storage containers is preferable to containers made of wood, bamboo or thatch or mud placed on raised platform and covered with thatch or metal roof sheet. This may be applicable only to the developing countries.

20. Jute bags are preferable to polymeric bags for pest control purposes as the former facilitate aeration.

21. Prevention of mycotoxin-increase during storage and transportation depends on keeping a low moisture content, the temperature in the environment, and the hygienic condition. *A.flavus* / *A.parasiticus* cannot grow or produce AFs at water activities less than 0.7; relative humidity should be kept below 70% and temperatures between 0 and 10^{o}C are optimal for minimizing deterioration and fungal growth during long storage.

22. Where possible, use controlled anaerobic atmosphere of about 1% oxygen and 20% carbon dioxide for storage.

Processing

Sorghum grains for human and animal consumption are usually processed to sorghum flour (Figure 1), from which sorghum dough, meals and other foods are prepared. In general, the process consists of husking, polishing, grinding and scouring.

23. Precaution must be taken to reject grains with signs of pest damage or mould growth because of the risk of their bearing AFs and OTA. AFs and OTA tests results should be known before allowing lots of raw grains to be processed. Any lot showing raw grains with unacceptable levels of mycotoxin should not be accepted.

24. Mould infected and/or damaged kernels should be separated and discarded in an appropriate manner in order to prevent their entry into the food chain and feed manufacturing process.

25. Clean thoroughly and disinfect processing equipment and environment with approved disinfectants.

26. Commence grain processing with at least one of the following food processing techniques that have been shown to reduce AF levels in grains; washing, wet and dry milling, grain cleaning, dehulling, roasting, baking and frying[2].

27. Wash and dry all equipment, machinery or instrument after grinding a batch of produce in order to reduce risk of cross contamination.

28. A major source of mycotoxin contamination in the sorghum traditional processing line is unwholesome household storage of sorghum flour before use. Therefore avoid keeping flour for long periods of time, but if it is unavoidable then it should be stored in proper storage containers and conditions (at safe moisture level with minimum temperature changes. Such container must deter insect and rodents infestation) as described in paragraphs 20-21 above.

29. The steeping process (soaking and germination phases) raise the seed moisture level to about 45% which is favourable for fungal growth and mycotoxin production. The situation is problematic if the process is done under open, poor sanitary conditions. Therefore, steeping should be carried out in weatherproof containers under controlled atmosphere.

30. Poorly preserved starter cultures are significant sources of mycotoxin contamination in the traditional brewing system which underscores the need for starter cultures to be stored in clean, weatherproof jars, free from infestation, and sealed to prevent water, pest and mould from reaching them before use.

Packaging and Marketing

31. Package sorghum grains and products in containers with qualities described in paragraphs 30-33 above. Examples of such containers are jute bags, cartons and polypropylene bags. Sisal bags are preferable because they allow for adequate aeration during transit and marketing.

32. Do not sell sorghum and sorghum products in uncovered containers particularly in the open market system. Such practices support spoilage as a result of weather changes and abrupt rains that will wet the grain.

Practices for prevention and reduction of Ochratoxin A (OTA) in sorghum and sorghum products

The intervention strategies discussed previously are applicable for both AFs and OTA reduction. However, the following practices (paras. 34 to 36) are specific only to OTA reduction.

Planting

33. Do not grow sorghum in or close to cocoa trees, coffee bean plants or grape vines as these crops are highly susceptible to ochratoxigenic fungi and OTA contamination and thus will inoculate the soil with *Asperigillus ochraeous* or *Penicillium verrucosum* in tropical and temperate climates respectively with consequent carryover to the grain.

Harvest, storage, transportation and processing

34. For grains in the temperate regions where *P.verrucosum* produces OTA, freshly harvested grain should be rapidly dried to 18% seed moisture content and cooled to 15^{o}C, and further dried to 13% seed moisture level and cooled at 5^{o}C. These conditions should be maintained during transportation, storage and processing[3].

35. The optimal temperature and seed moisture content for OTA production by *A.ochraeous* are 31-37^{o}C and above 16% respectively. Therefore maintaining a temperature and seed moisture content 0-10^{o}C and <13% as indicated in paragraphs 23 and 34 respectively will suffice for reduction of OTA during transportation, storage and processing in the tropics[3].

Complementary management system for the future

Refer to paragraphs 35-40 of the General Code of Practice

36. The emergence of probiotic feed ingredients offers a new tool in the reduction of mycotoxins in sorghum and sorghum products. For example a combination of mouldy Sorghum, *cassia tora* and spontaneous fermentation significantly reduce AFs, fumonisin and ergosterol contents with marginal improvement in nutritive value of feed[4]. This innovation can be exploited for fungal toxins reduction during processing of grains.

37. Gamma irradiation of packaged grains and products which is an effective control method against recontamination after processing and packaging provide a good option for mycotoxin reduction in foods and feeds derived from sorghum in the future.

38. Natural plant products such as spices and herbs have increasingly been determined to possess antifungal properties. *Garcinia kola* for instance is bioactive against AFs production[5] while *Aframomum danielli* has been demonstrated to reduce OTA level in cocoa powder[6,7]. These natural, safe, environment-friendly fungicidal products should be exploited as bio-preservatives to replace the toxic synthetic pesticides.

39. Starch derived from mouldy and mycotoxin contaminated sorghum used in the production of ethanol, citric acid, lactic acid, sorbitol and erithrotol[8] and the waste and byproduct streams from such products manufactured are unfit for human and animal consumption and should not be used.

40. It is pertinent to warn that caution should be exercised when using alcohol derived from sorghum grains for human consumption. This is because mycotoxins are not completely destroyed by brewing process such that 18-27% of AFs is carried over from grain to beer. OTA is stable during processing as 96% of it remained during brewing process and none was destroyed during pasteurization and boiling of beer[8].

General Recommendations

41. Sorghum is mostly cultivated and consumed in developing countries within Africa, Asia and Latin America where the mycotoxin burden is high as a result of unawareness of the toxins, drought, and lack of political will, technical capacity and infrastructure to respond to the needs of mycotoxin reduction[9]. It is also used for animal nutrition in developed countries. It might therefore be useful to add recommendations on appropriate good agricultural and manufacturing practices, public enlightenment of policy makers, farmers and traders on mycotoxins, and enforcement of regulatory limits on both local and imported products in order to reduce the hazards of mycotoxins in these countries.

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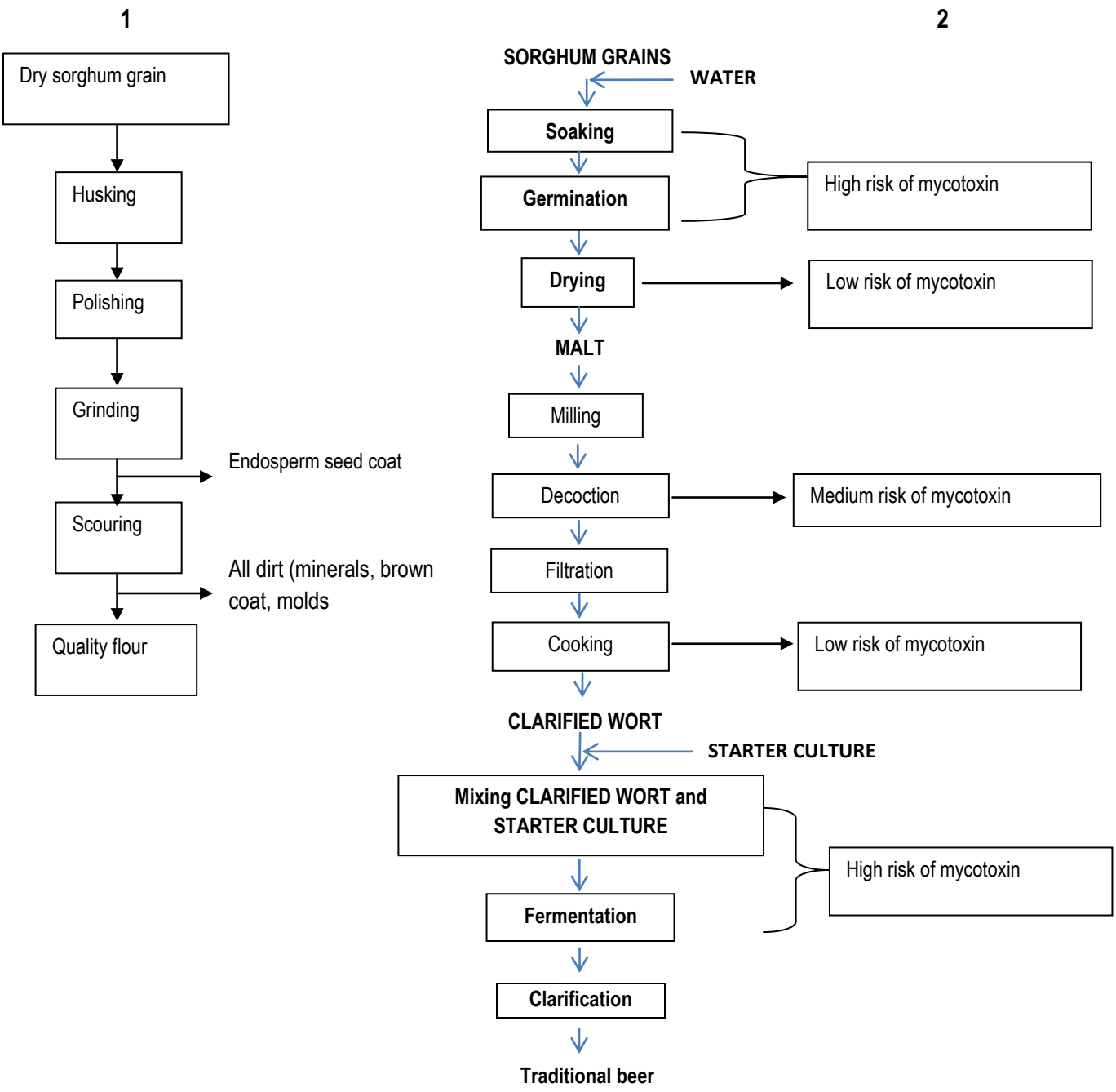

Figure 1-Sorghum flour production,

Figure 2-Mycotoxin risk assessment during the process production of African traditional beer (Djoulde, 2012 unpublished)

APPENDIX 2
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