CODEX ALIMENTARIUS COMMISSION

Food and Agriculture Organization of the United Nations

World Health Organization

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CL 2017/25-CF

February 2017

TO:	Codex Contact Points Interested International Organizations
FROM:	Secretariat, Codex Alimentarius Commission, Joint FAO/WHO Food Standards Programme
SUBJECT:	**REQUEST FOR COMMENTS AT STEP 3 ON THE PROPOSED DRAFT CODE OF PRACTICE FOR THE PREVENTION AND REDUCTION OF ARSENIC CONTAMINATION IN RICE**
DEADLINE:	**20 March 2017**
COMMENTS:	**To:** Codex Contact Point The Netherlands Email: info@codexalimentarius.nl
	Copy to: Codex Secretariat Codex Alimentarius Commission Joint FAO/WHO Food Standards Programme E-mail: codex@fao.org

BACKGROUND

1. The 8th Session of the Codex Committee on Contaminants in Food (March 2014) agreed to propose new work on a Code of Practice for the Prevention and Reduction of Arsenic Contamination in Rice for approval by the 37th Session of the Commission[1]. The Commission approved the elaboration of the COP as new work[2].

2. The 9th Session of the Committee (March 2015) agreed to the text in Section 1 (Introduction) and Section 2 (Scope) as important starting points[3].

3. The 10th Session of the Committee (April 2016) noted that no new information and data on effective/ implemented/proved measures had been received and that results of various studies would become available only in the next 2 to 3 years. The Committee considered whether it should continue this work and if the work was to be continued, whether it should be postponed awaiting the results from above-mentioned studies.

4. After some discussions, the Committee made the following agreement on the understanding that the COP could be reviewed in the future when more information and data become available[4]:

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[1] REP14/CF, paras 93-95 and Appendix VIII
[2] REP14/CAC, para. 96 and Appendix VI
[3] REP15/CF, paras 70 - 74
[4] REP16/CF, paras 91-100

1) to continue work on the finalization of the COP through an electronic working group to be chaired by Japan and co-chaired by Spain.

2) to issue a circular letter[5] requesting further information and data to assist the EWG in the development of the COP for consideration by the next session of CCCF; and

5. The list of participants to the EWG is shown in Appendix III.

6. The CL was issued with specific notes for submission (Table 1) requesting information on management practices readily available that are:

   1) proven to be feasible and effective for application for local and/or regional conditions to prevent and reduce arsenic contamination in rice; and

   2) limited to source directed measures and agricultural measures.

7. A summary of the data / information submitted in reply to the CL as well as a summary of the discussion that took place in the EWG is presented in Appendix II for information.

REQUEST FOR COMMENTS

8. Codex members and observers are kindly invited to provide comments on the proposed draft Code of Practice for the Prevention and Reduction of Arsenic Contamination in Rice as presented in Appendix I. Particular attention should be paid to those sections in square brackets that require further consideration by the Committee.

9. In submitting comments, Codex members and observers are kindly invited to take into consideration the information presented in Appendix II in particular for those sections in square brackets.

[5] CL 2016/20-CF

APPENDIX I

PROPOSED DRAFT CODE OF PRACTICE FOR THE PREVENTION AND REDUCTION OF ARSENIC CONTAMINATION IN RICE
(For comments)

1. INTRODUCTION

1.1 [Arsenic is a toxic metalloid and inorganic arsenic is identified as a human carcinogen.] Soil in rice paddy fields can contain arsenic naturally and also can be polluted by irrigation water, rain and air that are contaminated with arsenic from anthropogenic sources such as mining and smelting and materials for agricultural and livestock production. Rice plants absorb arsenic from soil, especially when soil is in reducing conditions, and accumulate it in grain and straw. Rice may contain inorganic arsenic (arsenite and arsenate) and organic arsenic (monomethylarsonic acid and dimethylarsinic acid).

1.2 The effectiveness of measures in the Code of Practice can vary depending on local environmental conditions (e.g. soil properties, management regimes and, temperature). Field studies should be conducted to identify measures that are feasible and effective for local or regional conditions. If possible, the field studies should be conducted across crop years because arsenic uptake in rice crops is highly variable from year to year. Implementation of measures that are likely to result in insufficient supply of rice to the market should be avoided.

2. SCOPE

2.1 The Code intends to provide national or relevant food control authorities, producers, manufacturers and other relevant bodies with all possible guidance to prevent and reduce arsenic contamination in rice as follows:

i. Source directed measures; and

ii. Agricultural measures

2.2 The Code also includes guidance on monitoring and risk communication.

3. DEFINITIONS

3.1 ***Paddy rice*** (rice grain) is rice (species *Oryza sativa* L.) which has retained its husk after threshing (GC 0649[1]).

3.2 ***Husked rice*** (brown rice or cargo rice) is paddy rice from which the husk only has been removed. The process of husking and handling may result in some loss of bran (CM 0649[1]).

3.3 ***Polished rice*** (milled rice or white rice) is husked rice from which all or part of the bran and germ have been removed by milling (CM 1205[6]).

3.4 ***Arsenic*** is a metalloid and is found in the environment both from natural occurrence and from anthropogenic activity.

Note: In this paper, the term “arsenic” refers to inorganic and organic arsenic.

3.5 ***Organic arsenic*** is an arsenic compound that contains carbon, including monomethylarsonic acid and dimethylarsinic acid.

3.6 ***Inorganic arsenic*** is an arsenic compound that does not contain carbon. As(III) and As(V) are the inorganic arsenic compounds typically found in rice. [Inorganic arsenic is considered the significant toxic form of arsenic in rice.]

3.7 ***Flooded condition*** is a condition that a paddy field is filled or covered with water during growth.

3.8 ***Aerobic condition*** of soil in a paddy field where rice is grown is [a condition that a paddy field is more aerobic than flooded condition.] [in well drained, [non-puddled][non-flooded] and unsaturated soils.]

3.9 ***Intermittent ponding*** means a variety of possible water management practices in which a paddy field is alternately in flooded and aerobic/non-flooded condition.

[3.10 ***Production under irrigation*** means any type of irrigation such as sprinkler or drip irrigation, except flooding irrigation.]

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1 *Classification of Food and Feed* (CAC/MISC 4-1993)

4. MEASURES TO PREVENT AND REDUCE ARSENIC CONTAMINATION

[4.1 Inorganic arsenic is the most toxic form of arsenic. Measures to reduce arsenic (e.g., flooding/aerobic growth) may affect inorganic and organic arsenic differently. The most important goal is to reduce inorganic arsenic.]

4.2 Measures to prevent and reduce arsenic contamination in rice are recommended particularly on highly contaminated areas. National or relevant food control authorities may consider implementing the measures in Section 4.3 prior to the implementation of measures in Section 4.4, if appropriate.

4.3 Source Directed Measures

4.3.1 Sources of arsenic in the environment are: 1) natural sources, including volcanic action, elution from soil or sediment such as Holocene sediments, geogenic weathering and low temperature volatilization; and 2) anthropogenic sources, including emission from industries, especially from mining and smelting of non-ferrous metals; burning of fossil fuels; use of arsenic pesticides; and disposal of timber treated with copper chrome arsenate (CCA). In the paddy environment, use of soil amendments and fertilizers contaminated with significant concentration of arsenic are also sources of arsenic[2].

4.3.2 National or relevant food control authorities should consider implementation of source directed measures in the *Code of Practice concerning Source Directed Measures to Reduce Contamination of Food with Chemicals* (CAC/RCP 49-2001). In particular, authorities can consider whether measures in the following areas are appropriate for their countries:

- Irrigation water;
  - Identification of irrigation water with high arsenic concentration
  - Reduction of arsenic from irrigation water with high arsenic concentration
  - Avoidance of use of irrigation water with high arsenic concentration for rice production
- Soil;
  - Identification of paddy fields in which arsenic concentration in soil is high and/or where rice with high concentration of [inorganic] arsenic is produced
- Identification and control of potential sources of arsenic:
  - Atmospheric emissions and waste water from industries;
  - Materials used in agricultural and livestock production such as pesticides, veterinary medicines, feed, soil amendments and fertilizers; and
  - Waste (such as timber treated with copper chrome arsenate)

4.4 Agricultural Measures

4.4.1 National or relevant food control authorities should educate rice producers about practices to prevent and reduce arsenic concentration in rice. Education programmes may include:

- Publishing and disseminating technical guidance on rice cultivation techniques to reduce arsenic in rice
- Establishing farmer field schools

4.4.2 Aerobic conditions or intermittent ponding during rice production, instead of flooded conditions, may reduce arsenic concentration in rice. Studies have shown aerobic soils reduce arsenic uptake as compared to flooded soils even when there are high amounts of arsenic in the soil. Intermittent ponding can also reduce availability of arsenic for plant uptake compared to flooded soils.

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2 Many fertilizers contain trace levels of arsenic. “Contaminated” should not be interpreted as equivalent to trace levels of arsenic.

4.4.3 However, if cadmium concentrations in rice are of concern in a geographic region, risk managers should ensure that implementation of arsenic control measures would not increase cadmium concentrations in rice to unsafe levels[3]. If appropriate, risk managers may consider implementation of source directed measures for cadmium reduction in soil, water or fertilisers that are used for rice production[4].

4.4.4 It is also noted that implementation of aerobic or intermittent ponding conditions may result in a decrease in rice production in some areas. Aerobic growth may also have to be balanced with the use of flooding for weed control or temperature control in cooler areas.

4.4.5 National or relevant food control authorities may identify rice cultivars with lower arsenic concentrations (either in husked and/or polished rice) and encourage public research institute or private firms to develop rice cultivars that result in husked and/or polished rice with low arsenic concentration. Producers could select such rice cultivars, if available and suitable.

5. MONITORING

5.1 The effectiveness of measures should be monitored [by] [to assess] arsenic concentration in rice.

5.2 If agricultural land or ground waters used for growing rice are widely contaminated by natural sources, non-point source or [past] [historical] activities, monitoring of arsenic concentrations in soil and/or irrigation water may also be necessary.

6. RISK COMMUNICATION

6.1 National or relevant food control authorities should share information on risks and benefits of consuming polished and/or husked rice among stakeholders in the light of arsenic concentrations and nutrient components, [noting that there are health benefits associated with consumption of husked rice][considering concerns regarding arsenic concentrations and the nutritional benefits of rice consumption].

6.2 National or relevant food control authorities should share the following information with distributors and consumers and encourage them to implement practices that would reduce arsenic concentration during processing and cooking.

6.3 [It is known that during polishing process more arsenic is removed from husked rice that contains higher concentration of arsenic and that husked rice polished at the higher polishing rate results in polished rice with lower arsenic concentration.] Polished rice contains less inorganic arsenic than husked rice, because polishing removes inorganic arsenic in the bran layer. [Husked rice polished at the higher polishing rate results in polished rice with lower arsenic concentrations.] [Thus, husked rice containing high concentration of arsenic can][may] be distributed and safely consumed after it is appropriately processed into polished rice.

6.4 Arsenic concentration in polished rice can be reduced by washing polished rice, applying “rinse-free”[5] treatment or cooking polished rice with large amounts of water followed by discarding excess water.

6.5 When water used for cooking is highly contaminated with arsenic, national or relevant food control authorities should inform consumers that they should avoid use of such water for washing and cooking rice, as rice absorbs arsenic in water. Consumers should be encouraged to use water for washing and cooking rice that contains lower concentration of arsenic.

7. COMPLEMENTARY INFORMATION FOR FURTHER CONSIDERATION OF MEASURES

7.1 The results of ongoing or planned research studies on the effectiveness of measures to prevent and reduce arsenic concentration in rice should be considered in future revisions to this Code of Practice. Research on the following topics may help in further developing this Code of Practice:

7.1.1 Effects of soil amendments and fertilizers (e.g. silicates, phosphates and organic materials) on arsenic concentrations in rice including considering the effects of applying different amounts of the materials or applying the materials with different timing and frequency (e.g. one-off or repeated use in each season);

7.1.2 Indirect effects (e.g. change of yield, cadmium concentration in rice) of implementing measures to reduce arsenic concentrations in rice;

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3 Use of some rice cultivars that absorb little amount of cadmium, if available, may be a solution.

4 See the *Code of Practice concerning Source Directed Measures to Reduce Contamination of Food with Chemicals* (CAC/RCP 49-2001)

5 “Rinse-free” rice, also known as “Musemmai”, is rice in which bran that remains on the surface after polishing is completely removed and thus it is not necessary to wash before cooking.

7.1.3 Effects of varying the timing and duration of flooded/aerobic conditions during the rice growth period;

7.1.4 Understanding factors affecting arsenic concentrations in rice, including from the arsenic concentrations in soil and/or other factors (e.g. iron, silicates, phosphates concentrations etc.) before cultivation; and

7.1.5 Efficiency and cost of removing arsenic in soil using agricultural crops that absorb and accumulate arsenic from the soil or using chemical compounds that absorb arsenic and are easily separated from the soil.

APPENDIX II

SUMMARY OF THE INFORMATION PROVIDED IN REPLY TO CL 2016/20-CF AND ANALYSIS OF THE INFORMATION PROVIDED (For information)

Table 1. Information on measures proven to be effective for prevention and/or reduction of arsenic in rice in the field/paddy (agriculture stage), such as the following:

	Note for submission of information/data
➢ Summary of *proven* measure	Describe a summary (key principles and technologies) of measure proven to be effective in prevention and/or reduction of arsenic in paddy/field rice in the real agricultural conditions.
➢ Detailed description of the measure	Detailed description of the above.
➢ Location of implementation/study	Describe the location of implementation/ study by providing address.
➢ Study years	Describe the starting year and ending year.
➢ Plot size of implementation/study where samples were taken	Describe the plot size, preferably in a form of length (m) x width (m). If information is available on the water flow, please provide.
➢ Variety of rice	Describe the variety of rice together with its subspecies (*indica, japonica* or *javanica*). Information on subspecies only is OK.
➢ Planting time	Describe the date (day, month, and year) of planting.
➢ When samples (rice at harvest time) were taken in respect of the implementation of measure (e.g., one year before, and 3 years after)	Describe the timing of sampling in relation to the implementation of measures as shown in the left column. Rice samples should be taken at the time of harvest.
➢ Number of samples taken	Describe the number of samples taken from the paddy/field.
➢ Concentrations of arsenic in samples (total arsenic; if available, inorganic arsenic) before and after the implementation of measures	Describe the analytical results of total arsenic in mg/kg. If available, describe the concentration of inorganic arsenic in mg/kg of the same sample. Indicate the sampling timing and whether the samples are husked rice (brown rice) or polished rice (milled rice, white rice).
➢ Levels in soil and water if available	If available, describe the total and/or arsenic (in mg/kg) in the soil of paddy/field where the sample rice was taken; and in water in the paddy or used for irrigation.

Information on any working measures at other stages and any other relevant information is welcome.

INFORMATION PROVIDED

1. Information provided in response to the Circular Letter is shown in Table 2. The information contained in CX/CF 16/10/8 is also included in the same table.

Table 2. Information on arsenic mitigation measures provided by Members

Country	Measures/ ongoing studies	Results available in	Memo
Brazil	• Studies on methods of analysis for total and inorganic arsenic for monitoring concentration in rice • Studies on As mitigation in rice grains, including: selection of rice cultivar with low As uptake, As concentration dependency on production region and cultivar, and irrigation during cultivation	Feb 2019	(Source: Reply to CL)
Japan	• Multi-year field studies in several areas to investigate appropriate irrigation measures	Mar 2019	(Source: CX/CF 16/10/8)
Philippines	• Studies to determine the levels of total Arsenic in rice grown near natural and anthropogenic sources during the wet and dry season to predict the futuristic effect of climate change using appropriate programs for environmental assessment and formulation of mitigating measures	Feb 2019	These studies involve similar investigations on Cadmium (Source: CX/CF 16/10/8)
Republic of Korea	• Studies on the effect of application of soil amendments/treatments such as calcium superphosphate, granular sulphur, steel slag and S-containing fertilizer (combination of ammonium sulphate, potassium sulphate and calcium superphosphate) to highly contaminated paddy fields (314 mg/kg of aqua-regia extractable arsenic). Each experimental field was 1.5 m x 2.1 m and each trial was replicated 3 times. The report indicated that application of these amendments resulted in the reduction of arsenic concentration in husked rice.	Available	It was not clear whether the effect was statistically significant. It should also be noted that the relationship between dose of application and the effect was not clear; although application of lower amount of steel slag (0.7 t/ha) showed reduction of As in husked rice, application of higher amount (1.4 t/ha) did not. (Source: Reply to CL)
	• Field scale study on the measure to control irrigation water was ongoing	Late 2017	(Source: Reply to CL)
Thailand	• Studies on the relationship between chemical species of arsenic in soil and rice • Seeking suitable management to reduce arsenic accumulation in rice, such as water management and application of fertilizer and rice husk ash in paddy fields with different soil types	Early 2018	(Source: CX/CF 16/10/8)

Country	Measures/ ongoing studies	Results available in	Memo
United States of America	• Aerobic water management (intermittent flood or not flooded) dramatically reduces As due to redox potential, arsenic species, soil microbe population, As availability and As uptake • The longer the flood time the more arsenic accumulation and a greater proportion is DMA • However, severe water stress may cause significant loss in yield • Thus, it is important to investigate “water management sweet spot”, which would optimize yield while reducing arsenic	Available	The information is already included in the draft (Source: Reply to CL)
	• Iron-reducing bacteria make As more available for uptake	Available	Somenhally et al. 2011a. Soil Biology & Biochemistry, 43:1220-1228. Somenhally et al. 2011b.Environmental Science & Technology. 45: 8328-8335. (Source: Reply to CL)
	• Some varieties uptake lower concentration of total arsenic than other varieties; however, soil and cultural management factors largely determine the proportion of inorganic and organic forms of arsenic found in the grain	Available	Pillai et al. 2010. Crop Science. 50: 2065-2075. Norton et al. 2012. New Phytologist. 193: 650-664. Pinson et al. 2015. Crop Science. 55: 294-311. (Source: Reply to CL)
Uruguay	• Studies aiming to understand Arsenic dynamics with a 2 to 3-year field experiments on four widely used varieties, with two irrigation regimes in two soil types which represent the main rice regions in the country (North and East)	2017	(Source: CX/CF 16/10/8)

ANALYSIS OF THE INFORMATION PROVIDED

2. Some of the information newly provided by members were already included in the draft. The others were scientifically useful, but unrelated to measures to be put into practice in the field, or not supported by sufficient scientific evidence. The current version of the COP includes all the available information that is proven to be effective and feasible at the field level.

3. During the discussion in the EWG, all the comments submitted by members were analysed and amendments were made reflecting comments / proposals or taking into consideration Codex common conventions / wording. However, while there were divergent views, different terms/descriptions were kept in square brackets for further considerations by CCCF.

DISCUSSION

4. The COP was circulated three times in the EWG. Comments were provided by 5 Members (Brazil, Chile, Japan, Thailand, United States of America and Uruguay), 6 Members (Brazil, Chile, India, Japan, Nigeria and United States of America), and 4 Members (Chile, Costa Rica, Japan and Uruguay) for the first, second and third circulation, respectively. In addition to editorial amendments, the following were discussed in the EWG.

Title

5. With regard to the term “reduction” in the text and throughout the document, some members were of the view that it should be replaced with “decrease” because the term also has a specific chemical meaning (opposition of “oxidation”). The EWG concluded to use “reduction” for consistency with other COPs.

Introduction

6. One Member proposed to include information on toxicity of inorganic arsenic as follows:

Inorganic arsenic is highly toxic and cause several adverse health effects which include nausea, vomiting, hypotension, irritation of the skin, birth defects etc. Long-term exposure to high levels of arsenic is associated with higher rates of skin, bladder and lung cancers, as well as other adverse health effects like pulmonary disease, cardiovascular disease etc.

As intake of inorganic arsenic from rice associates with long-term exposure and acute toxicity is not relevant, a short explanation is included in section 1.1 in square brackets for consideration by CCCF.

Definitions

<u>3.3 Polished rice</u>

7. The same definition as in the *Standard for Rice* (CODEX STAN 198-1995) is used for consistency.

<u>3.5 Organic arsenic</u>

8. As the term “organic arsenic” includes not only monomethylarsonic acid and dimethylarsinic acid but also other organic arsenic compounds, “including” is more appropriate than “as” although usually monomethylarsonic acid and dimethylarsinic acid are analysed.

<u>3.6 Inorganic arsenic</u>

9. In response to the proposal to add information that “inorganic arsenic is considered the significant toxic form of arsenic”, this text was included in square brackets for consideration by CCCF.

<u>3.8 Aerobic condition</u>

10. Two definitions were proposed: “more aerobic than flooded condition” and “well-drained, [non-puddled] [non-flooded], and unsaturated soils”. The second proposal seems more specific. It should be noted that the first proposal covers a wider range of situations (e.g. situation of well-drained, non-puddled but saturated soils is covered by the first proposal but not by the second proposal). Both proposals are included in square brackets for discussion by CCCF.

<u>3.10 Production under irrigation</u>

11. It should be noted that the term does not appear in the COP and, therefore, may not be necessary. The proposed definition is included in square brackets for discussion in CCCF.

Measures to prevent and reduce arsenic contamination

Section 4.1

12. There was a proposal to include a new text, “Inorganic arsenic is the most toxic form of arsenic. Measures to reduce arsenic (e.g., flooding/aerobic growth) may affect inorganic and organic arsenic differently. The most important goal is to reduce inorganic arsenic.” The CCCF is invited to consider whether or not to include the text.

Section 4.3.2

13. Reference to permitted limits in irrigation water, which is national regulation, was not included.

14. With regard to the bullet point on soil, the existing text was amended for clarity. The CCCF is invited to discuss whether or not to include “inorganic” currently in square brackets.

Monitoring

15. There are two sets of texts in square brackets (one set in each paragraph) for consideration by CCCF.

Risk communication

Section 6.1

16. The CCCF is invited to select either text in square brackets.

Section 6.3

17. Texts in the first pair of square brackets and in the second pair of square brackets contain similar information and CCCF should consider which text is more appropriate.

18. The text in the third pair of square brackets introduces polishing as a mitigation measure. The CCCF is invited to discuss whether or not to include it.

19. One member proposed to mention analysis. It was, however, not included as the section is about risk communication. It should also be noted that there is no need to mention the maximum levels in the COP as maximum levels for inorganic arsenic in polished and husked rice have already been adopted and are in the *Codex General Standard for Contaminants and Toxins in Food and Feed* (CODEX STAN 193-1995).

Section 6.4

20. Some members proposed not including two mitigation measures, washing polished rice and applying “rinse-free” treatment. These measures are, however, retained in the document because both of the measures have been proven to be effective by scientific evidences.

APPENDIX III

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