CODEX ALIMENTARIUS COMMISSION

Food and Agriculture Organization of the United Nations

World Health Organization

Viale delle Terme di Caracalla, 00153 Rome, Italy - Tel: (+39) 06 57051 - E-mail: codex@fao.org - www.codexalimentarius.org

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JOINT FAO/WHO FOOD STANDARDS PROGRAMME

CODEX COMMITTEE ON CONTAMINANTS IN FOODS

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FORWARD WORK-PLAN FOR THE CODEX COMMITTEE ON CONTAMINANTS IN FOODS

DISCUSSION PAPER ON THE REVIEW OF STAPLE FOOD-CONTAMINANT COMBINATIONS FOR FUTURE WORK OF CCCF

(Prepared by the Host Country, JECFA and Codex secretariats)

1. Background

1. At CCCF11, the Committee agreed to consider a forward work plan to manage (prioritize) its overall work in order to address increasing requests for new work from Codex members in reasonable time (REP17/CF, para. 126).

2. At CCCF12, the Codex Secretariat underlined the importance for CCCF to operate strategically by prioritizing items within its workload, and explained that CCCF might benefit from applying an approach that looks at the overall workload of CCCF, in order to keep a balance between ongoing work and proposals for new work and to strategize the agenda for future meetings. It was not intended to leave out work, but to prioritize work so that all work had the same opportunity for discussion and completion with a reasonable timeframe (REP18/CF, paras. 150-151).

3. The Representative of WHO proposed that there might be real value in longer term forward planning, by systematically identifying areas for food contamination of concern for public health and with trade implications, e.g. starting with key staple foods and known contamination problems. This would allow delegates to work within their countries on information and data gathering well in advance before topics come on the agenda of CCCF (REP18/CF, para. 153).

4. CCCF12 agreed that a further discussion paper would be prepared by the Codex, JECFA and the Host Country Secretariats with assistance of EU. The paper would focus on whether CCCF covered the main staple foods moving in international trade and the related presence of contaminants being of public health concern (REP18/CF, para. 154).

5. At CCCF13, the Host Country Secretariat introduced the approach (i.e. to have a systematic exploration of possible contamination of the identified staple foods and identify if there were key staple food - contaminant combinations that could be of health concern but had not been considered by CCCF) and made the following clarifications to the appendix: Millet and sorghum should be included in the list of the most important staple food; and the inventory in the table more referred to “cereal grains” rather than “raw grains”. CCCF agreed that the approach could provide an adequate framework to identify important topics of work for CCCF (REP19/CF, paras. 172 - 173).

6. CCCF13 agreed that the host country, JECFA and the Codex Secretariats would continue work on this matter taking into account comments received during and after the meeting and report back to CCCF14 (REP19/CF, para. 175).

7. The current discussion paper was prepared by the Host Country, JECFA and Codex secretariats.

2. Introduction

8. One important goal for the development of a forward plan for CCCF is to systematically identify areas for food contaminants of concern for public health and with trade implications (REP18/CF, para 153). Staple foods moving in international trade are chosen as a first approach as these constitute a major part of global and regional diets and contamination of these foods could directly have a significant impact on exposure. The identification of key staple food – contaminant combinations that CCCF did not yet consider could guide prioritization of future work of CCCF.

9. The goal of the current exercise was to compile a first 'list of interest' with possible relevant staple food – contaminant combinations. It should be noted that the work only focused on collecting and screening information to identify known staple food-contaminant combinations that could be of possible interest. Combinations of interest should be explored further in detail to determine whether work by CCCF is actually needed, e.g. in a discussion paper. The current document describes an approach for collecting and screening information to come to such a 'list of interest'. Three staple foods (sorghum, yams and soy beans) were chosen as examples to illustrate the approach. After agreement on this approach by CCCF, it could be expanded to other staple foods.

3.1 Staple foods for consideration

10. To be able to identify which foods should be part of the screening exercise, a list of staple foods was compiled. A first overview of staple foods was gathered in the *Discussion paper on a forward plan for CCCF, Appendix A* (CX/CF 19/13/18). This was used as the basis for the current review, and supplemented with other staple foods. Staple food-contaminant combinations that have been or are being dealt with by CCCF (either with maximum levels (MLs), codes of practice (COPs) or discussion papers) were compiled to be excluded from further screening. Three staple foods (sorghum, yams and soybeans) were selected as examples to test an approach for identifying relevant contaminants.

3.2 Contaminants in selected staple foods

11. GEMs/food contaminants database was searched for contaminants in these three examples. Resulting staple food-contaminant combinations were included in a database developed for this purpose. Next, a literature search was performed to identify published articles with findings of additional contaminants in the three staple foods. Information on contaminants found and analytical results was extracted from the articles and included in the database. This was done without further quality assessment of the performed study, and although this may result in an overview that could contain inaccurate findings, it can provide a first indication of possible contamination in the selected staple foods.

3.3 Identification of possible relevant staple food-contaminant combinations

12. Using the overviews generated from the database, possible relevant staple food-contaminants combinations were selected and included in a 'list of interest' for further exploration.

4.1 Compiling an overview of staple foods

13. A first list of staple foods was proposed in the *Discussion paper on a forward plan for CCCF, Appendix A* (CX/CF 19/13/18). Based on the comments received before CCCF13 and during the plenary discussion, the list of the proposed staple foods was modified which resulted in the following overview:

- Cereals[1]: maize, rice, wheat, millet and sorghum;
- Roots and tubers: cassava, potatoes, sweet potatoes and yams;
- Pulses: soy beans;
- Starch-rich fruits: plantains, breadfruit and sago
- Terrestrial and aquatic animal products: meat, milk, eggs, cheese, fish meat and other seafood
- Oilseeds and derived products: vegetable oils

[1] The category 'cereal grains' also includes pseudocereals..

14. It should be noted that the list of 20 staple foods is neither exhaustive nor fully specified. It provides several examples in each category but within each category, there are more commodities listed in the Codex Classification of Food and Feed (CXA 4-1989) for pesticide residues which might be considered staple foods. As an example, quinoa, which is listed in the 'cereal grain' category of the Classification, has gained wider use with the introduction of new varieties and improved processing, so it could be considered as a staple food and therefore be included in the category of cereals in the proposed list of staple foods[2]. Furthermore, people's diet can change over time, like rising incomes may enable people to eat a more varied diet etc., so this overview could be viewed as a dynamic list for revision by CCCF.

15. Very broad categories that have been included in the list of staple foods were excluded from further review for the time being. This was the case for meat, cheese, fish, other seafood and oilseeds and derived products (vegetable oils). Searching for data on contaminants in such general categories would generate too many results for this preliminary exercise. In addition, it can be expected that within these categories, contamination per type of food (e.g. beef versus pork, differences between fish species) varies. If CCCF agrees with the methodology used in this paper, it can be discussed if/how these categories can be more refined for further evaluation.

4.2 Existing/ongoing CCCF work for the list of staple foods

16. To exclude the staple food-contaminant combinations that have been discussed/dealt with by CCCF from further review, an inventory was made of existing MLs and COPs, past discussion papers and current compounds on the agenda of CCCF dealing with staple foods. The inventory and the list of reviewed Codex documents can be found in Appendix A.

17. Commodities that have already been considered or identified by CCCF were examined. As can be found in Appendix A, nine specific staple food commodities have been found in CCCF work, they are maize, rice, wheat, millet, sorghum, cassava, potatoes, milk and eggs, respectively. In principle, the staple food – contaminant combinations that are part of CCCF work or already under discussion will be excluded from further search.

18. It should be noted that staple food-contaminant combinations that were mentioned in COPs, e.g. as background information, but were not the subject of the actual practices , were also included in Table A1. These staple food-contaminant combinations were indicated in cursive in Table A1 and as they can be of interest for future work, these were taken up in a database that was set up for the current exercise.

19. In the overview of CCCF work, also very broad food categories were found (e.g. 'food and feed'). As these could not be narrowed to specific staple food-contaminant combinations, these could not be dealt with in the current review.

4.3 Selection of three examples

20. Three staple foods were selected as examples to test a screening approach to identify staple food-contaminant combinations. If CCCF14 agrees with the approach taken, with or without adaptations, it can be applied to the other staple foods.

21. Six food commodities were left from the original list of 20 staple foods. To have examples from different food categories, yams and soy beans were chosen from the two categories roots and tubers and pulses.

22. To examine whether it can be expected that other contaminants are present in the food commodities than dealt with by CCCF, sorghum was picked as an example. For this first example, the search will focus on contaminants other than that have already been dealt with by CCCF, i.e. other than cyanide (HCN, mentioned in background information in CXC 73-2013).

23. This selection process resulted in three examples: sorghum, yams and soy beans. The selection process is illustrated in Figure 1.

[2] United Nations Food and Agriculture Organization: Agriculture and Consumer Protection. 'Dimensions of Need – Staples: What do people eat?', 2010.

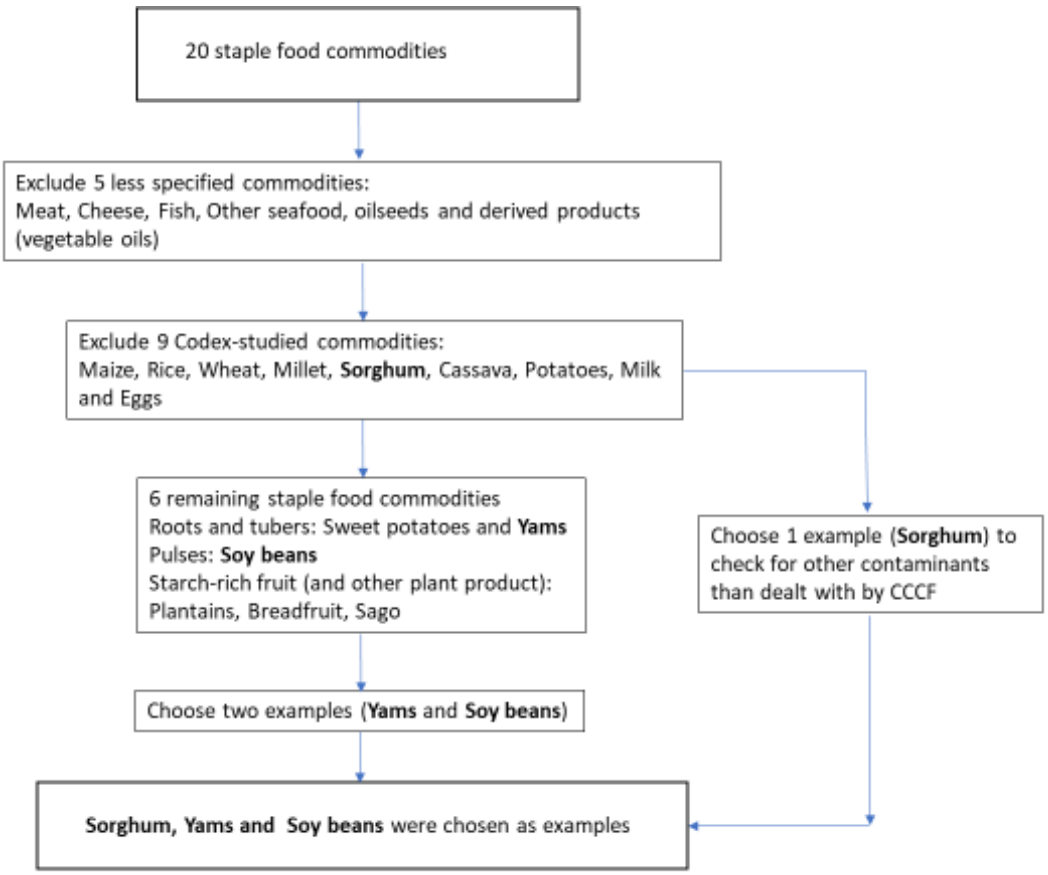

Figure 1. Procedure for selection of three staple foods as examples

5.1 Contaminants in sorghum, yams and soy beans in GEMs/Food contaminants database

24. As a second step, occurrence data for sorghum, yams and soy beans were searched in the GEMs/Food contaminant database[3]. It should be noted that data in the GEMs/Food contaminants database are largely related to existing MLs/ongoing work in Codex, and thus food-contaminants combinations already dealt with by CCCF. In addition, submission of data to GEMs/Food contaminants database is done on a voluntary basis which because of the necessary work, might not be done by all parties that analyse contaminants. However, it does provide a very broad overview of available data and therefore as a start, GEMs/Food contaminants database is checked. Results on staple food-contaminant combinations in sorghum, yams and soy beans that were found in GEMs/Food contaminants database and that had not been dealt with by CCCF were included in the database that was set up for the current exercise for further exploration.

5.2 Contaminants in yams and soy beans in additional database

25. Recently, an exercise has been performed in The Netherlands using a similar quick screening method of literature to identify mycotoxins in food and feed as proposed for the staple foods in this discussion paper (see screening method in paragraph 5.3). Results were stored in a database developed for this purpose4. No additional food-contaminant combinations were found to the results reported in the GEMs/Food contaminant database.

5.3 Literature search on occurrence of contaminants in sorghum, yams and soy beans.

26. A literature search was performed to identify remaining food-contaminant combinations in sorghum, yams and soy beans that may be of interest for work of CCCF. Results from the previous steps were excluded from literature review as these had already been identified for possible further compilation in a 'list of interest'. The full literature search strategy is listed in Table 1. The full search strategy can be found in Appendix D.

[3] Accessed on 10 March 2020

[4] RIVM letter report 2019-0223. A.D. van den Brand and A.S. Bulder, An overview of mycotoxins relevant for the food and feed supply chain: using a novel literature screening method.

Table 1. Strategy for literature search on contaminants in sorghum, yams and soy beans.

Literature Search Item	Details
Database selection	• Embase.com • Scopus
Study selection (screening)	• Level 1: Reviews • Level 2: Research articles
Strategy of setting key words and phrases	• Sorghum, yams and soy beans, contaminants, excluding the contaminants that have already been listed in Codex standards, GEMs/food database and RIVM database. • Synonymies or different forms, for instance soy beans can also be soy beans, soya bean etc.
Languages	• English
Search time range	• 2010-2020

27. The results of the literature search were cleaned up using Endnote by separating review articles. These review articles were then evaluated for containing information on occurrence of contaminants other than already identified in CCCF work and GEMs/Food contaminants database.

28. Next, non-relevant literature was excluded based on title/abstract, using criteria such as:

- Found citations were not research articles but meeting abstract, poster, etc;
- Research objects in the article were not sorghum, yams or soy beans, or not the edible part of the plants;
- Research objects in the article were not contaminants.

29. After this, the remaining articles were evaluated for reporting results on chemical analysis of contaminants in sorghum, yams and soy beans. If occurrence data were reported, these were extracted and summarized in a database developed for this goal (see next paragraph). It should be noted that data were extracted without quality evaluation of the study performed. Detailed evaluation of all articles requires large amounts of time while this 'quick and dirty' screening method does provide a usable impression of findings of contaminants in the three foods. A first selection of possible interesting staple food-contaminant combinations can be compiled based on these results. In a future second step, the literature can be assessed in detail (e.g. in a discussion paper) to determine if the reported results are of sufficient quality to take into account for possible further consideration in CCCF.

5.4 Literature search results

5.4.1. Number of retrieved results of the literature search

30. Specific literature search strategies and search results can be found in Appendix D.

5.4.2. Number of screened articles

31. In total 461 results for sorghum, 76 results for yams and 1512 results for soy beans were retrieved from the literature search and screened for analytical results.

5.4.3. Number of entries in the database

32. In total 91 results from literature for sorghum, 10 results for yams, and 122 results for soy bean were included in the database.

5.4.4. Number of staple food-contaminant combinations in the database

33. As summarized in Appendix C, Figure C.1, the number of staple food-contaminant combinations in the database are 79, 10 and 44 for sorghum, yams and soy beans, respectively. Information on frequency of staple food-contaminant combinations can be found Table C.1.

6. Selection of staple food-contaminant combinations in a 'list of interest' for future work of CCCF

34. A staple food-contaminant combination database was developed to include screening results of occurrence of contaminants in sorghum, yams and soy beans. The database includes fields on contaminant found, used analytical method, contaminant reported level, references.

35. The database was then used to generate overviews of for which contaminants had been found in the three examples, and how many references had reported these. Results from searches in CCCF work and GEMs/Food contaminants database are shown in Appendix B, Table B.1. Results from literature search are shown in Appendix C. From the results, staple food-contaminant combinations of interest were included in a 'list of interest', as described in the following paragraphs. The whole process is illustrated in Figure 2.

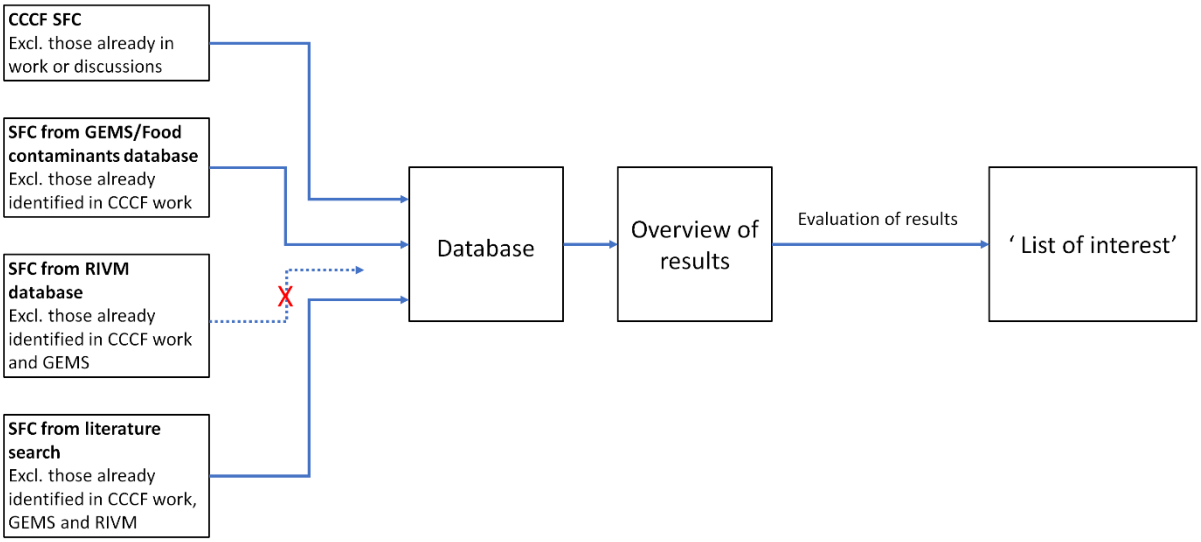

Figure 2. Work process for identification of relevant staple food-contaminant combinations (SFC) for a ' list of interest'. Performed for three examples: sorghum, yams and soy beans.

6.1 Results from search in CCCF work and GEMs/Food contaminants database

36. Only one staple food -contaminant combination reported in CCCF work as being of relevance but not included in actual CCCF work has been found for sorghum, i.e. hydrocyanic acid / hydrogen cyanide (HCN), see Appendix B.

37. From GEMs/Food database, all staple food -contaminant combinations found were included in the 'list of interest', irrespective of the amount of analytical results. Results have been quality checked before inclusion in GEMs, therefore every finding is considered reliable and relevant.

38. For sorghum, results included arsenic (total), cadmium, lead, mercury, 15-acetyldeoxynivalenol, 3-Acetyldeoxynivalenol, Aflatoxicol, Arsenic (total), Atrazine, Atropine, Cadmium, Citrinin, DON-3-glucoside, Fusarenon X, Neosolaniol, O-Methylsterigmatocystin, Roquefortin C, Scopolamine, and T-2 toxin.

39. For soy bean, results included arsenic (total), cadmium, lead, mercury.

40. For yam, results included arsenic, cadmium, chromium, cobalt, lead, mercury, nickel, radionuclides.

6.2 Results from literature search

41. From literature search, only results that were found more than once were included in the 'list of interest' for further reflection of CCCF.

42. For sorghum, as shown in Figure C.3, 71 contaminants were reported once in literature, and 8 contaminants were reported more than once, with Enniatin A, Enniatin A1 and Enniatin B1 found the most (3 times), These were included in the 'list of interest' for further consideration.

43. For yams, no contaminants were reported more than once, there were only 10 contaminants reported once. Therefore, no yam-contaminant combinations from literature were included in the 'list of interest'.

44. For soy beans, as shown in Figure C.4, 22 new staple food-contaminants combinations were reported more than once in literature, with polycyclic aromatic hydrocarbons (PAHs) found the most (9 times). These were included in the 'list of interest' for further consideration by CCCF.

The resulting 'list of interest' is shown in Table 2.

Table 2. 'List of interest' for further review by CCCF

Staple food	Contaminant (group)	Source
Sorghum	Hydrocyanic acid	Scan of CCCF work
	Arsenic (total), cadmium, lead, mercury, 15-acetyldeoxynivalenol, 3-Acetyldeoxynivalenol, Aflatoxicol, Arsenic (total), Atrazine, Atropine, Cadmium, Citrinin, DON-3-glucoside, Fusarenon X Neosolaniol, O-Methylsterigmatocystin, Roquefortin C, Scopolamine, T-2 toxin	GEMs/Food contaminant database
	-Enniatins, beauvericin, citrinin, curvularin, cytochalasin B	Literature search
Yams	-	Scan of CCCF work
	Arsenic, Cadmium, Chromium, Cobalt, Lead, Mercury, Nickel, radionuclides	GEMs/Food contaminant database
	-	Literature search
Soy beans	-	Scan of CCCF work
	Mycotoxins, arsenic (total), cadmium, lead, mercury, cobalt, nickel, radionuclides, nitrate, NDL-PCBs	GEMs/Food contaminant database
	PAHs, chromium, 3-MCPD esters, nitrite, acrylamide, aluminium, manganese	Literature search

7.1 List of staple foods

45. List to be expanded/specified before further review can be done

46. The results proved the effectiveness of the searching and screening strategy in identifying new staple food-contaminant combinations. However, it is important to note that data were extracted without quality evaluation of the study performed thus the screening strategy may result in an overview that could contain inaccurate findings. In future follow-up, articles of interest can be assessed in more detail.

7.2 Selection of combinations for the 'list of interest'

47. First indication of possibly relevant for public health, this was also the reason to focus on staple foods.

48. Staple food-contaminant combinations from CCCF COPs and GEMs/Food contaminants database were counted as one combination, while data from literature research were counted separately.

49. Selection method for the list of interest staple foods-contaminant combinations was only based on occurrence, and data on consumption and trade volumes are not taken into account at this stage, however to some extent, trade volumes and high consumption are implicitly included in the choice to focus on staple foods. The intrinsic large consumption of staple foods was the basis for this work, therefore in this first stage, consumption figures do not need to be part of the screening exercise. As the current exercise was based only on possible health implications, also trade volumes are not taken into account.

7.3 Use of the 'list of interest

50. Decision to work further on the identified staple food-contaminant combinations (e.g. in discussion papers) may also depend on other factors such as prioritization of CCCF work, experience of delegations with identified staple food-contaminant combinations etc.. CCCF needs to decide how to select work from the list to be taken up.

Recommendations

51. CCCF is invited to consider:

52. Whether the approach summarized in section 3) provides an adequate framework to identify new staple food-contaminant combinations moving in trade of relevance to public health perspective for future work of CCCF. If so, please consider the following elements and provide relevant inputs:

8.1 Whether the list of staple foods should be further developed by CCCF, if so how, e.g.

- Which other staple foods to include
- How to refine of the current broad categories
- If this work should be part of a separate paper developed by an EWG
- Other aspects not considered above.

8.2 If screening of publications provides sufficient information on contaminants in staple foods for prioritizing work.

- If not, please indicate what should be changed or added. Note that in-depth analysis hampers the ability to screen large numbers of publications.

8.3 How the 'list of interest' should be compiled

- How to weigh results for combinations resulting from the different sources, i.e. results from CCCF work and GEMs/Food Contaminants database (with bias) against results from articles,
- Whether the number of records in the GEMs/Food database can be used as additional consideration for certain contaminants.
- Which criteria to use for selection of staple food-contaminant combinations to be included in the list
- Other aspects not considered above

8.4 How the 'list of interest' should be used

- If the list should be developed further before choosing combinations for follow-up, and if so, how.
- How to select new topics from the list to be explored, i.e. which other factors to take into account e.g. (see examples in 7.3)
- What an appropriate follow-up should be for such combinations, e.g. develop a discussion paper in an EWG.

8.5 How the 'list of interest' should be maintained

- If there should be periodic updates or is a single exercise sufficient.
- Who should maintain this list.
- Other aspects to be considered.

Appendix A.: Staple foods in existing standards/past/ongoing work by CCCF

Table A.1. Staple foods in existing standards/past/ongoing work by CCCF. Contaminants in red cursive are mentioned in COP as known contamination in the staple food but were not subject of the measures in COP.

Commodities	MLs	COPs	Discussed	Topics ongoing
Cereals				
Maize	Deoxynivalenol (DON), Fumonisins (B1+ B2), Cadmium	Aflatoxins, deoxynivalenol, nivalenol, zearalenone, fumonisins, Acrylamide		
Rice	(Inorganic)Arsenic, Cadmium	Arsenic (rice) Acrylamide		
Wheat (FFP)	Deoxynivalenol (DON), Cadmium, Ochratoxin A	*Alternariol, alternariol methyl ether, tenuazonic acid*, deoxynivalenol, nivalenol, zearalenone, *Ergot sclerotia*, Acrylamide		
Millet		Deoxynivalenol		
Sorghum		Deoxynivalenol, nivalenol, *zearalenone* and diacetoxyscirpenol, *alternariol, alternariol methyl ether, tenuazonic acid and altenuene, fumonisins*, Aflatoxins, ochratoxin A, ergot alkaloids, *sterigmatocystin, Hydrogen cyanide (HCN)*		Aflatoxin, Altenuene, Fumonisins, HT-2 toxin, Ochratoxin A, Deoxynivalenol, Zearalenone, Alternariol, AlternarioMonomethylether, Diacetoxyscipenol, Sterigmatocystin (CX/CF 15/9/3-Add.1) Total Aflatoxins; Total Fumonisins; Sterigmatocystin; Diacetoxyscirpenol; Zearalenone; Ochratoxin A, Alternariol and Alternariolmonether (CX/CF 16/10/3-Add.1)
Cereal grains (unspecified)	Cadmium, lead, Deoxynivalenol (DON),	Acrylamide, Mycotoxins, (zearalenone, fumonisins, ochratoxin A, trichothecenes, aflatoxins, ergot and ergot alkaloids), pyrrolizidine alkaloids (weed control in crops), Chloropropanols, Polycyclic aromatic hydrocarbons (PAH)	Zearalenone: CCFAC31 decided that Codex MLs were not necessary for the time being (ALINORM 99/12A, para. 111).	MLs for Aflatoxins in certain cereals and cereal-based products including foods for infant and young children (REP 19/CXC, Appendix V). T2/HT-2 and 4,15-1 Diacetoxyscirpenol (DAS): update of risk assessment (REP 19/CF, Appendix X, priority list). Ergot alkaloids: full evaluation (REP 19/CF, Appendix X, priority list).

Roots and tubers				
Cassava		Hydrocyanic acid (HCN)		ML for Hydrocyanic acid (HCN) and COP for mycotoxins in fermented cassava products (REP 19/CF, para. 144).
Potatoes		Acrylamide		
Sweet potatoes				
Yams				
Root and tuber vegetables	Cadmium, lead			
Gari, cassava flour	Hydrocyanic acid (HCN)			
Pulses				
Pulses	Cadmium, Lead			
Soy beans			CCFAC36 decided to discontinue developing ML for cadmium in soy beans (dry). (ALINORM 04/27/12, para. 176)	
Starch-rich fruits (or other plant product)				
Plantains				
Breadfruit				
Sago				
Terrestrial and aquatic animal products				
Meat	Lead, Tin (canned meat)	Dioxins, PCBs, Chloropropanols (processed meat)	CCFAC36 decide to discontinue developing MLs for cadmium in meat of cattle, pigs, sheep, and poultry; horse meat (ALINORM 04/27/12, para. 176)	Dioxins and dioxin-like PCBs (REP 19/CF. Appendix X. Priority list).
Milk	Aflatoxin M1, Lead Copper (milkfat products), Iron (milkfat products)	Aflatoxin B1, Dioxins, PCBs, Pyrrolizidine alkaloids (PAs)		Dioxins and dioxin-like PCBs (REP 19/CF. Appendix X. Priority list).
Eggs		Dioxins, Polychlorinated biphenyls (PCBs), Pyrrolizidine alkaloids (PAs)		Dioxins and dioxin-like PCBs (REP 19/CF. Appendix X. Priority list). Establish of ML for lead (REP/19, para. 92).
Cheese				

Commodities	MLs	COPs	Discussed	Topics ongoing
Fish and other seafood				
Fish	Lead, Methylmercury	Methylmercury Dioxins and PCBs, Chloropropanols (smoked fish), Polycyclic aromatic hydrocarbons (PAH) (smoked fish)	CCFFP: Standard for Live and Raw Bivalve Molluscs (CXS 292-2008) which includes provisions for several marine biotoxins (eg Saxitoxin (STX) group; Domoic acid (DA) group; Brevetoxin (BTX) group; etc).	Ciguatoxins (REP/19, para. 19) Dioxins and doxin-like PCBs (Rep 19/CF. Appendix X. Priority list).
Marine bivalve mollusks	Cadmium, Okadaic acid group, Domoic acid group, Brevetoxin group, Azaspiracid group			
Cephalopods	Cadmium			
Oilseeds and derived products (vegetable oils)				
Olive oils and pomace oils	Halogenaed solvents, Copper[5], Iron			
Edible fats and oils	Arsenic, Lead, Copper, Iron	Polycyclic aromatic hydrocarbons (PAH), 3-Monochloropropane-1,2- Diol Esters (3-MCPDEs) and Glycidyl Esters (GEs)		
Foods		Acrylamide, Acrylonitrile	Radionuclides (REP 19/CF, para. 26). Vinyl Chloride Monomer: guideline level in Food and Packaging Material (CAC29, (CXG 6-1991) (ALINORM 06/29/41)).	

[5] It was pointed out that copper had been considered as quality factors rather than safety factors and therefore the levels for the substance had been currently not included in Schedule I of the GSCTF. The same with iron and zinc.

			Perchlorate: no health concern was identified at current estimated levels of exposure from food and drinking water (REP11/CF, para. 99). Polybrominated diphenyl ethers (PBDEs): no action was required (CCFAC37 (2005), ALINORM 05/28/12, Appendix IV).	
Food and Feed	Melamine	Pyrrolizidine alkaloids (PAs)		

Reviewed CCCF standards and documents

CXC 51-2003, Code of practice for prevention and reduction of mycotoxin contamination in cereals

CXC 56-2004, Code of Practice for the Prevention and Reduction of Lead Contamination in Foods

CXC 60-2005, Code of Practice for the Prevention and Reduction of Inorganic Tin Contamination in Canned Foods

CXC 62-2006, Code of Practice for the Prevention and Reduction of Dioxin, Dioxins-like PCBs and non-Dioxin-like PCBs in Food and Feed

CXC 67-2009, Code of Practice for the Reduction of Acrylamide in Foods

CXC 68-2009, Code of Practice for the Reduction of Contamination of Food with Polycyclic Aromatic Hydrocarbons (PAH) from Smoking and Direct Drying Processes

CXC 73-2013, Code of Practice for the Reduction of Hydrocyanic Acid (HCN) in Cassava and Cassava Products

CXC 74-2014, Code of Practice for Weed Control to Prevent and Reduce Pyrrolizidine Alkaloid Contamination in Food and Feed

CXC 77-2017, Code of Practice for the Prevention and Reduction of Arsenic Contamination in Rice

CXC 79-2019, Code of Practice for the Reduction of 3-Monochloropropane-1,2- Diol Esters (3-MCPDEs) and Glycidyl Esters (GEs) in Refined Oils and Food Products Made With Refined Oils

CXS 193-1995, General Standard for Contaminants and Toxins in Food and Feed

CXS 292-2008, Standard for Live and Raw Bivalve Molluscs

ALINORM 06/29/41 Joint FAO/WHO Food Standard Programme CODEX Alimentarius Commission Twenty-nine Session report (2006).

REP19/CAC Joint FAO/WHO Food Standard Programme CODEX Alimentarius Commission Forty-second Session report (2019).

ALINORM 99/12A Report of the 31st Session of the CODEX Committee on Food Additives and Contaminants (1999).

ALINORM 04/27/12 Report of the 36th Session of the CODEX Committee on Food Additives and Contaminants (2004).

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CX/CF 15/9/3-Add.1 Matter of interest arising from FAO and WHO (including JECFA) status report on the FAO/WHO project on mycotoxins in sorghum supported by the Codex Trust Fund

CX/CF 16/10/3-Add.1 Matter of interest arising from FAO and WHO future analysis of data provided by the FAO/WHO project on mycotoxins in sorghum

Appendix B. Staple food-contaminant combinations found in CCCF work and GEMs/Food contaminants database

Table B.1. Staple food -contaminant combinations reported in CCCF work and GEMS/Food contaminants database, accessed on 10 March 2020. These were excluded from literature review.

Sorghum			Soy beans			Yams		
CCCF	GEMs/No. of reports		CCCF	GEMs/No. of reports		CCCF	GEMs/No, of reports	
Hydrogen cyanide (HCN)	Arsenic (total)	8	No results	15-acetyldeoxynivalenol	41	No results	Aflatoxicol	12
	Cadmium	8		3-Acetyldeoxynivalenol	41		Aflatoxin B1	14
Aflatoxins	Lead	24	Work on cadmium in soy bean was discontinued	Aflatoxin (total)	249		Aflatoxin B2	14
Altenuene	Mercury	8		Aflatoxin B1	403		Aflatoxin G1	14
Alternariol				Aflatoxin B2	263		Aflatoxin G2	14
Alternariol methyl ether	15-Acetyldeoxynivalenol	1533		Aflatoxin G1	263		Aflatoxin M1	12
Alternariolmonether	3-Acetyldeoxynivalenol	1533		Aflatoxin G2	263		Citrinin	12
DiacetoxyscirpenoL	Aflatoxicol	10		Altenuene	11		Cypermethrin	32
Deoxynivalenol	Arsenic (total)	8		Alternariol	33		Deoxynivalenol	12
Ergot alkaloids	Atrazine	1		Alternariol-Monomethylether	11		Fumonisin B1	12
Fumonisins	Atropine	5		Coumarin	11		Fumonisin B2	12
HT-2 toxin	Cadmium	8		Deoxynivalenol	61		Fumonisin B3	12
Nivalenol	Citrinin	10		Diacetoxyscirpenol	87		Fumonisin B4	12
Ochratoxin A	DON-3-glucoside	10		Ergocornine	130		Ochratoxin A	13
Sterigmatocystin	Fusarenon X	1533		Ergocorninine	119		Zearalenone	12
Tenuazonic acid	Neosolaniol	1533		Ergocristine	131			
Zearalenone	O-Methylsterigmatocystin	10		Ergocristinine	119		Arsenic (total)	12
	Roquefortin C			Ergocryptine (sum of alpha and beta epimers)	106		Cadmium	12
	Scopolamine	1533					Chromium	3
	T-2 toxin	5		Ergometrine	91		Cobalt	3
		1550		Ergometrinine	99		Lead	68
				Ergosine	111		Mercury	6
				Ergosinine	99		Nickel	3
				Ergot alkaloïds	14			
				Ergotamine	110		Cesium 134	30
				Ergotaminine	99		Cesium 137	28

				Fumonisin B1	346		Cesium total	2
				Fumonisin B2	338		Iodine 131	2
				Fumonisin B3	70			
				Fumonisin total	15			
				Nivalenol	18			
				Ochratoxin A	76			
				Tenuazonic acid	11			
				T-2/HT-2 toxin	83			
				Zearalenone	67			
				Arsenic (total)	1293			
				Cadmium	3189			
				Cobalt	35			
				Lead	2750			
				Mercury	79			
				Nickel	115			
				Iodine 131	36			
				Cesium 134	67			
				Cesium 137	42			
				Cesium total	36			
				Nitrate	133			
				NDL-PCB 101	47			
				NDL-PCB 138	47			
				NDL-PCB 153	47			
				NDL-PCB 180	47			
				NDL-PCB 28	47			
				NDL-PCB 52	47			

Appendix C: Results on occurrence of contaminants in sorghum, soy bean and yam from literature search

Only results from literature are reported, results from search in CCCF work and GEMs/Food contaminants database were excluded.

Figure C.1. Number of staple food-contaminant combinations in the database

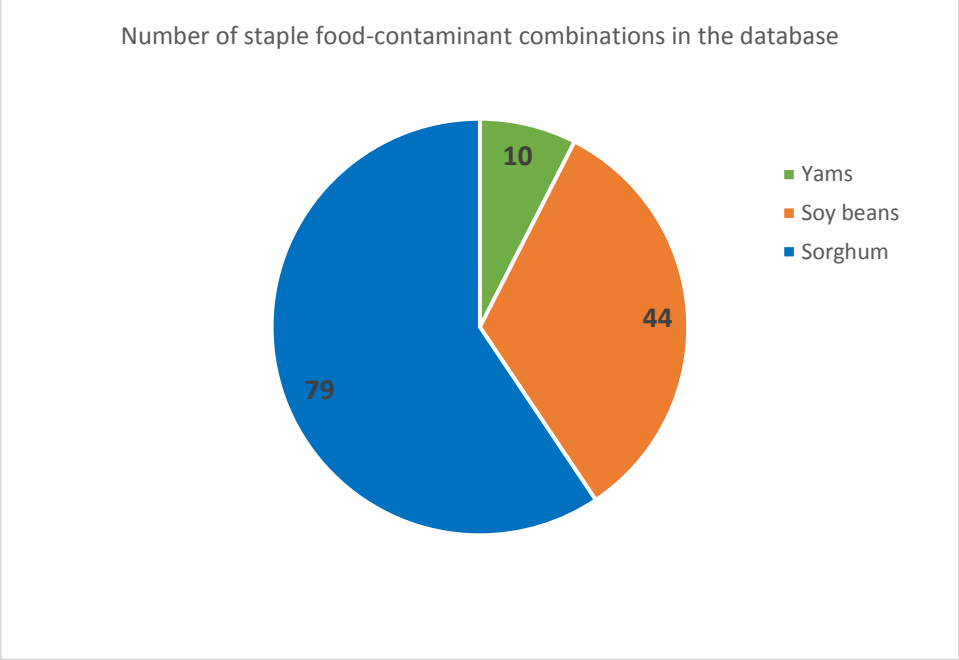

Figure C.2. Overview of contaminants in sorghum, yams and soy beans reported in the literature for more than 1 time

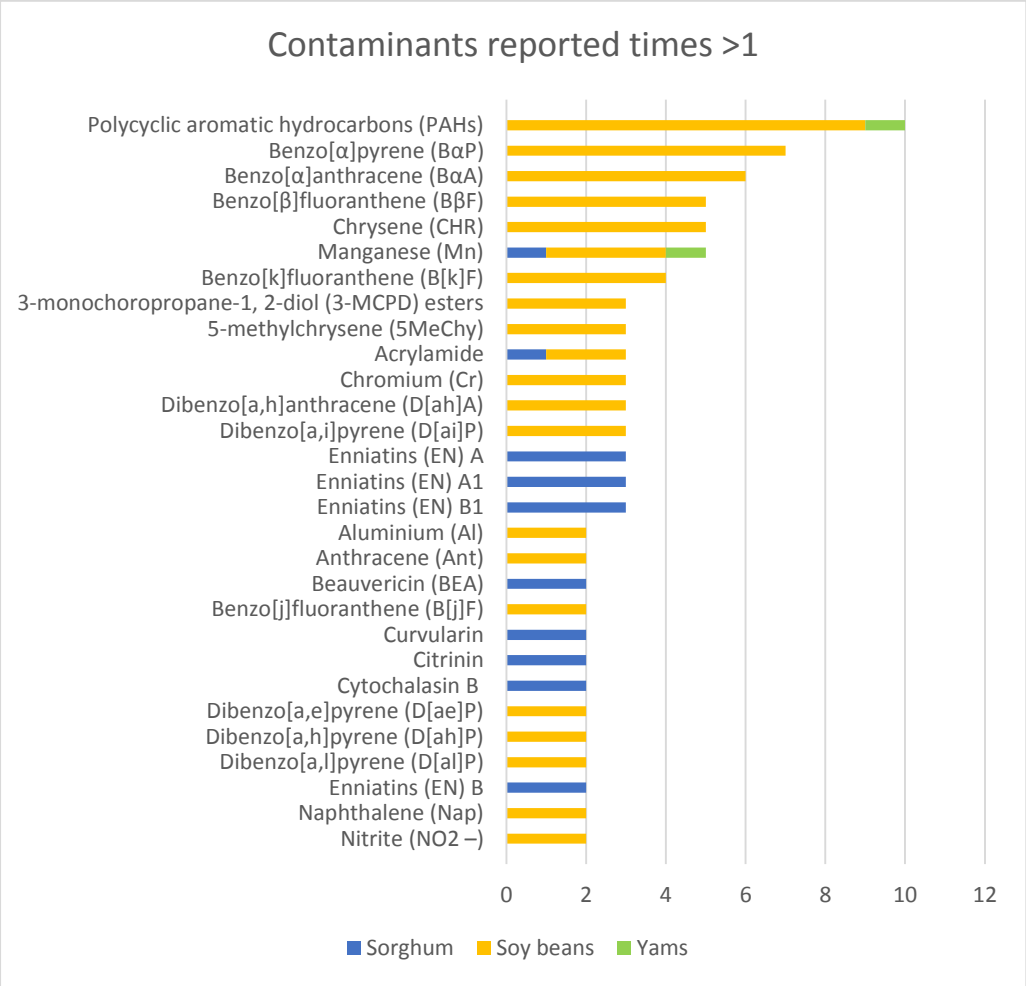

Figure C.3. Contaminants in sorghum reported for more than 1 time and the maximum reported level

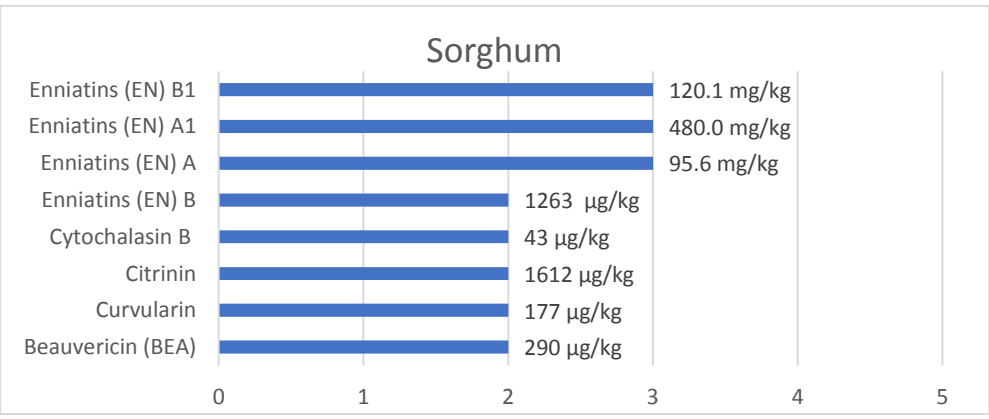

Figure C.4. Contaminants in soy beans reported for more than 1 time and the maximum reported level

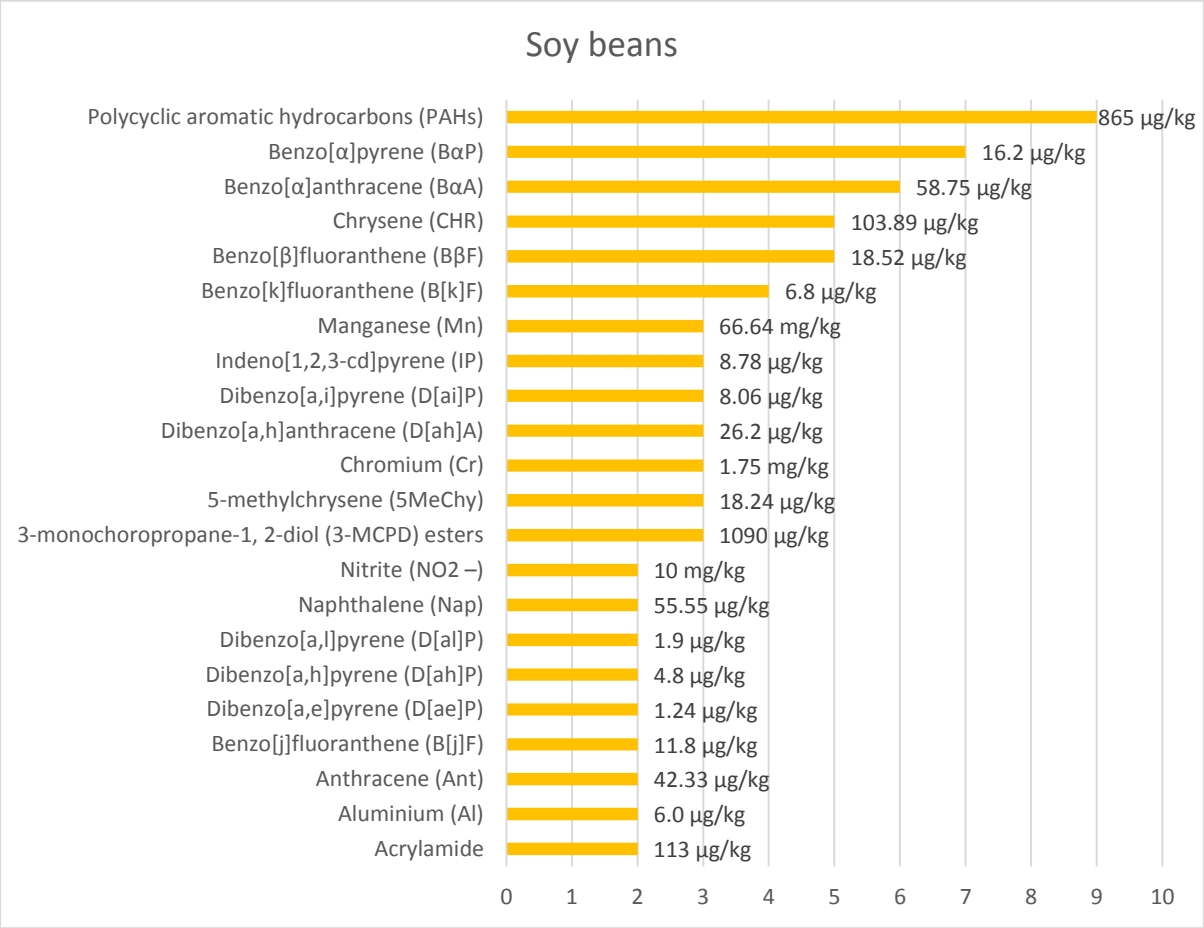

Table C.4. Overview of contaminants in sorghum, yams and soy beans reported in literature. Table also includes results that were reported once.

Sorghum	Frequency	Soy beans	Frequency	Yams	Frequency
Enniatin A	3	Polycyclic aromatic hydrocarbons (PAHs)	9	15-Acetyl-deoxynivalenol	1
Enniatin A1	3	Benzo[α]pyrene (BαP)	7	3-Acetyl-deoxynivalenol	1
Enniatin B1	3	Benzo[α]anthracene (BαA)	6	Diacetoxyscirpenol	1
Beauvericin (BEA)	2	Chrysene (CHR)	5	Engineered nanoparticles , (NPs), i.e., zinc oxide (ZnO) and titanium dioxide (TiO2) NPs	1
Citrinin	2	Benzo[β]fluoranthene (BβF)	5	Fusarenon-X	1
Curvularin	2	Benzo[k]fluoranthene (B[k]F)	4	Molybdenum (Mo)	1
Cytochalasin B	2	3-monochoropropane-1, 2-diol (3-MCPD) esters	3	Thorium (Th)	1
Enniatin B	2	5-methylchrysene (5MeChy)	3	Manganese (Mn)	1
15-Hydroxyculmorin	1	Chromium (Cr)	3	T-2 toxin	1
3-Nitropropionic acid	1	Dibenzo[a,h]anthracene (D[ah]A)	3	Polycyclic aromatic hydrocarbons (PAHs)	1
Acrylamide	1	Dibenzo[a,i]pyrene (D[ai]P)	3		
Altertoxin-I	1	Indeno[1,2,3-cd]pyrene (IP)	3		
Apicidin	1	Manganese (Mn)	3		
Aspercolorin	1	Acrylamide	2		
Aspterric acid	1	Aluminium (Al)	2		
Atpenin A5	1	Anthracene (Ant)	2		
Aurofusarin	1	Benzo[j]fluoranthene (B[j]F)	2		
Averantin	1	Dibenzo[a,e]pyrene (D[ae]P)	2		
Averufanin	1	Dibenzo[a,h]pyrene (D[ah]P)	2		
Averufin	1	Dibenzo[a,l]pyrene (D[al]P)	2		
Bikaverin	1	Naphthalene (Nap)	2		
Brefeldin A	1	Nitrite (NO2 –)	2		
Brevianamid F	1	∑BaPeq	1		
Butenolid	1	∑HPAs	1		
Calphostin C	1	∑PAEs	1		
Chanoclavine	1	2,3-DCP	1		
Chloramphenicol	1	210Po	1		
Chryophanol	1	234U	1		
Cobalt (Co)	1	238U	1		
Copper (cu)	1	2-Phenylethylamine	1		
Culmorin	1	Acenaphthene(Ace)	1		
Cycloaspeptide A	1	Acenaphthylene(Acy)	1		
Cytochalasin C	1	Alternariol (AOH)	1		
Dechlorogriseofulvin	1	Alternariol monomethyl ether (AME)	1		
Di(2-ethylhexyl) phthalate (DEHP)	1	Benzo[g,h,i]perylene (BghiP)	1		
Diethyl phthalate (DEP)	1	Botulinum toxin type B	1		

Sorghum	Frequency	Soy beans	Frequency	Yams	Frequency
Dihydrogriseofulvin	1	Butylbenzylphthalate(BBP)	1		
Diisobutyl phthalate (DIBP)	1	Cadaverine	1		
Dimethyl phthalate (DMP)	1	Di-n-octylphthalate(DnOP)	1		
Di-n-butyl phthalate (DBP)	1	Emetic toxin	1		
Emodin	1	Ethyl carbamate (EC)	1		
Equisetin	1	Fluoranthene(Flu)	1		
Festuclavine	1	Fluorene(Fl)	1		
Fusaric acid	1	Furan	1		
Gliotoxin	1	Genotoxic PAH8 (include the sum of benz[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, indeno[1,2,3-cd]pyrene, dibenz [a,h]anthracene, and benzo[ghi]perylene.)	1		
Griseofulvin	1	Histamine	1		
Iodine (I)	1	HPAHs	1		
Kojic acid	1	Isophthalic acid (IPA)	1		
Macrosporin	1	LPAHs	1		
Macrosporin A	1	Nanomaterials (ENMs)	1		
Malformin A	1	PAH4	1		
Malformin C	1	Perfluoroalkyl substances (PFASs)	1		
Manganese (Mn)	1	Phenanthrene(Phe)	1		
Meleagrin	1	Plastics: Di(2-ethylhexyl) phthalate (DEHP) and diisobutyl phthalate (DiBP), Benzylbutyl phthalate (BzBP), dibutyl phthalate (DBP), and diethyl phthalate (DEP)	1		
Monactin	1	Polychlorinated dibenzo-p-dioxins, dibenzofurans and dioxin-like PCBs	1		
Moniliformin	1	Polycyclic aromatic hydrocarbons (PAHs), polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/Fs), polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), phthalic acid esters (PAEs), and perfluorinated substances	1		
Monoacetoxyscirpenol	1	Putrescine	1		
Monocerin	1	Pyrene(Pyr)	1		
Mycophenolic acid	1	Terephthalic acid (TPA)	1		
Nidurufin	1	Thallium (Ti)	1		
Nigericin	1	Tropane alkaloids	1		
Nonactin	1	Tyramine	1		
Norsolorinic acid	1				
Paxillin	1				
Physcion	1				

Sorghum	Frequency	Soy beans	Frequency	Yams	Frequency
Plasticizer: Phthalate esters (PAEs)	1				
Radicicol	1				
Secalonic acid D	1				
Selenium (Se)	1				
Setosusin	1				
Skyrin	1				
Tentoxin	1				
Terphenyllin	1				
Tryptophol	1				
Versicolorin A	1				
Versicolorin C	1				
Viomellein	1				
Zearalenon-14-glucoside	1				
Zearalenon-4-Sulfat	1				

Appendix D: Literature search strategy on contaminants in sorghum, yams and soy beans

Sorghum

Table D.1. Search strategy and results for Embase database.

Query	Search terms	Number of records
#1	'sorghum'/exp OR 'sorghum*':ti,ab OR 'blumenbachia koeler*':ti,ab OR 'sarga ewart*':ti,ab OR 'vacoparis spangler*':ti,ab OR 'andropogon':ti,ab	6,528
#2	'contamination'/exp OR 'contamina*':ti,ab	276,192
#3	#1 AND #2	328
#4	#1 AND #2 AND [english]/lim AND [2010-2020]/py	199

This resulted in 199 records.

The following search terms were used for the Scopus database:

(TITLE-ABS-KEY (sorghum* OR blumenbachia-koeler* OR sarga-ewart* OR vacoparis-spangler* OR andropogon*)) AND (TITLE-ABS-KEY (contamina*)) AND PUBYEAR > 2009 AND (LIMIT-TO (LANGUAGE , "English"))

This resulted in 436 records. After removal of duplicate records between the Embase and Scopus results, there were in total 461 records.

Yams

Table D.2. Search strategy and results for Embase database.

Query	Search terms	Number of records
#1	'yam'/exp OR yam:ti,ab OR yams:ti,ab	2,581
#2	'contamination'/exp OR 'contamina*':ti,ab	276,192
#3	#1 AND #2	43
#4	#1 AND #2 AND [english]/lim AND [2010-2020]/py	25

This resulted in 25 records.

The following search terms were used for the Scopus database:

(TITLE-ABS-KEY (yam OR yams)) AND (TITLE-ABS-KEY (contamina*)) AND PUBYEAR > 2009 AND (LIMIT-TO (LANGUAGE , "English"))

This resulted in 71 records. After removal of duplicate records between the Embase and Scopus results, there were in total 76 records.

Soy beans

Table D.3. Search strategy and results for Embase database.

Query	Search terms	Number of records
#1	'soybean'/exp OR 'soybean*':ti,ab OR 'soybean*':ti,ab OR 'soyabean*':ti,ab OR 'soya bean*':ti,ab OR soja:ti,ab OR 'soja bean*':ti,ab OR 'sojabean*':ti,ab	50,199
#2	'contamination'/exp OR 'contamina*':ti,ab	276,192
#3	#1 AND #2	1,062
#4	#1 AND #2 AND [english]/lim AND [2010-2020]/py	579

This resulted in 579 records.

The following search terms were used for the Scopus database:

(TITLE-ABS-KEY(soybean* OR soy-bean* OR soyabean* OR soya-bean* OR soja OR soja-bean* OR sojabean*)) AND (TITLE-ABS-KEY(contamina*)) AND PUBYEAR>2009 AND (LIMIT-TO (LANGUAGE,"English"))

This resulted in 1407 records. After removal of duplicate records between the Embase and Scopus results, there were in total 1512 records.