CODEX ALIMENTARIUS COMMISSION

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World Health Organization

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CF11/CRD25

PROPOSED DRAFT CODE OF PRACTICE FOR THE PREVENTION AND REDUCTION OF ARSENIC CONTAMINATION IN RICE

(Prepared by the EWG chaired by Japan and co-chaired by Spain)

Note: In addition to editorial amendments, the following changes were proposed on the text of the proposed draft COP.

Section 1.1

The text “that may be found in various foods, including rice” was included for clarity.

There was a proposal to include information on non-carcinogenic toxicity. As JECFA in 2011 calculated BMDL on a basis of carcinogenicity, and as non-carcinogenic toxicities of inorganic arsenic are proposed for inclusion in the priority list for future JECFA evaluation, only information on carcinogenicity is mentioned in the text of the proposed draft COP pending availability of JECFA risk assessment of non-carcinogenic toxicities of inorganic arsenic.

Section 1.2

With regard to the proposal to replace “management regimes” with “water management”, management regimes are more appropriate for examples because the term covers wider ranges of measures.

One member proposed inclusion of the following text:

> Field studies have been conducted in various regions, the results of which have helped inform the development of measures outlined in the COP. Results of further studies should be considered to help further develop and refine the measures already outlined in this COP.

As the information is important for the establishment of the COP, the report of the CCCF at its last session contains this kind of information (paras 91 and 99). However, as it is not a mitigation measure, it was not included in this CRD.

Section 3.7

There was a proposal to replace the term “flooded” with “anaerobic” for consistency with the term “aerobic” (throughout the document). “Flooded” is retained because it is a more commonly used word and widely accepted in the EWG discussion.

Section 3.10

Inclusion of this section was supported by some members. However, it was not included because the term “production under irrigation” is not used in the COP.

Section 4.3.2 ([Soil][paddy field])

Replacement of “soil” with “paddy field” was proposed as the text focuses on the identification of paddy field rather than that of soil. Committee is invited to consider which is more appropriate.

The Committee is invited to consider whether the term “inorganic” should be included in the paragraph (and also in section 5.1). It should be noted that the title of COP does not specify “inorganic” arsenic but rather covers arsenic (both inorganic and organic arsenic).

Section 4.4.2

The text was included to explain the relationship between aerobic conditions and cadmium concentrations in rice to make Section 4.4.3 more understandable.

Section 4.4.3

The removal of the paragraph was proposed as the risk of cadmium is out of the scope of the COP. The text was retained because it is important not to increase risk from cadmium when introducing arsenic mitigation

measures for consumers' health, which is one of the major objective of Codex.

Section 4.4.5

Replacement of "lower arsenic concentrations" with "low arsenic uptake" was proposed. The original text was retained because, in the COP, the concentration of arsenic in rice is of concern. If a rice cultivar that easily absorbs arsenic does not accumulate arsenic in rice grain, the cultivar is useful.

Section 5.2

There were two proposals ("past" or "historical"). The Committee is invited to select one from them.

Section 6.3

The Committee is invited to consider whether the last sentence in square brackets should be included.

Section 7.1.6

New proposal for consideration by the Committee.

INTRODUCTION

1.1 ~~[~~Arsenic is a toxic metalloid that may be found in various foods, including rice. ~~and i~~Inorganic arsenic is identified as a human carcinogen.~~]~~ Soil in rice paddy fields can contain ~~arsenic~~ naturally occurring arsenic 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~~ unnecessarily restrict~~result in insufficient~~ supply of rice to the market should be avoided.

1. 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.

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

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. Arsenite (As(III)) and Arsenate (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 in which~~that~~ a paddy field is filled or covered with water during growth.

3.8 ***Aerobic condition*** of soil is a condition in which ~~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~~ or 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.]~~

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 in rice.~~]~~

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][paddy field];
  - 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)

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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 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 while there is a possibility to increase cadmium 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.

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 to prevent or reduce [inorganic] arsenic should be monitored ~~[by] [~~to assess~~]~~ [inorganic] 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 both 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 which contains most of the inorganic arsenic. ~~[~~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.~~ [However, there are also benefits associated with consumption of husked rice.]

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

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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

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;

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.

[7.1.6 Effects of reduction of arsenic using biological technique (e.g. phytoremediation)]

completely removed and thus it is not necessary to wash before cooking.