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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

Agenda item 11 **CX/CF 25/18/12**

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JOINT FAO/WHO FOOD STANDARDS PROGRAMME

CODEX COMMITTEE ON CONTAMINANTS IN FOODS

Eighteenth Session
23-27 June 2025
Bangkok, Thailand

DISCUSSION PAPER ON THE REVIEW OF THE *CODE OF PRACTICE FOR THE REDUCTION OF ACRYLAMIDE IN FOODS* (CXC 67-2009)

(Prepared by the Electronic Working Group chaired by India and co-chaired by Saudi Arabia)

BACKGROUND

1. At the 16th session of the Codex Committee on Contaminants in Foods (CCCF16), India requested the inclusion of acrylamide in the priority list of contaminants for evaluation by the Joint FAO/WHO Expert Committee on Food Additives (JECFA). The JECFA Secretariat indicated that acrylamide was evaluated by JECFA twice, in 2005 and 2011, and was identified as a genotoxic carcinogen; therefore, a health-based guidance value could not be established, and it was unlikely that new data that might have become available since the last evaluation could change this outcome. Based on the above considerations, India expressed its interest in developing a discussion paper on acrylamide in foods and CCCF established an electronic working group (EWG), chaired by India and co-chaired by Saudi Arabia, to develop a discussion paper on acrylamide in foods, focusing on the feasibility of risk management measures, for consideration by CCCF17.[1]

2. At CCCF17 (2024), there was general support for the revision of the Code of practice (CoP) for the reduction of acrylamide in foods (CXC 67-2009), if supported by further work assessing the availability of new mitigation measures. CCCF17 agreed to:

   (i) re-establish the EWG, chaired by India and co-chaired by Saudi Arabia, to develop a discussion paper with a proposal for a draft revised Code of practice and project document, and

   (ii) issue a circular letter (CL) to collect information on new risk management measures for the reduction of acrylamide.[2]

WORK PROCESS

3. The Codex secretariat issued a circular letter (CL 2024/79-CF) requesting data and information on risk management measures to reduce acrylamide contamination in foods. Eleven Codex member countries (Brazil, Canada, Chile, China, Costa Rica, European Union, Iraq, Japan, the United Kingdom, United Arab Emirates, United States) and four observer organizations (Food Industry Asia, FoodDrinkEurope, International commission for Uniform Methods of Sugar Analysis (ICUMSA) and Institute of Food Technology (IFT)) provided information on the risk management measures. The EWG chairs conducted a literature search to identify publications that could inform the revision of the CoP.

4. The information was used to draft a discussion paper, and the first draft of both the discussion paper and the project document was circulated in the EWG for comments. Three member countries (Spain, United States, and Japan) and three observer organizations (FoodDrinkEurope, Food Industry Asia, and PEP) have shared their comments and suggestions for improving the discussion paper and project document. The second draft has been revised based on these comments and has been shared with the EWG and the Codex Secretariat.

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1 REP23/CF16, paras. 115-117, 133 (iv)

2 REP24/CF17, paras 110-114

5. The project document is presented in Appendix I. Appendix II summarizes the key points of discussion in the EWG that should be considered for revision under each section of the current CoP based on the information through the circular letter and literature research, including an assessment of the information on mitigation strategies available to the EWG. Appendix III compiles comments submitted in reply to CL 2024/79-CF. The list of participants is available in Appendix IV.

CONCLUSIONS

6. Based on the revisions to the CoP provided in Appendix II, it can be concluded that there is new information available that justifies the revision of the CoP.

RECOMMENDATIONS

7. CCCF is invited to consider whether there is sufficient information available on new mitigation measures to justify the revision of the *Code of Practice for the Reduction of Acrylamide in Foods* (CXC 67- 2009) based on the proposed revisions provided in Appendix II.

8. If CCCF supports the revision of the CoP:

   (i) to review the project document accordingly to forward it to the Executive Committee (CCEXEC) and the Commission for approval as new work for the Committee (see Appendix I); and

   (ii) to re-establish the EWG to further develop the CoP based on the guidance provided by CCCF, and the proposed revised CoP in Appendix II for consideration by CCCF19.

APPENDIX I

PROJECT DOCUMENT

Proposal for a new work on the revision of the

***Code of practice for the reduction of acrylamide in foods* (CXC 67-2009)**

(For consideration by CCCF)

1) Purpose and scope of the project

The purpose of the proposed work is to update the *Code of Practice for the Reduction of Acrylamide in Foods* (CXC 67-2009) to incorporate new insights, including the latest mitigation measures proposed by the food and drink industries (example: FoodDrinkEurope "Acrylamide Toolbox"), as well as scientific advancements aimed at further reducing acrylamide levels in food products.

2) Relevance and timelines

The 17th Session of the Codex Committee on Contaminants in Foods (CCCF17, 2024) noted that there was general support for the revision of the Code of Practice for the Reduction of Acrylamide content in Foods (CXC 67-2009). If supported by further work to assess the availability of additional or new mitigation measures, which could be included in a revised discussion paper for consideration by CCCF18. A circular letter was issued following CCCF17, and in response, member countries and organizations provided information on mitigation measures. Acrylamide was last evaluated by the 72nd Meeting of the Joint FAO/WHO Expert Committee on Food Additives (JECFA72, 2010). JECFA72 reaffirmed the conclusions of JECFA64 (2005) that it is genotoxic and carcinogenic. Based on the margin of exposure (MOE) values and the health concerns associated with acrylamide, new work aims to continue reducing exposures by updating the existing CoP.

3) Main aspects to be covered

The work will focus on updating information in the CoP on acrylamide mitigation strategies, guided by scientific evidence and updated data made available since the adoption of CXC 67-2009. These strategies should be proven effective and widely implementable across different regions. Additionally, the work will cover key factors contributing to acrylamide formation, including the identity of precursors and the stages of food processing most susceptible to acrylamide development. The revision will reflect the information received in response to CL 2024/79-CF and address diverse and broader food categories compared to the current CoP where information is available. The details include agronomy, processing methods, recipes, and product design of plant-based products, including bread, breakfast cereals, potato snacks, coffee, and coffee substitutes, as well as foods for infants and young children.

4) Assessment against the criteria for the establishment of work priorities

(a) Consumer protection from the point of view of health and fraudulent practices

A revised (CoP) that incorporates the latest information on proven measures to reduce acrylamide levels will directly contribute to lowering consumer exposure to acrylamide across a wide range of food products, providing food business operators with standardized, scientifically-backed protocols aimed at reducing acrylamide, thus promoting transparency and trust in food safety practices.

(b) Diversification of national legislations and apparent resultant or potential impediments to international trade

A revised CoP is necessary to ensure that all member countries have access to the latest information on recommended practices for reducing acrylamide levels in foods. This will help producers implement effective mitigation strategies, aiding compliance with emerging guidelines.

(c) Scope of work and establishment of priorities between the various sections of the work

The revision should prioritize the inclusion of proven, globally applicable practices to reduce acrylamide levels in foods already covered in the current Code of Practice (CoP), as well as those not previously included. Food categories with high exposure risks should be emphasized, with a focus on practical solutions that are technically feasible, provide effective consumer protection, and have global applicability. Any measures proposed to mitigate acrylamide in the foodstuffs concerned must also take into account risk-risk and risk-benefit considerations, as well as the important aspect of consumer acceptability of the final product.

(d) Work already undertaken by other international organizations in this field

JECFA assessments were conducted in 2005 (JECFA64) and 2010 (JECFA72). JECFA72 reaffirmed the conclusions of JECFA64. JECFA72 concluded that Margins of Exposure (MOEs) for cancer were 300 at mean intake and 75 at high intake, highlighting potential health risks. To share the best practices and reduce the exposure to acrylamide from food, CXC 67-2009 was published, as well as FoodDrinkEurope 's comprehensive Acrylamide Toolbox and the U.S. Food & Drug Administration's Guidance for Industry: Acrylamide in Foods, all which provide practical guidance for the food industry on reducing acrylamide levels in various food products.

5) Relevance to Codex Strategic Goals

(a) Goal 1: Address current, emerging, and critical issues in a timely manner

The proposed new work will assist competent authorities and food business operators in implementing practical interventions to effectively reduce the risk of acrylamide formation in food products, addressing both current and emerging food safety concerns.

(b) Goal 2: Develop standards based on science and Codex risk-analysis principles

The revision will bring the CoP up to date with the latest science-based best practices for minimizing this contaminant.

(c) Goal 3: Increase impact through the recognition and use of Codex standards

Updating the content of the CoP will encourage broader adoption by member countries and food business operators and increase its impact by driving further improvements in food production and processing conditions.

(d) Goal 4: Facilitate the participation of all Codex Members throughout the standard-setting process

Leveraging expert knowledge and existing best practices on acrylamide mitigation across key food categories important in international trade will facilitate the participation of all Codex members through the standard-setting process for this CoP.

(e) Goal 5: Enhance work management systems and practices that support the efficient and effective achievement of all strategic plan goals.

This work will support the creation and implementation of effective food safety management systems designed to reduce acrylamide levels in the concerned foodstuffs. By doing so, it aligns with Codex's overarching goals of safeguarding public health and promoting smooth international trade.

6) Information on the relationship between the proposal and other existing Codex documents

The current CoP is an existing Codex test that plays a crucial role in supporting the implementation of measures across a wide range of foods to reduce overall acrylamide exposure of the diet (see points 1 and 4d). This work will bring the CoP up to date and improve its effectiveness.

7) Identification of any requirement for any availability of expert scientific advice

JECFA72 has already provided needed expert scientific advice.

8) Identification of any need for technical input to the standard from external bodies

In response to the issuance of circular letter (CL 2024/79-CF), member countries and observers provided comments and technical input. This information, along with publicly available literature, can support the revision of the CoP to include new management measures that are proven to be effective in reducing the acrylamide content in wide range of foods.

9) Timeline for completion of the new work

Work will start following approval by CAC in 2025. Completion of work is expected by 2028.

APPENDIX II

Proposed revisions to the
Code of Practice for the ~~Prevention and~~ Reduction of Acrylamide in Foods
(CXC 67-2009)
(For information)

BACKGROUND

1. Acrylamide is a contaminant formed during food processing and is recognized as a genotoxic and carcinogenic compound. It was ~~,~~ first identified in Food by a scientific group at University of Stockholm. ~~highlighted by the Swedish National Food Administration.~~ Its presence in high levels in potato and plant based foods ~~cereal-based snacks,~~ such as bakery products, potato chips, French fries, breakfast cereals and coffee, has prompted the development of risk management strategies aimed at reducing its formation following the ALARA (as low as reasonably achievable) principle in these commonly consumed foods.

2. Acrylamide was classified as genotoxic based on studies in test rats and mice by the sixty fourth meeting and reaffirmed by the seventy second meeting of the Joint FAO/WHO Expert Committee on Food Additives (JECFA).

3. Given the health concerns due to MOE values by JECFA evaluation, ~~mean dietary exposure to acrylamide, in 2009,~~ the Codex Alimentarius Commission established a *Code of Practice (CoP) for the ~~Prevention and~~ Reduction of Acrylamide in Foods (CXC67-2009)*. The CoP includes recommended practices for reducing acrylamide formation during food processing, such as selecting appropriate raw materials, optimizing cooking methods with control or addition ingredients, and controlling temperature and time during the heating of foods to minimize acrylamide formation in commonly consumed items like bread, potato products, cereal based products and coffee ~~-~~etc.

1. INTRODUCTION

~~3.~~4. The existing introduction contains an overview of information prior to the 2009. The information provided in the introduction can be updated and references~~that emerged through~~ to the new information sources such as FoodDrinkEurope's Acrylamide Toolbox ~~recent studies and surveillance~~ can be included ~~and referenced~~ in the introduction of the C~~o~~O~~o~~P along with the existing references.

2. SCOPE

~~4.~~5. Current C~~o~~O~~o~~P scope is limited to only three stages of processing (i.e.) raw materials, control/ addition of other ingredients and food processing and heating. The scope can be expanded for the mitigation measures in the pre-harvest and harvest level, optimizing the storage and handling practices, selection of raw materials, using different additives, processing aids and pre-treatment methods and controlling major contributing processing factors.

~~5.~~6. ~~Further, t~~The existing C~~o~~O~~o~~P primarily describes risk mitigation measures ~~majorly~~ for potato and cereal based products while providing minimal coverage for ~~in general and covers~~ coffee ~~very limitedly~~. This can be further extended and ~~e same can be~~ expanded to specific products like f~~F~~rench fries, potato crisps, bread, breakfast cereals, bakery wares, coffee and coffee substitutes, foods for infant and young children

3. DEFINITIONS

~~6.~~7. There are no definitions mentioned in the existing C~~o~~O~~o~~P. The definition of relevant terms like Mai~~mai~~llard reaction, minor pathways of acrylamide formation, ~~from glycerol and amino acids,~~ a~~A~~sparagine, reducing sugars, blanching, reconditioning, vacuum frying, etc. can be included in the C~~o~~O~~o~~P for reference.

4. RECOMMENDED PRACTICES BASED ON GOOD AGRICULTURAL PRACTICES (GAP)

The following additional information as suggested by the member countries to be considered for revision of the existing C~~o~~O~~o~~P can be restructured that includes this updated information~~:~~

4.1 Potato based products

4.1.1 Pre-harvest

~~7.~~8. Information relevant to the field fertilizer application and crop management to reduce the formation of free a~~A~~sparagine in the tubers.

~~8.~~9. Additional ~~D~~details on the selection of crop varieties with minimum r~~to minimize r~~educing sugars.~~-~~

4.1.2 Harvest

~~9.~~10. Acceptance criteria like time of harvest, stage of maturation and maximum amount of damage on the raw potatoes to be harvested for minimizing the reducing sugar content.

4.2 Cereal based products

4.2.1 Pre-harvest

~~10.~~*11.* Agronomy i~~I~~nformation relevant to the field and crop management to reduce the formation of free a~~A~~sparagine in the grains like balancing field Sulphur levels, controlled nitrogen application.

12. Prioritization of usage of low-asparagine varieties of cereals in sowing, considering other important traits as well as drought and disease resistance, etc.

~~11.~~*13.* Inclusion of Good Phytosanitary Practices to prevent fungal infection. Link between fungal infection and free asparagine levels in grains.

5. RECOMMENDED PRACTICES BASED ON GOOD MANUFACTURING PRACTICES (GMP)

5.1 Potato based products

5.1.1 Storage and transport

~~12.~~*14.* The information in the existing Co~~O~~P under the Para 9 of Raw Materials may be separated into additional ~~as~~ separate section and additional details on the optimum storage and transport condition for the raw potatoes to avoid sprouts and minimize the level of reducing sugars.

5.1.2 Raw Materials

~~13.~~*15.* The criteria for the selection of raw potatoes for the preparation of specific products like f~~F~~rench f~~F~~ries, p~~P~~otato c~~C~~risps, etc.

5.1.3 Pre-treatment

16. Information on the fermentation (use of lactobacillus), ~~new enzymes or~~ processing aids (washing, blanching, par frying) and n~~N~~on-thermal technologies to reduce the formation of a~~A~~crylamide during processing.

17. The application of vacuum drying and pulse electric field treatment should be discussed.[1]

~~14.~~*18.* Use of ultrasound pretreatment to reduce acrylamide (~ 95 %) in potato chips should be mentioned.[2]

5.1.4 French Fries

5.1.4.1 Ingredients and recipes

~~15.~~*19.* Information on the impact of other ingredients (divalent cations, amino acids, acidulants) not mentioned in the existing Co~~O~~P on the acrylamide formation during the preparation of f~~F~~rench f~~F~~ries.

5.1.4.2 Processing

~~16.~~*20.* Information on the frying oil temperature, final product moisture content and ~~other process and~~ other additional details on the processing parameters including management or reduction ~~to consider for reducing the formation~~of the variability with the processes. ~~of acrylamide~~

~~17.~~*21.* Alternate processing or cooking methods (vacuum frying)[3] to minimize the formation of acrylamide.

~~*18. Information on the frying oil temperature, moisture content and other process*~~

~~19.~~*22.* The outcomes of these processes that mitigate acrylamide formation impact~~Control of final~~ product characteristics like colour, texture, flavor etc.~~to reduce the acrylamide formation in the product~~

5.1.5 Potato crisps

5.1.5.1 Ingredients and recipes

~~20.~~*23.* Information on the impact of other ingredients not mentioned in the existing Co~~O~~P on the acrylamide formation during the preparation of p~~P~~otato c~~C~~risps.

5.1.5.2 ~~5.1.5.2~~ Processing

~~21.~~ Inclusion of additional details on the processing parameters[4] or cooking methods,[3] recipe design that can reduce ~~to consider on reducing~~ the formation of acrylamide.

24.

~~22. Alternate processing or cooking methods~~Using blanching and methods to prevent enzymatic browning explained.[4] ~~to reduce the formation of acrylamide~~

25.

5.1.6 Dough-based Potato Products

5.1.6.1 Ingredients and recipes

~~23.~~26. Additional i~~I~~nformation on the selection of dehydrated ingredients and replacement of ingredients such as asparaginase, acids or their salts, and calcium salts in wet dough to reduce acrylamide formation.

~~24.~~27. Additional mitigation measures can be implemented for ingredients with higher reducing sugar levels.

~~25. Use of asparaginase, acids or their salts, and calcium salts in wet dough to reduce acrylamide formation~~

5.1.6.2 Processing

~~26.~~28. Control of frying, baking, and drying temperatures as well as moisture content post frying.

~~27.~~*29.* Balancing the reduction of acrylamide formation with maintaining desirable ~~Control of~~ final product characteristics like colour, texture, flavor. ~~to reduce the acrylamide formation in the product~~

5.2 Cereal Based Products

5.2.1 Raw Materials

~~28.~~*30.* The criteria for the selection of type of raw materials (different type of grains) for the preparation of specific products like f~~F~~ine bakery wares, b~~B~~read, b~~B~~reakfast c~~C~~ereals, etc.

5.2.2 Pre-treatment

31. Information on the new enzymes (amidases) or processing aids and n~~N~~on-thermal technologies to reduce the formation of Acrylamide during processing.[5]

~~29.~~32. Information on new yeast varieties that may impact the asparagine content of dough during fermentation and resting steps in baked goods.

5.2.3 Bakery Wares

5.2.3.1 Ingredients and recipes

33. Selection criteria of suitable flours and p~~P~~artial replacement of wheat flour with other types of flours to reduce the level of asparagine levels while maintaining the nutritional properties of the finished product.

~~30.~~*34.* The use of genetically modified wheat or other ingredients to lower acrylamide should be discussed.[6]

~~31.~~*35.* Information on the impact of other ingredients like leavening agents, ~~raising agents,~~antioxidants, sweetening agents, organic acids, asparaginase[7] and co-ingredients (nuts, fruits) etc. not mentioned in the existing C~~o~~o~~O~~P on the acrylamide formation.

5.2.3.2 Processing

~~32.~~*36.* Inclusion of additional details on the processing parameters, cooking methods that can reduce ~~to consider on reducing~~ the formation of acrylamide.

~~33. Alternate processing or cooking methods to reduce the formation of acrylamide~~

~~34. Control of final product characteristics like colour, texture, flavor to reduce the acrylamide formation in the product~~

37. Guidance to reduce the impact of rework on the final product in terms of acrylamide formation.

~~35.~~*38.* Lower acrylamide by optimizing the thermal profile of equipment, taking care to maintain organoleptic quality and safety of the final product.

5.2.4 Breakfast Cereals

5.2.4.1 Ingredients and recipes

~~36.~~*39.* Selection criteria for~~of~~ grains to reduce the level of acrylamide in the final product.

~~37.~~*40.* Controlling ~~measures of~~ addition of heat~~ed~~ treated ingredients and minor ingredients (glycine, lysine, phosphate salts).

~~38.~~ Information on the impact of other ingredients not mentioned in the existing C~~o~~o~~O~~P on the acrylamide formation.

5.2.4.2 Processing

~~39.~~*41.* Inclusion of additional details such as pH, ~~on~~ the processing parameters (thermal input) to consider on reducing the formation of acrylamide.

~~40.~~*42.* Alternate processing or cooking methods to reduce the formation of acrylamide where an effective combination of temperature and heating times must be specified.

~~41.~~*43.* Control of final product characteristics like colour, texture, flavor to reduce the acrylamide formation in the product.

~~42.~~44. Guidance to reduce the impact of rework on the final product in terms of acrylamide formation.

5.3 Coffee

5.3.1 Pre-treatment

~~43.~~45. Information on the new enzymes such as acrylamidase,[8] roasting technologies and~~or processing aids and~~ n~~N~~on-thermal technologies to reduce the formation of a~~A~~crylamide during processing.

5.3.2 Ingredients and recipes

~~44.~~46. Selection of coffee beans and i~~I~~nformation on the impact of coffee blends and varietal difference in acrylamide formation.

~~45.~~47. Use of coffee substitutes such as cereals and chicory and control of acrylamide exposures.

5.3.3 Processing

~~46.~~48. Inclusion of details on the processing parameters like level of roasting, temperature and moisture and their impact on acrylamide formation. For example, darker roast will lower acrylamide, but significantly change the taste profile, whilst also increasing levels of furans. Impact on furan levels and on acceptability by consumers should be considered.~~to consider on reducing the formation of acrylamide~~

~~47.~~49. Information on innovative roasting methods like s~~S~~uperheated s~~S~~team r~~R~~oasting and vacuum r~~R~~oasting which can reduce acrylamide levels as compared to traditional methods.[9]

50. Correlation ~~ntrol~~ of final product characteristics like colour, and ~~texture,~~ flavor with~~to~~ ~~reduce~~ the acrylamide content~~formation~~ in the product.

51. Importance of supercritical CO_2 extraction to reduce acrylamide levels should be mentioned.[10]

52. The relationship between brewing methods and acrylamide levels must be mentioned.[11]

5.4 Coffee Substitutes

53. **5.4.1 Ingredients and recipe**

54. Impact of chicory and control of acrylamide exposures in coffee substitutes.

55. Impact of cereals and control of acrylamide content.

5.~~4~~5 ~~4~~Foods for infant and young children

5.~~4~~5.1 Ingredients and recipes

~~48.~~56. Selection ~~criteria~~ of ingredients can impact~~to reduce~~ the level of acrylamide in the final product.[12]

~~49.~~57. Addition of a~~A~~sparaginase enzyme in the production process of cereal based infant foods to reduce the ~~to reduce the asparagine~~acrylamide of the final products.~~content in the raw materials~~

~~50.~~58. Control of sugar level, pH to minimize the final acrylamide levels

5.4.2 Processing

~~51.~~59. Inclusion of details on the processing parameters like temperature and moisture to consider on reducing the formation of acrylamide in the final product

~~52.~~60. Inclusion of fermentation (malting and weaning) and other innovative processing methods to reduce the acrylamide level.

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APPENDIX III

ORIGINAL LANGUAGE ONLY

Comments in reply to CL 2024/79-CF

submitted by

Brazil, Canada, Chile, China, Costa Rica, European Union (EU), Iraq, Japan, United Arab Emirates (UAE), United Kingdom, United States of America (USA), Food Industry Asia, FoodDrinkEurope, International Commission for Uniform Methods of Sugar Analysis (ICUMSA), Institute of Food Technologists (IFT)

Background

1. This document compiles comments received through the Codex Online Commenting System (OCS) in response to CL 2024/79-CF[1] issued in August 2024. Under the OCS, comments are compiled in the following order: general comments are listed first, followed by comments on specific sections.

Explanatory notes on the appendix

2. The comments submitted through the OCS are hereby annexed and presented in tabulated format.

[1] https://www.fao.org/fao-who-codexalimentarius/resources/circular-letters/en/
https://www.fao.org/fao-who-codexalimentarius/committees/committee/related-circular-letters/en/?committee=CCCF

ANNEX I

COMMENT	MEMBER/OBSERVER
Brazil would like to thank you for the opportunity to share data and information in response to CL 2024/79-CF on risk management measures to prevent or reduce acrylamide contamination in foods. We attached some recently released publications that may help in discussing the need for reviewing the Code of Practice for the Reduction of Acrylamide in Foods (CXC 67-2009). -- Thermal Contaminants in Coffee Induced by Roasting: A Review https://anvisabr-my.sharepoint.com/:b:/r/personal/larissa_porto_anvisa_gov_br/Documents/Attachments/3.2.1.1.53.%20IJERPH%20coffee%202023.pdf?csf=1&web=1&e=Q6LxoI -- Strategies to reduce neurotoxic acrylamide in biscuits, a systematic review https://anvisabr-my.sharepoint.com/:b:/r/personal/larissa_porto_anvisa_gov_br/Documents/Attachments/2024%20-%20Mitigation%20biscuits.pdf?csf=1&web=1&e=pWe0Co -- Toxicity, metabolism, and mitigation strategies of acrylamide: a comprehensive review https://anvisabr-my.sharepoint.com/:b:/r/personal/larissa_porto_anvisa_gov_br/Documents/Attachments/2024%20-%20Review.pdf?csf=1&web=1&e=P62l6h -- Acrylamide in alternative snacks to potato: A review https://anvisabr-my.sharepoint.com/:b:/r/personal/larissa_porto_anvisa_gov_br/Documents/Attachments/2024%20Cristiane.pdf?csf=1&web=1&e=9aA0S5 -- Acrylamide Toolbox 2019 - FoodDrink Europe https://anvisabr-my.sharepoint.com/:b:/r/personal/larissa_porto_anvisa_gov_br/Documents/Attachments/FoodDrinkEurope_Acrylamide_Toolbox_2019.pdf?csf=1&web=1&e=OiNdA0 If you encounter any difficulties accessing the links, please feel free to contact us, and we will promptly send the documents to you.	**Brazil**
Canada supports risk reduction measures for acrylamide in food, such as those outlined at: Acrylamide in food - Canada.ca (cut a copy link for https://www.canada.ca/en/health-canada/services/food-nutrition/food-safety/chemical-contaminants/food-processing-induced-chemicals/acrylamide.html). CL2024/79-CF was distributed to Canadian stakeholders that have signed up to Canada's CCCF distribution list (some food manufacturers and industry associations). No comments were received. Canada notes that there does not appear to be information in the existing Code of Practice (CXC 67-2009) on the use of agricultural commodities that have been developed or selected for traits that would reduce acrylamide formation. Canada has approved genetically modified potato cultivars that have lower levels of the amino acid asparagine and the sugars glucose and fructose for the purpose of reducing acrylamide formation when potatoes are cooked at high temperatures (e.g., baking, frying, etc.). For example (cut and copy link for: https://www.canada.ca/en/health-canada/services/food-nutrition/genetically-modified-foods-other-novel-foods/approved-products/simplot-innate-potato-event-gen2-z6.html). Canada has also approved a genetically modified Acrylamide-reducing Baker's Yeast, i.e (cut and copy link for: https://www.canada.ca/en/health-canada/services/food-nutrition/genetically-modified-foods-other-novel-foods/approved-products/acrylamide-reducing-bakers-yeast.html)	**Canada**

COMMENT	MEMBER/OBSERVER
Paragraph 6 of CXC 67-2009 states that some countries have approved asparaginase as a processing aid. Canada has approved it for use as a food additive for use in a variety of foods. See (cut and copy link): https://www.canada.ca/en/health-canada/services/food-nutrition/food-safety/food-additives/lists-permitted/5-enzymes.html Canada is also aware that efforts have been made to reduce acrylamide in other foods such as molasses, e.g. Patent 2843447 Summary - Canadian Patents Database (cut and copy link; https://brevets-patents.ic.gc.ca/opic-cipo/cpd/eng/patent/2843447/summary.html). Overall, Canada would support the development of a discussion paper that identifies new or improved measures to update the existing Codex Code of Practice for the Reduction of Acrylamide in Foods (CXC 67-2009) for consideration by CCCF18.	
Chile appreciates the opportunity to present data and information on risk management measures to prevent or reduce acrylamide contamination in food throughout the food production or supply chain. In this regard, Chile would like to share the following information: -There is a free access document, developed by the Food and Beverage Industry Association of Europe (FoodDrinkEurope). This document is a guide that presents tools and measures to reduce the formation of acrylamide in foods, developing a variety of specific tools for different food categories such as potato snacks, cereals, coffee, and baby foods. These tools are grouped into parameters such as measures at the agronomy level (management of reducing sugars and asparagine), interventions in the recipe (pH adjustments, adjustment of minor ingredients), and processing (temperature controls, humidity, pretreatment, color of the final product). Link to document is shared below: https://www.fooddrinkeurope.eu/wp-content/uploads/2021/05/FoodDrinkEurope_Acrylamide_Toolbox_2019.pdf - In September of this year, the conference “Acrylamide and process formed contaminants: A supply chain approach” was held, organized by ACRYRED (https://acryred.eu/). At this conference, several works related to the proposal of new measures for the mitigation of this contaminant were presented, which, although they still require development, are shared for the information of the Electronic Working Group (EWG), established by the CCCF, in its 17th meeting, chaired by India, and co-chaired by Saudi Arabia. -Finally, Chile wants to share some of the findings made by its researchers, who have participated in the following publications in this regard, which we hope will be useful: *Publicación Mariotti M., Cortés P., Fromberg A., Bysted A., Pedreschi F. and Granby K. (2015). Heat Toxicant Contaminant Mitigation In Potato Chips. LWT-Food Science and Technology, 60, 2, 860-866. http://dx.doi.org/10.1016/j.lwt.2014.09.023 Lo destacado Blanching reduces acrylamide (54%) contents in potato chips. Optimum blanching conditions in the experimental region studied were 64 °C and17 min, therefore, blanching process may be considered as an alternative unit operation to produce healthier potato chips. *Publicación Mariotti-Celis M.S., Cortés P., Dueik V., Bouchon P. and Pedreschi F. (2017). Application of vacuum frying as a furan and acrylamide mitigation technology in potato chips. Food and Bioprocess Technology, 10, 11, 2092-2099. https://doi.org/10.1007/s11947-017-1981-5	**Chile**

COMMENT	MEMBER/OBSERVER
Lo destacado Vacuum-fried potato chips showed reductions of about 58 % of acrylamide, when compared to their atmospheric counterparts. Additionally, the texture was not affected ($p > 0.05$) by changes in the pressure during frying. Results clearly showed that vacuum frying is an effective technology for acrylamide mitigation in potato chips, since it reduces the content of this contaminants and preserves the quality attributes of fried snacks. *Publicación Pedreschi F., Saavedra I., Bunger A., Zúñiga R.N., Pedreschi R., Chirinos R., Campos D. and Marioti-Celis M.S. (2018). Tara pod (Caesalpinia spinosa) extract mitigates neo-contaminant formation in Chilean bread preserving their sensory attributes. LWT-Food Science and Technology, 95, 116-122. https://doi.org/10.1016/j.lwt.2018.04.086 Lo destacado Hallulla bread contains considerable amounts of acrylamide, Tara extract addition reduces acrylamide (~85%) formation and also preserves the descriptive profile of hallulla bread. *Publicación Pedreschi F., Ferrera A., Bunger A., Álvarez F., Huaman-Castilla L., and Marioti-Celis M.S. (2021). Ultrasonic-assisted leaching of glucose and fructose as an alternative mitigation technology of acrylamide and 5-hydroxymethylfurfural in potato chips. Innovative Food Science and Emerging Technologies, 73, 102752. https://doi.org/10.1016/j.ifset.2021.102752 Lo destacado Ultrasound pre-treatment reduced the acrylamide content (~95%) of potato chips. *Publicación Pedreschi F., Matus J., Bunger A., Pedreschi R., Huaman N., Mariotti M.S. (2022). Effect of the integrated addition of a red tara pods (Caesalpinia spinosa) extract and NacCl over the neo-Formed contaminants content and sensory properties of crackers. Molecules, 27, 1020-1032. https://doi.org/10.3390/molecules27031020 Lo destacado Red Tara pods extract significantly reduced ($p < 0.05$) the acrylamide content, while NaCl only influenced the HMF formation. However, the sensory attributes did not significantly change ($p > 0.05$), excepting the violet-gray color and salty flavor, but at acceptable levels compared with the control sample. *Publicación Campos D., Chirinos R., Huaraca-Espinoza P., Aguilar-Galvez A., García-Ríos D., Pedreschi F., Pedreschi R. (2024). Atmospheric immersion and vacuum impregnation of gallotannins and hydrolysed gallotannins from tara pods (Caesalpinia spinosa) mitigate acrylamide and enhances the antioxidant power in potato chips. Food Chemistry 436, 137675. https://doi.org/10.1016/j.foodchem.2023.137675 Lo destacado	

COMMENT	MEMBER/OBSERVER
Mitigation of acrylamide in potato chips depends on the addition technique, atmospheric pressure immersion (API) or vacuum impregnation (VI) of tara gallotannins. Tara extract of non-hydrolyzed gallotannins was efficient in mitigating acrylamide when it was added by vacuum impregnation. Tara extract of hydrolyzed gallotannins added either by API or VI were efficient in mitigating acrylamide in potato chips.	
Monitoring programs to measure the effectiveness of AA mitigation are highly dependent on many factors (raw material variety, raw material variability, seasonality, geographic location, processing plant, production lines, process parameters, process variability, etc.), therefore manufacturers should design their sampling plan independently, taking into consideration the statistical significance, feasibility and viability, and to evaluate their AA outcomes in an appropriate way. Refer to the primary research describing the AA mitigation where available. Potato Crisps Manufacturing Process (Addition to current Codex AA COP): Control degree of peeling appropriately to achieve levels that are ALARA. Carry out in-line colour sorting to remove black and brown crisps. Robust moisture control in finished products is critical to controlling AA formation rate. Agriculture Mitigation Measures – Potatoes (Addition to current Codex AA COP): Select varieties suited for local growing conditions to minimize defects. Reduction of tuber sprouting with appropriate techniques is recommended, to avoid increase of reducing sugar. Apply potato storage best practices for each potato variety considering factors such as ideal temperature ranges, humidity, ventilation and light management in warehouse and warehouse transit areas. Whenever possible, minimize potato storage time in trucks and railcars as this may increase reducing sugar levels. Strong inventory management with just-in time deliveries and first in, first out practices can further contribute to better AA outcomes. Ingredients (Fabricate Potato Snacks) (Addition to current Codex AA COP): During product development of fabricated potato snacks, alternative ingredients for replacement of potato flakes may be explored without compromising consumer acceptability. Such replacements may include refined starches (e.g., tapioca, corn, potato), besides rice flour. Asparaginase is most effective to support reduction of AA level under certain conditions (pH, contact time, dosing, storage, etc.). Follow recommendations from manufacturers on conditions and practices of storage. Commercialized product in market has proved that organic acids can be used to lower pH to support better AA outcomes.	**China**
La gestión del nitrógeno es una práctica agronómica común que puede controlar los niveles de precursores de AA y, en consecuencia, el potencial de formación de AA en los tubérculos de papa. De hecho, cuanto mayor es la cantidad de nitrógeno, mayor es el nivel de asparagina (Peivasteh-Roudsari, 2024). La asparagina libre (no proteica y soluble) en el grano de trigo es un precursor clave en la formación de acrilamida durante el procesamiento. Por lo tanto, reducir la cantidad de asparagina libre en el trigo podría disminuir la formación de acrilamida (Oddy, 2023).	**Costa Rica**

COMMENT	MEMBER/OBSERVER
En estudios, la adición de asparaginasa en la preparación de la masa ha demostrado reducir significativamente los niveles de acrilamida en productos horneados, como pan tostado, galletas saladas y pan. Por ejemplo, se lograron reducciones de hasta el 80% en pan tostado y al menos el 70% en galletas saladas. La efectividad de la enzima aumenta con la dosis utilizada; mayores concentraciones de asparaginasa resultan en reducciones más significativas de la acrilamida. Factores como la dosis de la enzima, la duración de la reacción, la temperatura y el pH afectan la eficacia de la asparaginasa. Por ejemplo, la asparaginasa de Aspergillus oryzae es más activa a temperaturas de hasta 60°C en un rango de pH neutro, pero pierde actividad durante el horneado debido a las altas temperaturas. La composición química y la estructura de la matriz alimentaria influyen en la actividad de la enzima. Los niveles de humedad suficientemente altos facilitan la movilidad de la enzima hacia el sustrato (asparagina), mejorando así su eficacia en la reducción de acrilamida (Pesce, 2024). El uso de granos con bajo contenido de asparagina libre, reemplazar total o parcialmente el bicarbonato de amonio (NH4HCO3) con otros agentes leudantes, la adición de asparaginasa, y la reevaluación de ingredientes tratados térmicamente pueden ser útiles para reducir la formación de acrilamida. Otros métodos incluyen reemplazar fructosa o ingredientes que contengan fructosa, agregar coingredientes basados en azúcar después del tratamiento térmico, añadir ciertos aminoácidos o ácidos orgánicos, y ajustar el tamaño de las piezas o la relación superficie-volumen del producto durante el diseño. La extensión del tiempo de fermentación, la optimización de la temperatura de horneado, el perfil de temperatura, el tiempo y la humedad durante el procesamiento pueden ayudar a mitigar la acrilamida. Por ejemplo, la fermentación de pan durante 10-12 horas ha demostrado reducir sus niveles. Disminuir la temperatura de horneado de 200°C a 180°C en galletas redujo los niveles de acrilamida en más del 50%, manteniendo constantes otros factores como pH, tiempo de horneado y concentración de azúcar (Boyaci, 2023). En el artículo titulado: Dietary Acrylamide: A Detailed Review on Formation, Detection, Mitigation, and Its Health Impacts, muestra esta tabla a continuación que detallan una serie de estrategias de mitigación. Datos comparativos que muestran el porcentaje de reducción de acrilamida utilizando diversas estrategias de mitigación. Estrategias de Mitigación para Freído en aire y al vacío, con un porcentaje de Reducción (%) de 72–98% en un Modelo de Muestra de Papas fritas. Estrategias de Mitigación para escaldado, con un porcentaje de Reducción (%) de 65 y 96 % en un Modelo de Muestra de Papas fritas y papas crujientes. Estrategias de Mitigación para aditivos, con un porcentaje de Reducción (%) de 30-60% en un Modelo de Muestra: Modelo químico de aminoácido/azúcar. Estrategias de Mitigación para fermentación, con un porcentaje de Reducción (%) de 70 % en un Modelo de Muestra para café tostado. Estrategias de Mitigación para Recubrimiento de hidrocoloides, con un porcentaje de Reducción (%) de 48 % en un Modelo de Muestra de Papas fritas Estrategias de Mitigación para Atmósfera de horneado inhibitoria e inerte, con un porcentaje de Reducción (%) de 50-99 % en un Modelo de Muestra para pan. Fuente: Pandiselvam, 2024. Referencias • Boyaci Gunduz, C. P. (2023). Formulation and processing strategies to reduce acrylamide in thermally processed cereal-based foods. International journal of environmental research and public health, 20(13), 6272. • Oddy, J., Addy, J., Mead, A., Hall, C., Mackay, C., Ashfield, T., ... & Halford, N. G. (2023). Reducing dietary acrylamide exposure from wheat products through crop management and imaging. Journal of Agricultural and Food Chemistry, 71(7), 3403-3413.	

COMMENT	MEMBER/OBSERVER
• Pandiselvam, R., Süfer, Ö., Özaslan, Z. T., Gowda, N. N., Pulivarthi, M. K., Charles, A. P. R., ... & Jeevarathinam, G. (2024). Acrylamide in food products: Formation, technological strategies for mitigation, and future outlook. Food Frontiers, 5(3), 1063-1095. • Peivasteh-Roudsari, L., Karami, M., Barzegar-Bafrouei, R., Samiee, S., Karami, H., Tajdar-Oranj, B., ... & Mousavi Khaneghah, A. (2024). Toxicity, metabolism, and mitigation strategies of acrylamide: a comprehensive review. International Journal of Environmental Health Research, 34(1), 1-29. • Pesce, F., Ponzo, V., Mazzitelli, D., Varetto, P., Bo, S., & Saguy, I. S. (2024). Strategies to reduce acrylamide formation during food processing focusing on cereals, children and toddler consumption: a review. Food Reviews International, 40(1), 185-211.	
The European Union (EU) wishes to provide the enclosed information in reply to CL 2024/79-CF related to the request for data and information on risk management measures to prevent or reduce acrylamide contamination in foods. The risk management measures provided in this document are established by Commission Regulation (EU) 2017/2158 of 20 November 2017 establishing mitigation measures and benchmark levels for the reduction of the presence of acrylamide in food. The EU has also elaborated a guidance on the implementation of the above mentioned Regulation and sector specific brochures on the applicable mitigation measures were developed by FoodDrinkEurope in cooperation with the EU (Biscuits, Crackers & Crispbreads, Bread Products, Breakfast Cereals, Fried Potato Products/Potato Crisps, Fried Potato Products/French Fries, Food for infants and young children). https://food.ec.europa.eu/document/download/ce8f5354-24f0-49c4-b136-f651e1440ef2_en?filename=cs_contaminants_catalogue_acrylamide_guidance-doc_en.pdf Further comments have been sent by email, as they contain tables that cannot be submitted in OCS. See Annex II	**EU**
No comments	**Iraq**
Japan is honored to have the opportunity to submit comments for the review of the Code of Practice for the Reduction of Acrylamide in Food (CXC 67-2009). The Ministry of Agriculture, Forestry and Fisheries of Japan has developed guidelines for reducing acrylamide in food, which align with the Codex Code of Practice, and has been promoting voluntary reduction measures by food business operators. The ministry regularly conducts surveillance on processed foods that significantly contribute to acrylamide exposure in the Japanese diet and publishes the results on its website. As a result, we have confirmed a significant reduction in acrylamide levels, particularly in potato snacks. Based on the information we collected from food business operators, the measures they are implementing are largely already covered by the current Code of Practice. We believe that the current Code of Practice remains effective and valid. Developing country-specific guidelines and conducting government-led surveillance tailored to the dietary habits of each country are effective in supporting the efforts of food business operators. Additionally, the Ministry of Agriculture, Forestry and Fisheries has created and published videos on YouTube to inform consumers about the voluntary efforts of food business operators to reduce acrylamide and to promote understanding of their efforts to enhance food safety. In addition to the voluntary efforts by food business operators based on our current guidelines, we believe that the creation of country-specific codes of practice by national authorities, continuous surveillance, and the publication of results, as well as the introduction of these voluntary efforts through videos and other media, would be effective in promoting voluntary initiatives by food business operators without the need for mandatory measures. These actions could be added to the current Code of Practice as necessary. Here is some information that may be worth adding to the Code of Practice.	**Japan**

COMMENT	MEMBER/OBSERVER
By performing pulse electric field (PEF) treatment on potato chip slices, ultra-fine pores are created in the cell membranes of the potatoes, promoting the release of reducing sugars. This process is known to not only improve the productivity and quality of potato chips but also reduce acrylamide levels. In Japan, some potato chip manufacturers have already put this method into commercial use and are reportedly seeing positive results. Several papers have been published on the effects of PEF, which can serve as references. In Japan, although it has not yet been commercialized in the industry, there is information that an amidase enzyme, which directly breaks down acrylamide in food, such as soluble coffee, has been introduced to the market. If member countries or food businesses provide data showing the effectiveness of using such enzymes, we believe it could be added to the Code of Practice as a new reduction technology. We are also aware that low-asparagine wheat, developed through new breeding techniques such as genome editing, is currently under research. While these technologies have not yet been commercialized in any country, and it may be premature to include them in the Code of Practice, we believe they are worth noting as technologies that contribute to the reduction of acrylamide. •Guidlines for reducing acrylamide in food （MAFF, 2013） https://www.maff.go.jp/j/syouan/seisaku/acryl_amide/a_gl/sisin.html •Website: Cases for reducing acrylamide in food (MAFF) https://www.maff.go.jp/j/syouan/seisaku/acryl_amide/a_syosai/nousui/ganyu/teigen_jirei.html •Leaflet for consumers: What we can do at home to reduce acrylamide in foods （MAFF,2015） https://www.maff.go.jp/e/policies/food_safety/attach/pdf/acrylamide_booklet.pdf •The Secret of Potato Chips: Reducing Acrylamide (MAFF, 2024) https://youtu.be/3lRnz1lykCY?si=2gqyuFBXSIKuJO9F •Refereces for PEF https://doi.org/10.1016/j.ifset.2019.05.008 https://doi.org/10.1007/978-3-030-70586-2_9 https://doi.org/10.1016/j.lwt.2020.110198 https://doi.org/10.1016/j.heliyon.2024.e31790 https://doi.org/10.1016/j.ifset.2020.102561 https://doi.org/10.3390/foods12112147 https://doi.org/10.1016/j.jfoodeng.2019.109898 https://doi.org/10.1016/j.ifset.2020.102553 etc. •Introducing Acrylerase®: an innovative enzymatic solution to reduce acrylamide levels in soluble coffee products https://www.c-lecta.com/company/news/introducing-acrylerase •Low asparagine wheat: Europe’s first field trial of genome edited wheat amid rapidly changing regulations on acrylamide in food and genome editing of crops https://doi.org/10.1270/jsbbs.23058	

COMMENT	MEMBER/OBSERVER
United Arab Emirates comments on CL 2024/79-CF SUBJETC: Request for data and information on risk management measures to prevent or reduce acrylamide contamination in foods. Regarding the invitation to provide data and information on risk management measures to prevent or reduce acrylamide contamination in foods along the food production/supply chain. United Arab Emirates, UAE proposed the following optional processing conditions to prevent or reduce acrylamide formation in popular food items especially in Arabic and Middle east Countries (Arabic bread, Falafel and Potato chips): As far last decade special consideration from different countries were raised for the detection of acrylamide content in heat treated food composed of carbohydrate and protein. This interest is due to carcinogenicity and neurotoxicity of acrylamide compound which is formed by the interaction of amino acids and reducing sugars under the effect of high temperature. An M.Sc. study (carried out by Mohammed alfares, in Jordan University of Science and Technology) which was intended as contribution toward the detection of acrylamide in food items widely handled in most Arab and Middle east countries markets and seek for a treatment using certain compounds to reduce the formation of acrylamide. From the above-mentioned study, it is concluded that by applying 40 microgram/kg of selenium as an antioxidant and inhibiting agent to pita Arabic bread, falafel and potato chips which are prepared in accordance with standard method. The revealed results indicated that the percentage of acrylamide reduction are 37.8%, 27.1% and 24.1% respectively. Which proved a remarkable reduction compared with control sample and consequently the market items. Moreover, the loss of selenium in the products after heat treatment are detected and showed a significant level of retention, as for pita Arabic bread, falafel and potato chips are 49.7%, 55.4% and 60.6% respectively. Based on that, the addition of selenium revealed in a remarkable reduction of acrylamide content and enriched the products with additional nutritive value as the product was fortified with selenium as an additive value. In response to the inquiry regarding risk management strategies to prevent or reduce acrylamide (AA) contamination in foods, United Arab Emirates, UAE would like to share current findings and ongoing initiatives in this field: The reduction of acrylamide formation is closely linked to the control of reducing sugars and asparagine levels in raw materials, particularly in potato and cereal-based products. Since the concentration of reducing sugars in potatoes is significantly higher than that of asparagine, managing these sugars prior to thermal processing is crucial in minimizing acrylamide generation in fried products. United Arab Emirates, UAE would like to outline the following mitigation strategies: 1. Use of Antioxidants: The incorporation of antioxidants, such as rosemary extract, oil, and dried leaves into wheat dough, has shown considerable potential in reducing acrylamide level by 62%, 67%, and 57%, respectively (Hedegaard et al., 2008). 2. Use of Asparaginase Enzyme: Asparaginase has proven effective in reducing acrylamide levels in fried potato products by catalyzing the hydrolysis of asparagine into aspartic acid and ammonia, without compromising the product's sensory properties. When blanched potato strips were soaked in an asparaginase solution at 40°C for 20 minutes, a reduction in acrylamide of approximately 60% was achieved (Pedreschi et al., 2008). 3. Use of Competitive Compounds: The use of compounds such as lysine or glycine, which compete with asparagine for carbonyl groups prior to thermal processing, offers another promising method. When potato slices soaked in a 3% solution of lysine or glycine prior to frying saw a reduction in acrylamide formation by over 80% (Heong et al., 2005; Morales et al., 2008). 4. Effect of Mono- and Divalent Cations: The introduction of mono- and divalent cations, such as sodium (Na+) and calcium (Ca2+), has also shown significant potential in reducing acrylamide formation. These ions interact with asparagine, inhibiting the formation of the Schiff base and reducing acrylamide production during heating. Potatoes dipped in calcium chloride (CaCl2) solutions demonstrated a reduction of up to 95% in acrylamide formation during frying, without negatively affecting the sensory characteristics of the final product (Gökmen & Şenyuva, 2007).	**UAE**

COMMENT	MEMBER/OBSERVER
5. Fermentation Processes: Fermentation using lactic acid bacteria (LAB) and yeast has proven effective in lowering acrylamide content in bread, with reductions reaching 84.7%. This decrease is primarily attributed to the reduction in pH during fermentation, rather than the consumption of precursor nutrients such as asparagine and reducing sugars (Wang et al. 2017).	
The United Kingdom (UK), would like to thank India as Chair and Saudi Arabia as co-chair of the electronic working group on the [Code of Practice for the reduction of acrylamide in foods] for the opportunity to provide information on the acrylamide risk management and mitigation measures in response to CL 2024/79-CF. Food business operators (FBOs) across the UK work to ensure that the level of acrylamide in their food products are as low as reasonably achievable (ALARA) without unduly impacting on the food quality. It is a requirement that for various foods, FBOs apply relevant mitigation measures and include these measures as part of their food safety management system. UK government agencies (Food Standards Agency and Food Standards Scotland), in collaboration with several key trade associations have developed acrylamide guidance for FBOs in the catering and food service industry. These mitigation guidelines are product specific and support the FBOs processes to comply with legislation. These resources can be accessed through the links below: https://www.food.gov.uk/sites/default/files/media/document/sfbb-caterer-cooking-04-acrylamide_0.pdf (Food Standards Agency, 2017) https://www.ukhospitality.org.uk/guidance/industry-guide-to-acrylamide/ (UKHospitality) Various food sectors at both national and international levels have also developed industry guidance on acrylamide mitigation, one of which can be accessed via this link: https://www.fooddrinkeurope.eu/resource/acrylamide-toolbox/ (FoodDrinkEurope, 2019). Industry stakeholders have expressed their commitment to minimizing acrylamide in foods, working together to understand its formation and to develop and apply mitigation techniques to their foods. In addition to the measures laid out in the current Codex code of practice for the reduction of acrylamide in foods, industry stakeholders have identified that including the following mitigation measures in their potatoes, fabricated potato-based snacks and sliced and fried potato crisp production process may offer additional prevention of acrylamide formation: **Agriculture** • Reduction of tuber sprouting with permitted suppressants or techniques • Applying potato storage best practices for each potato variety considering factors such as humidity, ventilation and light management in warehouse and warehouse transit areas. • Whenever possible, minimize potato storage time in trucks and railcars as this may increase reducing sugar levels. • Implementing strong inventory management with just-in time deliveries and first in, first out practices. **Ingredients** • Asparaginase is most effective under certain conditions (pH, contact time, dosing, storage, etc.). Manufacturer recommendations for storage should be followed. • Considering the use of organic acids to lower pH. • Considering the use of certain yeasts to reduce free asparagine content.	**United Kingdom**

COMMENT	MEMBER/OBSERVER
Potato crisps manufacturing process • Controlling degree of peeling appropriately to achieve levels that are ALARA. • Carrying out robust finished product moisture control. The UK supports the review of the current code of practice to strengthen our efforts to achieve acrylamide levels that are ALARA. We hope that the information provided above will be useful in reviewing the current code of practice. **References** 1. Safer Food Better Business for Caterers, 2017. Available at https://www.food.gov.uk/sites/default/files/media/document/sfbb-caterer-cooking-04-acrylamide_0.pdf (Accessed 24 October 2024) 2. Industry guide to acrylamide. UKHospitality. Available at: https://www.ukhospitality.org.uk/guidance/industry-guide-to-acrylamide/. (Accessed 24 October 2024) 3. Food Drink Europe, 2019. Acrylamide toolbox. Available at Acrylamide Toolbox - FoodDrinkEurope : FoodDrinkEurope (Accessed 24 October 2024)	
The United States appreciates the opportunity to provide comments in response to CL 2024/79-CF. The FDA Acrylamide Guidance and the FoodDrinkEurope's Acrylamide Toolbox contain additional information not found in the current acrylamide COP (CAC/RCP 67-2009). For example: From FDA Acrylamide Guidance (https://www.fda.gov/regulatory-information/search-fda-guidance-documents/guidance-industry-acrylamide-foods): • Selecting potato varieties that are low in acrylamide precursors, keeping in mind seasonal variation, may help reduce acrylamide. New potato varieties with lower reducing sugar content and greater resistance to cold-induced sweetening are under development, as are cultivars with lower levels of asparagine. As new potato varieties come on the market, consider adopting varieties that offer the potential to reduce acrylamide levels. • Avoiding handling potatoes with excessive roughness, avoiding bruising potatoes, and sorting out or carefully trimming potatoes with defects may help reduce acrylamide. • Selecting potato flakes with lower levels of reducing sugars may help reduce acrylamide. Lower reducing sugar levels may be found by specifying maximum sugar levels, buying early in the processing season, or by mixing flakes from different sources. Flakes treated with acidulants, calcium, or asparaginase during flake production may also produce flake-based products with lower acrylamide. • Adding calcium salts to potato doughs may help reduce acrylamide in fabricated potato products. • Adding acidulants to potato doughs may help reduce acrylamide in fabricated potato products. • Increasing peel removal may help reduce acrylamide in potato chips. • Cutting thinner potato chip slices may help reduce acrylamide. • Using calcium supplementation may help reduce acrylamide in non-calcium fortified breads or breakfast cereals, but the addition of calcium propionate may increase acrylamide levels.	**USA**

COMMENT	MEMBER/OBSERVER
• Monitoring production by using color as an indicator of acrylamide may help reduce acrylamide, but the correlation between color and acrylamide may have to be determined on a product-by-product basis. From FoodDrinkEurope's Acrylamide Toolbox (https://www.fooddrinkeurope.eu/wp-content/uploads/2021/05/FoodDrinkEurope_Acrylamide_Toolbox_2019.pdf) : • Fungal pathogen infection causes a significant increase in free asparagine levels in grain. It is therefore important to apply best practices on crop protection measures to prevent fungal infection. • The efficacy of asparaginase is dependent on recipe, ingredients, moisture content and process (temperature, pH, time, distribution in dough) and therefore differs from product to product. The United States also wishes to share the following information received from stakeholders: Agriculture Mitigation Measures – (Potatoes): • Select varieties suited for local growing conditions to improve the yield and minimize defects. • Reduction of tuber sprouting with permitted suppressants or techniques is recommended. • Apply potato storage best practices for each potato variety considering factors such as ideal temperature ranges, humidity, ventilation and light management in warehouse and warehouse transit areas. • Whenever possible, minimize potato storage time in trucks and railcars as this may increase reducing sugar levels. Strong inventory management with just-in time deliveries and first in, first out practices can further support better acrylamide outcomes. Ingredients (Fabricated Potato Snacks): • During product development of fabricated potato snacks, alternative ingredients for replacement of potato flakes may be explored without compromising consumer acceptability. Such replacements may include refined starches (e.g., tapioca, corn, potato). • Asparaginase is most effective under certain conditions (pH, contact time, dosing, storage, etc.). Follow manufacturer recommendations for storage. • Certain yeasts can reduce free asparagine content. Manufacturing Process (Potato Crisps): • Robust finished product moisture control is critical to controlling acrylamide formation rate. Codex Acrylamide COP General Comment Suggestions: • Monitoring programs to measure the effectiveness of acrylamide mitigation are highly dependent on many factors (raw material variety, raw material variability, seasonality, geographic location, processing plant, production lines, process parameters, process variability, etc.), therefore each manufacturer should independently determine what is the appropriate (statistically significant, feasible and viable) sampling plan to best evaluate their acrylamide outcomes.	
FIA welcomes the decision taken at the 17th Session of the Codex Committee on Contamination in Foods (CCCF17) to develop a discussion paper with a proposal for a draft revised Code of Practice (CoP) for the Reduction of Acrylamide in Foods (CXC 67-2009) and to collect information on new risk management measures for the reduction of acrylamide.	**Food Industry Asia**

COMMENT	MEMBER/OBSERVER
We are pleased to contribute to this review of the Codex CoP which we consider a critical enabling measure for food business operators (FBOs) of all sizes globally, to achieve acrylamide levels that are as low as reasonably achievable (ALARA). Given the complexity of factors affecting acrylamide (AA) formation, including natural, geographical, climatic, seasonal and varietal differences in raw materials, we believe this approach is necessary. As the CoP was adopted in 2009, a review of its content to incorporate the most current mitigation practices is timely. In response to the request for data and information on measures to prevent or reduce acrylamide in foods, FIA would like to highlight that the mitigation methods currently included in the CoP remain important and effective tools. Based on the experience of our members' continued investment in applying and refining AA mitigation strategies across their portfolio, FIA offers the following additional clarifying information on measures related to agronomical practices (potatoes), fabricated potato-based snacks, and sliced and fried potato crisp processing. FIA would also like to propose the expansion of the CoP to address mitigation measures with possible intervention steps for preventing or reducing AA levels in coffee, breakfast cereals, bakery wares and infant cereals. FIA would like to refer the EWG to commercially applicable mitigation methods outlined in the FoodDrinkEurope Acrylamide Toolbox (2019), which provides further detail likely to be helpful for FBOs. Agriculture Mitigation Measures – Potatoes (Addition to current CoP) • Select varieties suited for local growing conditions to improve the yield and minimize defects. • Reduction of tuber sprouting with permitted suppressants or techniques is recommended. • Select potato varieties with lower reducing sugar levels to support better AA outcomes. • Apply potato storage best practices for each potato variety considering factors such as ideal temperature ranges, humidity, ventilation and light management in warehouse and warehouse transit areas. • Whenever possible, minimize potato storage time in trucks and railcars as this may increase reducing sugar levels. Strong inventory management with just-in time deliveries and first in, first out practices can further support better AA outcomes. Ingredients (Fabricate Potato Snacks) (Addition to CoP) • During product development of fabricated potato snacks, alternative ingredients for replacement of potato flakes may be explored without compromising consumer acceptability. Such replacements may include refined starches (e.g., tapioca, corn, potato). • Asparaginase is most effective under certain conditions (pH, contact time, dosing, storage, etc.). Follow manufacturer recommendations for storage. • Organic acids can be used to lower pH. • Certain yeasts can reduce free asparagine content. Potato Crisps Manufacturing Process (Addition to CoP) • Control degree of peeling appropriately to achieve levels that are ALARA. • Conduct in-line colour sorting to remove black and brown crisps. • Robust finished product moisture control is critical to controlling AA formation rate. • Codex AA COP General Comment Suggestions:	

COMMENT	MEMBER/OBSERVER
• Monitoring programs to measure the effectiveness of AA mitigation are highly dependent on many factors (raw material variety, raw material variability, seasonality, geographic location, processing plant, production lines, process parameters, process variability, etc.), therefore each manufacturer should independently determine what is the appropriate (statistically significant, feasible and viable) sampling plan to best evaluate their AA outcomes. • Provide primary references on AA mitigation where available. We see this in other national acrylamide control guidance documents. Coffee 1. Processing: Asparaginase Applying asparaginase enzymes in coffee may have very limited application opportunities for steam treated coffees. 2. Processing: Thermal Input & Moisture Roasting technologies At the beginning of roasting, the AA formation starts rapidly. After reaching a maximum within the first half of the total roast cycle, the AA level decreases with continued roasting. Final finished product levels are at only 20-30% of the maximum level, final concentration being dependent on the target degree of roast and the total roast time. Darker roasting in general and extending the roast time by using lower roasting temperatures, tends to reduce the AA level but both parameters need to be fixed in narrow ranges to achieve the target flavour profile. 3. Processing: Finished Product Colour Colour is an important indicator of roasting degree and directly related to the organoleptic properties of the product. Darker roast coffees have less AA than light roast coffees. Other Considerations Roasting to darker colour is not considered an option to relatively lower AA due to the importance of the sensory attributes of the product. Additionally, the effects of process changes on levels of desirable constituents, e.g. polyphenols and melanoidins, and formation of other undesirable products under extreme roasting conditions need to be considered. 4. Processing: Texture/Flavour Organoleptic properties are finely tuned by careful selection of green coffee blends, roasting conditions, and processing technologies. Flavour and aroma are crucial to the identity of the products, and any blend/technology changes – however minor – to the existing products will have major impact on the organoleptic properties and subsequently on consumer acceptance. 5. Final Preparation: Consumer and Restaurant Guidance Typical brewing equipment transfers AA almost completely into the beverage. The cup/beverage concentrations for roast coffee and soluble coffee are similar. Espresso brewing may, however, show lower transfer rates due to specific extraction conditions. Soluble Coffee vs. Roast Coffee: similarly, in soluble coffee AA is efficiently extracted and concentrated into the final soluble coffee. After preparation/brewing the cup/beverage levels for roast coffee and soluble coffee are similar due to different typical recipes (with ~ 5-7g for roast coffee and ~ 2g of soluble coffee per cup, respectively). Breakfast Cereals Recipe and Product Design: Whole Grain Products	

COMMENT	MEMBER/OBSERVER
All of the major grains may be used in breakfast cereals and some grains yield more AA than others within a common process. Different kind of grains have shown different distribution of asparagine, the pre-cursor for the formation of acrylamide, i.e. products based on maize and rice tend to have less acrylamide than those made with wheat, rye, oats and barley. However, the choice of grain defines the food and therefore it is not possible to simply replace the grain by another grain without changing the whole product and losing the product identity the consumers like Recipe and Product Design: Reducing Sugars Reducing sugars (e.g. fructose and glucose) and ingredients containing reducing sugars (e.g. honey) are sometimes added for organoleptic reasons and process functionalities (binding clusters for cluster formation). If added prior to heat-treatment stages, they can function as precursors to acrylamide formation. In this case, controls over addition rates must be established and implemented at point of addition. Recipe and Product Design: Heat-Treated Ingredients Heat-treated dry-added ingredients may contribute to AA. E.g. Low-roast almonds contain about 10-fold less AA than high roast almonds. Peanuts and hazelnuts contain less than a fifth of asparagine as compared to almonds, so they yield much less AA. The acrylamide contribution from heat-treated dry-added ingredients (e.g. roasted/toasted nuts and oven- dried fruits) to the total acrylamide value must be assessed in the HACCP. Recipe: Asparaginase Asparaginase does not show a satisfactory reduction in cooked and toasted coarse grain cereal due to necessary time and temperature constraints at industrial level, preventing the appropriate conditions for the enzyme to significantly reduce Asparaginase. However, manufacturers can continue to investigate if asparaginase can be applied in certain breakfast cereal processes and recipes. Such as when the cereal is in a flour dough format and when the process enables a sufficient time, temperature and moisture content for asparaginase to reduce asparagine levels significantly. There might be no negative effect on flavour or risk of residual enzyme activity. Recipe and Product Design: Minor Ingredients Minor ingredients may have influence on formation of AA. Alternatives to sucrose may be used, however one should verify that these do not increase AA levels. Added fructose tends to cause severe browning. Honey, glucose, fructose and other reducing sugars are generally used in the sugar coat applied after toasting so they do not influence AA formation. Recipe and Product Design: Ph Reduction of phosphate salts has been proven to reduce acrylamide in breakfast cereals. However, this have limited applicability due to adverse effects over the sensorial attributes. Processing: Thermal Input and Moisture In general, higher heating temperatures and longer heating times generate higher acrylamide levels. An effective combination of temperature and/or heating times to minimize acrylamide formation minimizes acrylamide formation, without unacceptably compromising the taste, texture, colour, safety and stability (shelf-life) of the product. The formation of AA during the baking of cereal products is closely related to the combination of moisture content and baking temperature/time (thermal input).	

COMMENT	MEMBER/OBSERVER
Typical Minimum Moisture Content (g/100g) for consideration: • Toasted products: 1 g/100 g for extruded products, 1 g/100 g for batch cooked products, 2 g/100 g for steam rolled products • Direct expanded products: 0,8 g/100 g for extruded products • Baked products: 2 g/100 g for continuously cooked products • Filled products: 2 g/100 g for extruded products • Other drying: 1 g/100 g for batch cooked products, 0,8 g/100 g for gun puffed product Measurement systems should be calibrated at least annually, and these operating conditions controlled within set limits. These tasks should be incorporated into a HACCP pre-requisite programme. Recipe: Rework Reworking product back through the process has the potential to generate higher acrylamide levels through repeated exposure to the heat-treatment steps. Manufacturers shall assess the impact of rework on acrylamide levels and, if significant, focus on reducing or eliminating rework. Bakery Wares Includes categories for bread and ordinary bakery wares (7.1) and for sweet, salty and savoury fine bakery wares (7.2) as per Appendix A of FSS (Food Products Standards and Food Additives) Regulations. Recipe And Product Design: Whole Grain Products Free asparagine is the key determinant of acrylamide formation in cereal products. Accordingly, using wheat with a lower free asparagine content has a lower acrylamide potential. Using less whole meal and/or less bran and germ and more endosperms may result in lower acrylamide levels (as free asparagine is more concentrated in the germ/bran) but will significantly compromise the product's organoleptic and nutritional properties. Recipe and Product Design: Raising Agents Replacing (fully or partly) Ammonium bicarbonate with alternative raising agents (such as sodium bicarbonate and acidulants, sodium bicarbonate and disodium diphosphates with organic acids or potassium variants thereof) can relatively lower AA in certain products. However, considerations should include that changes may result in organoleptic (taste, appearance, texture, etc.) or nutritional changes (increased sodium content) that influence product identity and consumer acceptance. Recipe and Product Design: Asparaginase The use of asparaginase is proven to be one of the most efficient tools to reduce acrylamide levels and if used at low dosage rates has no negative impact on the organoleptic properties of the final product. For consideration, the efficacy of asparaginase is dependent on recipe, ingredients, moisture content and process (temperature, pH, time, distribution in dough), and therefore differs from product to product. Recipe and Product Design: Replacing Wheat Flour with Alternative Grain Types Different types of grain are different in asparagine levels. Typically, asparagine levels are higher in rye > oats > wheat > maize > rice. Accordingly, a partial replacement of wheat flour with an alternative grain flour may be an option.	

COMMENT	MEMBER/OBSERVER
Recipe and Product Design: Co-Ingredients Manufacturers shall consider the impact of co-ingredients that may have the potential to raise acrylamide levels in the final product (e.g. roasted almonds; dried fruits as potential fructose source). Manufacturers shall have a change control procedure in place to ensure that a change in products sourced from suppliers does not result in inadvertently increased acrylamide levels. Manufacturers shall ensure that suppliers of heat-treated ingredients which are susceptible to acrylamide formation provide an ingredient acrylamide risk assessment and implement the appropriate mitigation measures. Recipe and Product Design: Minor Ingredients Replacing fructose with glucose is very effective in reducing AA formation – particularly in recipes containing ammonium bicarbonate. Recipe: Shape And Piece Size – Biscuits, Crisp Bread In biscuits and crisp breads, the thicker the product, the lower the AA levels. Manufacturers shall consider piece size/ surface area to volume ratio during product design, as small product size potentially leads to higher acrylamide levels (heat impact). Processing: Fermentation Lower levels of AA in fermented products. Extension of fermentation time in bread may be an option to lower AA levels. For Sweet biscuits and Crackers, extended yeast fermentation time may be an option. The use of lower gassing yeast may be a mitigation option in some products since the latter is independent of asparagine consumption. Processing: Thermal Input & Final Product Moisture Manufacturers shall control thermal input by optimizing baking temperature, temperature profile and time. Thermal input as result of temperature and time is essential rather than temperature alone to control product characteristics and acrylamide formation. Solutions may vary depending on the particular product and capabilities of existing processing equipment. Processing: Finished Product Colour The Maillard reaction, which leads to the production of AA, also produces the colours and flavours which give baked cereal products their essential characteristics. If, though, one was able to produce lighter coloured and less baked products, without increasing moisture content, the AA level could be reduced. Processing: Rework Manufacturers shall adjust product and process design to account for ingredients that could be heat treated several times and as a result raise acrylamide level in final products (e.g. pre- processed cereal pieces, nuts, seeds, dried fruits, etc.) Final Preparation Pack instruction- For product pre-mixes that are to be baked at home or in catering establishments, clear on-pack preparation instructions shall be provided to lead to lower levels.	
FoodDrinkEurope welcomes the decision taken by CCCF17 to develop a discussion paper with a proposal for a draft revised Code of Practice (CoP) for the Reduction of Acrylamide in Foods (CXC 67-2009) and to collect information on new risk management measures for the reduction of acrylamide.	**FoodDrinkEurope**

COMMENT	MEMBER/OBSERVER
We emphasise the value and importance of the CoP which we consider to be a critical enabler for minimising acrylamide. It should continue to be implemented and supported by the global Codex community. In response to the request for data and information on risk management measures we would like to share our FoodDrinkEurope Acrylamide Toolbox 15th edition (2019), which has been a central pillar of our members' commitment to share knowledge on potential interventions. FoodDrinkEurope Acrylamide Toolbox (2019) – 15th edition: https://www.fooddrinkeurope.eu/wp-content/uploads/2021/05/FoodDrinkEurope_Acrylamide_Toolbox_2019.pdf Acrylamide formation and mitigation pose unique challenges for food business operators (FBOs). Owing to the complexity of factors involved, including the natural variations inherent in raw materials across geographies, seasons and climates, considerable differences in acrylamide formation occur, even when processing parameters are well-controlled. These nuances should be well reflected and guide the review of the CoP, given that: • acrylamide formation can never be totally prevented, but it can be minimised; • no single solution exists due to the complexity of factors that influence acrylamide formation; • whilst tools have been identified to mitigate acrylamide in many foods, their relevance in each case depends on the specific process and product. A particular tool may not be universally applicable to all foods susceptible to acrylamide formation; and • data collection including from FBOs' monitoring programs remains important to understand the effectiveness and impact of mitigation measures. In this context, FoodDrinkEurope reiterates its commitment to help FBOs to control acrylamide to the reasonably achievable minimum possible levels (ALARA) to protect consumers through the implementation of all reasonable mitigation measures. We are presently reviewing the 2019 FoodDrinkEurope Acrylamide Toolbox to reflect any new knowledge on acrylamide formation and mitigation, and especially to identify if new mitigation measures are applicable at industrial level. We will promptly send the updated Acrylamide toolbox to the EWG when available in early 2025. For the time being, and for implementing the current Acrylamide Toolbox 2019 correctly, FBOs need to assess and evaluate which measures could be effective for them and consider specific parameters that may be optimized to minimize acrylamide formation. Also to be considered: • their supply chains, • variability between product recipes, • designs of processes and equipment, and • brand-related product characteristics even within a single product category From the collection of tools described in our Toolbox, we strongly recommend considering only those that are classified under "commercial application" for inclusion in the CoP. These fulfill the applicability criteria (as per Codex request – Point 3): effective and readily available; proven to be cost-effective; applicable across regions; and applicable all scales of production. We look forward to contribute to the work of the EWG together with the CODEX members.	
There is a need for clear scientific strategies with respect to determination and validation of acrylamide testing, especially with respect to how it enters the food chain, This work must be completed first, discussed and agreed before any binding legislation will be meaningful.	**ICUMSA**

COMMENT	MEMBER/OBSERVER
IFT welcomes the initiative of CCCF to review the Code of Practice (COP) for the reduction of acrylamide in food. Since the introduction of the COP in 2009, there has been significant progress by food producers leveraging the helpful guidance tools to reduce levels of acrylamide in various food products. In addition, we appreciate that over fifteen years since the introduction, there are additional research findings, many industry and regulatory learnings to capture for further elaboration of the tools and guidance, and no doubt new opportunities to apply across other food categories that might not be specifically listed in the COP. IFT has begun a scientific literature review of new, relevant research papers on the subject of acrylamide mitigation in food and related health impacts and will submit those for consideration with the working group as it proceeds forward in discussions on the COP revisions. IFT supports the sharing of further data and possibilities from Codex members and observer organizations to help guide science-based mitigation of acrylamide in food. A key consideration for the success of the COP is the complexity and variety of foods that can leverage different tools within categories, and the importance to maintain the non-prescriptive guidance approach. This non-prescriptive approach encourages wider COP uptake, and agility to optimize and leverage the relevant tools that make sense for any given food. We look forward to engaging on the developments of this work under the EWG to prepare for further discussions at the CCCF session in 2025.	**IFT**

ANNEX II

CODEX COMMITTEE ON CONTAMINANTS IN FOOD

EU Reply to CL 2024/79-CF

Request for data and information on risk management measures to prevent or reduce acrylamide contamination in foods

European Union Competence

European Union Vote

The European Union (EU) wishes to provide the enclosed information in reply to CL 2024/79-CF related to the request for data and information on risk management measures to prevent or reduce acrylamide contamination in foods.

The risk management measures provided in this document are established by Commission Regulation (EU) 2017/2158 of 20 November 2017 establishing mitigation measures and benchmark levels for the reduction of the presence of acrylamide in food.

The EU has also elaborated a guidance on the implementation of the above mentioned Regulation and sector specific brochures on the applicable mitigation measures were developed by FoodDrinkEurope in cooperation with the EU (Biscuits, Crackers & Crispbreads, Bread Products, Breakfast Cereals, Fried Potato Products/Potato Crisps, Fried Potato Products/French Fries, Food for infants and young children)

SECTION A

SCOPE

Food business operators are obliged to apply the risk mitigaiton measures when producing and placing on the EU market the following foods:

(a) French fries, other cut (deep fried) products and sliced potato crisps from fresh potatoes;

(b) potato crisps, snacks, crackers and other potato products from potato dough;

(c) bread;

(d) breakfast cereals (excluding porridge);

(e) fine bakery wares: cookies, biscuits, rusks, cereal bars, scones, cornets, wafers, crumpets and gingerbread, as well as crackers, crisp breads and bread substitutes. In this category a cracker is a dry biscuit (a baked product based on cereal flour);

(f) coffee: roast coffee and instant (soluble) coffee;

(g) coffee substitutes;

(h) baby food and, processed cereal-based food intended for infants and young children as defined in Regulation (EU) No 609/2013 of the European Parliament and of the Council.

The risk mitigation measures are adapted to the size and nature of the operation of the food business operator.

SECTION B

RISK MITIGATION MEASURES TO BE APPLIED BY FOOD BUSINESS OPERATORS, WHICH PRODUCE AND PLACE ON THE MARKET FOODSTUFFS LISTED ABOVE, EXCEPT FOOD BUSINESS OPERATORS WHICH PERFORM RETAIL ACTIVITIES, AND/OR DIRECTLY SUPPLY ONLY LOCAL RETAIL ESTABLISHMENTS

Where the mitigation measures in this Section include the use of food additives and other substances, the food additives and other substances shall be used in accordance with the provisions provided for in Regulations (EC) No 1332/2008, (EC) 1333/2008 and (EU) No 231/2012.

Food business operators (hereinafter 'FBOs') shall keep a record of the applied risk mitigation measures.

FBOs shall perform sampling and analysis to determine the level of acrylamide in foods in accordance with the requirements set out in section E and shall record the results of the sampling and analysis.

If the sampling and analysis results indicate that the levels are not below the benchmark levels of acrylamide set out in section F, FBOs shall review without delay the mitigation measures. and adjust processes and controls with the aim to achieve levels of acrylamide as low as reasonable achievable below the benchmark levels set out in section F. FBOs shall hereby take into account the safety of foodstuffs, specific production and geographic conditions or product characteristics.

I. PRODUCTS BASED ON RAW POTATOES

Selection of suitable potato varieties

1. FBOs shall identify and use the potato varieties that are suitable for the product type and where the content of acrylamide precursors, such as reducing sugars (fructose and glucose) and asparagine is the lowest for the regional conditions.

2. FBOs shall use the potato varieties which have been stored in the conditions which are applicable to a specific potato variety and for the storage period determined for a specific variety. The stored potatoes shall be used within their optimal storage window.
3. FBOs shall identify potato varieties with lower acrylamide forming potential in cultivation, storage and during food processing. The results shall be documented.

Acceptance criteria

1. FBOs shall specify in their arrangements regarding potato supply the maximum content of reducing sugars in potatoes and also the maximum amount of bruised, spotted or damaged potatoes.
2. If the specified content of reducing sugar content in potatoes and the amount of bruised, spotted or damaged potatoes are exceeded, FBOs may accept the potato supply by specifying additional available mitigation measures to be taken to ensure that the presence of acrylamide in the final product is as low as reasonably achievable below the benchmark level set out in Section F.

Potato storage and transport

1. Where FBOs operate their own storage facilities:
   - the temperature shall be appropriate to the potato variety stored and it shall be above 6°C;
   - the level of humidity shall be such as to minimise senescent sweetening;
   - sprouting shall be suppressed in long term stored potatoes where permitted, using appropriate agents;
   - during storage the level of reducing sugars in potatoes shall be tested.
2. Potato lots shall be monitored for reducing sugars at the time of harvest.
3. FBOs shall specify the potato transport conditions in terms of temperature and duration especially if outside temperatures are significantly lower than the temperature regime applied during storage, to ensure that the temperature during the transportation of potatoes is not lower than the temperature regime applied during storage. These specifications shall be documented.

(a) SLICED POTATO CRISPS

Recipe and process design

1. For each product design, FBOs shall specify frying oil temperatures at the exit of the fryer. Those temperatures shall be as low as feasibly possible on a specific line and for the specific product, in line with quality and food safety standards and taking into account relevant factors such as fryer manufacturer, fryer type, potato variety, total solids, potato size, growing conditions, sugar content, seasonality and the target moisture content for the product.
2. Where the frying oil temperatures at the exit of the fryer is higher than 168°C due to a specific product, design or technology, then the FBOs shall provide data demonstrating that the level of acrylamide in the finished product is as low as reasonably achievable and that the benchmark level set out in Section F is achieved.
3. For each product design, FBOs shall specify the moisture content post frying which shall be set as high as feasibly possible for a specific production line and for a specific product, in accordance with expected quality and food safety standards and taking into account relevant factors such as potato variety, seasonality, tuber size, and the fryer exit temperature. The minimal moisture content shall not be lower than 1.0%.
4. FBOs shall use in-line colour sorting (manual and/or optical-electronic) for potato crisps post frying.

(b) FRENCH FRIES AND OTHER CUT DEEP FRIED OR OVEN-FRIED POTATO PRODUCTS

Recipe and Process design

1. Potatoes shall be tested for reducing sugars prior to use. This can be done by fry testing using colours as an indicator of potential high reducing sugar content: indicative fry testing 20-25 centre strips, which are fried to evaluate frying colours of the potato strips against the colour specification using a USDA Munsell colour chart or calibrated company-specific charts for small operators. Alternatively the overall finished frying colour can be measured by specific equipment (e.g. Agtron).
2. FBOs shall remove immature tubers having a low underwater weight and high reducing sugar levels. The removal can be done by passing tubers through a salt brine or similar systems which make immature tubers float or by pre-washing potatoes to detect bad tubers.

3. FBOs shall remove slivers right after cutting to avoid burned pieces in the final cooked product.
4. FBOs shall blanch potato strips to remove some of the reducing sugars from the outside of the strips.
5. FBOs shall adapt blanching regimes to the specific quality attributes of the incoming raw material and they shall stay within specification limits for finished product colour.
6. FBOs shall prevent (enzymatic) discolouration and after cooking darkening of potato products. This can be done by applying disodium diphosphate (E450), which also lowers the pH level of the washing water and inhibits the browning reaction.
7. The use of reducing sugars as a browning agent shall be avoided. They may be used only if needed, to consistently stay within specification limits. FBOs shall control the colour of the final product by performing colour checks on the final cooked product. If needed after blanching, controlled addition of dextrose enables meeting the finished colour specification. Controlled addition of dextrose after blanching results in lower acrylamide levels in the final cooked product at the same colour as observed in unblanched products with only naturally accumulated reducing sugars.

Information to the end users

1. For the end users, FBOs shall indicate recommended cooking methods specifying time, temperature, quantity for oven/ deep fryer/ pan on packaging and/or via other communication channels. For consumers the recommended cooking instructions shall be clearly displayed on all product packaging in compliance with Regulation 1169/2011 of the European Parliament and of the Council on the provision of food information to consumers.

   Recommended cooking methods shall be in agreement with customer specifications and requirements for professional end users and must be validated per product type to ensure products have optimal sensory quality at the lightest acceptable colour, per cooking method specified (e.g. fryer, oven) and have levels of acrylamide below the benchmark level determined in Section F.

   FBOs shall recommend to end users other than consumers that they should have tools available for the operators (e.g. chefs) to ensure good cooking methods and also provide calibrated equipment (e.g. timers, frying curves, colour grading charts (e.g. USDA/Munsell) and at minimum, clear pictures with targeted final prepared product colours.
2. FBOs shall recommend the end users in particular to:
   - keep the temperature between 160 and 175°C when frying, and 180-220°C when using an oven. Lower temperature can be used when the fan is switched on;
   - Preheat the cooking device (e.g. oven, air fryer) to correct temperature between 180-220°C according to on-pack cooking instructions, depending on the products specifications and local requirements;
   - cook potatoes until a golden yellow colour;
   - do not overcook;
   - turn oven products after 10 minutes or halfway through the total cooking time;
   - follow the recommended cooking instructions, as provided by the manufacturer;
   - when preparing smaller quantities of potatoes than indicated on pack, reduce the cooking time, to avoid excessive browning of the product;
   - do not overfill the frying basket; fill your basket up to the halfway mark to avoid excessive oil uptake by extended frying times.

II. DOUGH-BASED POTATO CRISPS, SNACKS, CRACKERS AND OTHER DOUGH-BASED POTATO PRODUCTS

Raw Materials

1. For each product, FBOs shall specify target values for reducing sugars in their dehydrated potato ingredients.
2. The target value of reducing sugars in the products concerned shall be set as low as feasibly possible, taking into account all relevant factors in the design and production of the finished product such as the amount of potato ingredients in the product recipe, further possible mitigation measures, further processing of the dough, seasonality and the moisture content in the finished product.

3. Where the content of reducing sugars is higher than 1.5% the FBOs shall provide data demonstrating that the level of acrylamide in the finished product is as low as reasonably achievable below the benchmark level set out in Section F.

Recipe and Process Design

1. Dehydrated potato ingredients shall be analysed prior to their use either by the supplier or the user to confirm that the sugar content does not exceed the specified level.
2. Where dehydrated potato ingredients exceed the specified sugar level, FBOs shall specify the additional mitigation measures to be taken to ensure that the level of acrylamide in the final product is as low as reasonably achievable below the benchmark level set out in Section F.
3. For each product FBOs shall review whether it is possible to utilise the partial replacement of potato ingredients with ingredients with lower acrylamide forming potential.
4. In wet dough-based systems, FBOs shall consider the use of the following substances insofar possible, taking into account that these substances may not be synergistic in their mitigation effect i.e. specifically applies to the use of asparaginase and lowering levels of pH:
   – Asparaginase
   – Acids or their salts (to reduce the level of pH of the dough)
   – Calcium salts.
5. Where dough-based potato crisps, snacks or crackers are fried, FBOs shall specify frying oil temperatures for each product at the exit of the fryer, control these temperatures and maintain records to demonstrate controls.
6. The oil temperature at the fryer exit shall be as low as feasibly possible on a specific line and for the specific product, in accordance with prescribed quality and food safety standards and taking into account relevant factors, such as the fryer manufacturer, fryer type, sugar content and the target moisture content for the product.

   Where the temperature is higher than 175°C at the fryer exit, FBOs shall provide data demonstrating that the level of acrylamide in the finished product. is below the benchmark level specified in Section F.

   (Note: Most pellet products are fried at temperatures higher than 175 °C because of their very short frying time and the temperatures needed to achieve the required expansion and texture of these products).
7. Where dough-based potato crisps, snacks or crackers are baked, FBOs shall specify for each product the baking temperature at the exit of the baking oven and maintain records to demonstrate controls.
8. The temperature at the exit of the baking oven /drying process shall be as low as feasibly possible on a specific line and for the specific product, in line with expected quality and food safety standards, and taking into account relevant factors such as the machinery type, reducing sugar content of the raw material and the moisture content of the product.
9. Where the product temperature is higher than 175°C at the end of the baking/drying process, the FBOs shall provide data demonstrating that the level of acrylamide in the finished product is below the benchmark level specified in Section F.
10. For each product, FBOs shall specify the moisture content post frying or baking which shall be set as high as feasibly possible on a specific production line and for a specific product, in line with the product quality and food safety requirements, and taking into account the fryer exit, baking and drying temperature. The moisture content in the final product shall not be lower than 1.0%.

III. FINE BAKERY WARES

The mitigation measures in this Chapter are applicable to the fine bakery wares such as cookies, biscuits, rusks, cereal bars, scones, cornets, wafers, crumpets and gingerbread, as well as unsweetened products such as crackers, crisp breads and bread substitutes. In this category a cracker is a dry biscuit (a baked product based on cereal flour), e.g. soda crackers, rye crispbreads and matzot.

Agronomy

In case of contract farming, where agricultural products are supplied to FBOs directly by their producers, FBOs shall ensure that the following requirements to prevent elevated asparagine levels in cereals are applied:

– to follow Good Agricultural Practices on fertilisation, in particular with regard to maintaining balanced sulphur levels in the soil and to ensure a correct nitrogen application;
– to follow Good Phytosanitary Practices in order to ensure the application of good practices on crop protection measures to prevent fungal infection.

FBOs shall carry out controls to verify the effective application of the aforesaid requirements.

Recipe and Product Design

In the manufacturing process FBOs shall apply the following mitigation measures:

1. For relevant products, FBOs shall consider reducing or replacing fully or partially ammonium bicarbonate with alternative raising agents such as
   (a) sodium bicarbonate and acidulants, or
   (b) sodium bicarbonate and disodium diphosphates with organic acids or potassium variants thereof.

   As part of this consideration, FBOs shall ensure that the use of the said alternative raising agents do not result in organoleptic changes (taste, appearance, texture etc.) or increase the overall sodium content which influence product identity and consumers acceptance.
2. For products where the product design allows, FBOs shall replace fructose or fructose-containing ingredients such as syrups and honey with glucose or non-reducing sugars such as sucrose, particularly in recipes containing ammonium bicarbonate where possible and taking into consideration that replacing fructose or other reducing sugars may result in a modified product identity due to loss of flavour and colour formation.
3. FBOs shall use asparaginase where effective and possible to reduce asparagine and mitigate the potential for acrylamide formation. FBOs shall take into account that there is limited or no effect on the levels of acrylamide of the use of asparaginase in recipes with high fat content, low moisture or high pH value.
4. Where a product characteristic allows, FBOs shall review whether it is possible to utilise the partial replacement of wheat flour with alternative grain flour, such as rice, taking into consideration that any change will have an impact on the baking process and organoleptic properties of the products. Different types of grains have shown different levels of asparagine (typical asparagine levels are the highest in rye and in descending order lower in oats, wheat, maize and with the lowest levels in rice).
5. FBOs shall take into account in the risk assessment the impact of ingredients in the fine bakery wares that may raise acrylamide levels in the final product, and use ingredients that do not have such effects but maintain physical and organoleptic properties (such as almonds or seeds roasted at lower rather than higher temperatures and dried fruits as fructose source).
6. FBOs shall ensure that suppliers of heat treated ingredients which are susceptible to acrylamide formation carry out an acrylamide risk assessment and implement the appropriate mitigation measures.
7. FBOs shall ensure that a change in products sourced from suppliers does not result in increased acrylamide levels in such cases.
8. FBOs shall consider to add organic acids to the production process or decrease the levels of pH as far as possible and reasonable in combination with other mitigation measures and taking into account that this can result in organoleptic changes (less browning, modification of taste).

Processing

FBOs shall take the following mitigation measures in the manufacture of fine bakery wares and shall ensure that the measures taken are compatible with the product characteristics and food safety requirements:

1. FBO shall apply the heat input, i.e. time and temperature combination that is the most effective to reduce acrylamide formation while achieving the targeted product characteristics.
2. FBOs shall increase the moisture content in the final product in consideration of achieving the targeted product quality, the required shelf life and food safety standards.
3. Products shall be baked to a lighter colour endpoint in the final product in consideration of achieving the targeted product quality, the required shelf life and food safety standards.
4. In developing new products, FBOs shall take into account in their risk assessment the size and surface area of a particular piece of product taking into account that small product size potentially leads to higher acrylamide levels due to heat impact.

5. As certain ingredients used in the manufacture of fine bakery wares could be heat treated several times (e.g. pre-processed cereal pieces, nuts, seeds, dried fruits, etc.), which results in the raise of acrylamide levels in final products, FBOs shall adjust product and process design accordingly to comply with the benchmark levels of acrylamide set out in Section F. In particular the FBOs shall not use burnt products as rework.
6. For product pre-mixes that are put on the market to be baked at home or in catering establishments, FBOs shall provide preparation instructions to their customers to ensure that the acrylamide levels in the final products are as low as reasonably achievable below the benchmark levels.

IV. BREAKFAST CEREALS

Agronomy

In case of contract farming, where agricultural products are supplied to FBOs directly by their producers, FBOs shall ensure that the following requirements to prevent elevated asparagine levels in cereals are applied:

– to follow Good Agricultural Practices on fertilisation, in particular with regard to maintaining balanced sulphur levels in the soil and to ensure a correct nitrogen application;
– to follow Good Phytosanitary Practices in order to ensure the application of good practices on crop protection measures to prevent fungal infection.

FBOs shall carry out controls to verify the effective application of the aforesaid requirements.

Recipe

1. Given that products based on maize and rice tend to have less acrylamide than those made with wheat, rye, oats and barley, FBOs shall consider using maize and rice in new product development where applicable and taking into consideration that any change will have an impact on the manufacturing process and organoleptic properties of the products.
2. FBOs shall control the addition rates at the point of addition of reducing sugars (e.g. fructose and glucose) and ingredients containing reducing sugars (e.g. honey) taking into consideration their impact on organoleptic properties and process functionalities (binding clusters for cluster formation) and which can act as precursors to acrylamide formation when added prior to heat-treatment stages.
3. FBOs shall take into account in the risk assessment the acrylamide contribution from heat-treated, dry ingredients, such as roasted and toasted nuts and oven dried fruits, and use alternative ingredients if the contribution is likely to bring the finished product above the benchmark level specified in Section F.
4. For heat-treated ingredients which contain 150 micrograms of acrylamide per kilogram (µg/kg) or more, FBOs shall take the following actions:
   – to establish a register of such ingredients;
   – to carry out audits of suppliers and/or analyses;
   – to ensure that no changes are made by the supplier of such ingredients that increase acrylamide levels.
5. When the cereal is in a flour dough format and the manufacturing process allows a sufficient time, temperature and moisture content for asparaginase to reduce asparagine levels, FBOs shall use asparaginase where required provided there is no adverse effect on flavour or risk of residual enzyme activity.

Processing

In the manufacture of breakfast cereals FBOs shall apply the following mitigation measures and shall ensure that the measures taken are compatible with the product characteristics and food safety requirements:

1. FBOs shall identify, by means of risk assessment, the critical heat-treatment step(s) in the manufacturing process that generate(s) acrylamide.
2. As higher heating temperatures and longer heating times generate higher acrylamide levels, FBOs shall identify an effective combination of temperature and heating times to minimise acrylamide formation without compromising the taste, texture, colour, safety and shelf-life of the product.
3. To avoid the generation of acrylamide spikes, FBOs shall control heating temperatures, times and feed-rates in order to achieve the following minimum moisture content in the final product after the final heat treatment in consideration of achieving the targeted product quality, the required shelf life and food safety standards:

- toasted products: 1 g/100 g for extruded products, 1 g/100 g for batch cooked products, 2 g/100 g for steam rolled products;
- direct expanded products: 0,8 g/100 g for extruded products;
- baked products: 2 g/100 g for continuously cooked products;
- filled products: 2 g/100 g for extruded products;
- other drying: 1 g/100 g for batch cooked products, 0,8 g/100 g for gun puffed products.

FBOs shall measure the moisture content and express acrylamide concentration in a dry mass to eliminate the confounding effect of moisture changes.

4. Reworking product back through the process has the potential to generate higher acrylamide levels through repeated exposure to the heat-treatments steps. FBOs therefore shall assess the impact of rework on acrylamide levels and reduce or eliminate rework.
5. FBOs shall have procedures in place, such as temperature controls and monitoring, to prevent the incidence of burnt products.

V. COFFEE

Recipe

In considering coffee blend composition FBOs shall take into account in the risk assessment that products based on Robusta beans tend to have higher acrylamide levels than products based on Arabica beans. Similarly, cofee beans which are more lighty (mildly) roasted tend to contain higher levels of acrylamide than coffee beans that are more darker roasted.

Processing

1. FBOs shall identify the critical roast conditions to ensure minimal acrylamide formation within the target flavour profile.
2. Control of roast conditions shall be incorporated into a Pre-requisite Program (PRP) as part of Good Manufacturing Practice (GMP).
3. FBOs shall consider the use of asparaginase treatment, insofar possible and effective to reduce the presence of acrylamide.

VI. COFFEE SUBSTITUTES CONTAINING MORE THAN 50% CEREALS

Agronomy

In case of contract farming, where agricultural products are supplied to FBOs directly by their producers, FBOs shall ensure that the following requirements to prevent elevated asparagine levels in cereals are applied:

- to follow Good Agricultural Practices on fertilisation, in particular with regard to maintaining balanced sulphur levels in the soil and to ensure a correct nitrogen application;
- to follow Good Phytosanitary Practices in order to ensure the application of good practices on crop protection measures to prevent fungal infection.

FBOs shall carry out controls to verify the effective application of the aforesaid requirements.

Recipe

1. Given that products based on maize and rice tend to have less acrylamide than those made with wheat, rye, oats and barley, FBOs shall consider using maize and rice in the new product development where applicable, taking into consideration that any change will have an impact on the manufacturing process and organoleptic properties of the product.
2. FBOs shall control the addition rates at the point of addition of reducing sugars (e.g. fructose and glucose) and ingredients containing reducing sugars (e.g. honey) taking into consideration the impact on organoleptic properties and process functionalities (binding clusters) and which can act as precursors to acrylamide formation when added prior to heat-treatment stages.
3. If coffee substitutes are not made exclusively from cereals, FBOs shall use of other ingredients which result in lower levels of acrylamide after high temperature processing where applicable.

Processing

1. FBOs shall identify the critical roast conditions to ensure minimal acrylamide formation within the target flavour profile.
2. Control of roast conditions shall be incorporated into a Pre-requisite Program (PRP) as part of Good Manufacturing Practice (GMP).

VII. COFFEE SUBSTITUTES CONTAINING MORE THAN 50% CHICORY

1. FBOs shall purchase only cultivars low in asparagine and FBOs shall ensure that no late and excessive nitrogen application has taken place during the growth of chicory.

Recipe

2. If coffee substitutes are not made exclusively from chicory namely, chicory content is less than 100% and more than 50%, FBOs shall add other ingredients, such as chicory fibres, roasted cereals, as these have been shown to be effective to reduce the acrylamide content in the final product.

Processing

1. FBOs shall identify the critical roast conditions to ensure minimal acrylamide formation within the target flavour profile. Conclusions shall be documented.
2. Control of roast conditions shall be incorporated into the manufacturer's food safety management system.

VIII. BABY BISCUITS AND INFANT CEREALS[1]

In case of contract farming, where agricultural products are supplied to FBOs directly by their producers, FBOs shall ensure that the following requirements to prevent elevated asparagine levels in cereals are applied:

– to follow Good Agricultural Practices on fertilisation, in particular with regard to maintaining balanced sulphur levels in the soil and to ensure a correct nitrogen application;

– to follow Good Phytosanitary Practices in order to ensure the application of good practices on crop protection measures to prevent fungal infection.

FBOs shall carry out controls to verify the effective application of the aforesaid requirements.

Product Design, Processing and Heating

1. FBOs shall use asparaginase to reduce the levels of asparagine in the flour raw material insofar possible. FBOs that cannot use asparaginase due to, for example the processing requirements or product design, shall use flour raw material low in acrylamide precursors, such as fructose and glucose and asparagine.
2. FBOs shall make an assessment during recipe development that provides information on reducing sugars and asparagine, and includes options on achieving low reducing sugars in the final recipe. This need for this assessment will be dependent on use of asparaginase in the recipe.
3. FBOs shall ensure that heat treated ingredients which are susceptible to acrylamide formation are obtained from suppliers that are able to demonstrate that they have taken the appropriate mitigation measures to reduce the presence of acrylamide in those ingredients.
4. FBOs shall have a change control procedure in place to ensure that they do not make any supplier changes that increase acrylamide.
5. If the use of heat-treated raw materials and ingredients results in that in the final product the acrylamide benchmark level specified in Section F is exceeded, FBOs shall review the use of those products in view of achieving levels of acrylamide as low as reasonably achievable below the benchmark level set out in Section F.

Recipe

1. Given that products based on maize and rice tend have less acrylamide than those made with wheat, rye, oats and barley, FBOs shall consider using maize and rice in new product development where applicable taking into consideration that any change will have an impact on the manufacturing process and organoleptic properties of the product.
2. FBOs shall take into account, in particular in their risk assessment, that products based on wholegrain cereals and/or with high levels of cereal bran have higher levels of acrylamide.
3. FBOs shall control the addition rates at the point of addition of reducing sugars (e.g. fructose and glucose) and ingredients containing reducing sugars (e.g. honey) taking into consideration the impact on organoleptic properties and process functionalities (binding clusters) and which can act as precursors to acrylamide formation when added prior to heat-treatment stages.
4. FBO shall determine the acrylamide contribution from heat-treated and dry ingredients, such as roasted and toasted nuts and oven dried fruits, and use alternative ingredients if the use of those ingredients brings the finished product above the benchmark level specified in Section F.

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[1] As defined in Regulation (EU) No 609/2013 of the European Parliament and of the Council of 12 June 2013

Processing

1. FBOs shall identify, by means of risk assessment, the critical heat-treatment step(s) in the manufacturing process that generate(s) acrylamide.
2. FBOs shall measure the moisture content and express acrylamide concentration in a dry mass to eliminate the confounding effect of moisture changes.
3. FBOs shall identify and apply an effective combination of temperature and heating times to minimise acrylamide formation without compromising the taste, texture, colour, safety and shelf-life of the product.
4. FBOs shall control heating temperatures, times and feed-rates. Feed-rate and temperature control measurement systems should be calibrated regularly and these operating conditions controlled within set limits. These tasks shall be incorporated into the HACCP procedures.
5. Monitoring and controlling product moisture content after the critical heat-treatment steps has proved to be effective in controlling acrylamide levels in some processes and therefore, in these circumstances, this process can be an adequate alternative to controlling heating temperatures and times, hence shall be employed.

IX. BABY JAR FOODS (LOW-ACID AND PRUNE-BASED FOODS)[2]

1. For the production of baby jar foods, FBOs shall choose raw materials with low acrylamide precursor content, e.g. reducing sugars such as fructose and glucose and asparagine. A low asparagine content is in particular important for organic products, as the use of the food enzyme asparaginase produced with the genetically modified *Aspergillus niger* strain is not allowed in organic products.
2. In case of contract farming, where agricultural products are supplied to FBOs directly by their producers, FBOs shall ensure that the following requirements to prevent elevated asparagine levels in cereals are applied:
   - to follow Good Agricultural Practices on fertilisation, in particular with regard to maintaining balanced sulphur levels in the soil and to ensure a correct nitrogen application;
   - to follow Good Phytosanitary Practices in order to ensure the application of good practices on crop protection measures to prevent fungal infection.

   FBOs shall carry out controls to verify the effective application of the aforesaid requirements.
3. In prune purée purchase contracts FBOs shall include requirements which ensure that heat treatment regimes in the prune purée manufacturing process are applied that aim to reduce the occurrence of acrylamide in that product.
4. FBOs shall ensure that heat treated ingredients which are susceptible to acrylamide formation are obtained from suppliers that are able to demonstrate that they have taken the mitigation measures to reduce the presence of acrylamide in those ingredients.
5. If the use of heat- treated raw materials and ingredients results in that in the final product the benchmark level of acrylamide specified in Section F is exceeded, FBOs shall review the use of those materials and ingredients in view of achieving levels of acrylamide as low as reasonably achievable below the benchmark level set out in Section F.

Recipe

1. FBOs shall take into account in the risk assessment of *acrylamide* in the foodstuffs concerned that products based on wholegrain cereals and/or with high levels of cereal bran have higher levels of acrylamide.
2. FBOs shall choose varieties of sweet potatoes and prunes which are as low as possible in acrylamide precursors, such as reducing sugars (e.g. fructose and glucose) and asparagine.
3. FBOs shall control the addition rates at the point of addition of reducing sugars (e.g. fructose and glucose) and ingredients containing reducing sugars (e.g. honey) added for organoleptic reasons and process functionalities (binding clusters) and which can act as precursors to acrylamide formation when added prior to heat-treatment stages.

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2 As defined in Regulation (EU) No 609/2013 of the European Parliament and of the Council of 12 June 2013.

Processing

1. FBOs shall identify the key heat-treatment step(s) in the process that generate(s) the most acrylamide in order to focus further acrylamide reduction/control efforts most effectively. This has to be achieved either via a risk assessment or by directly measuring the acrylamide levels in the product before and after each heat-treatment step.
2. To avoid the generation of acrylamide spikes, FBO shall control heating temperatures, times and feed-rates. Feed-rate and temperature control measurement systems should be calibrated regularly and these operating conditions controlled within set limits. These tasks shall be incorporated into the HACCP procedures.
3. FBOs shall ensure that the lowering of thermal input to reduce acrylamide in low acid and prune based foods do not affect microbiological safety of the foodstuffs concerned.

X. BREAD

Agronomy

In case of contract farming, where agricultural products are supplied to FBOs directly by their producers, FBOs shall ensure that the following requirements to prevent elevated asparagine levels in cereals are applied:

– to follow Good Agricultural Practices on fertilisation, in particular with regard to maintaining balanced sulphur levels in the soil and to ensure a correct nitrogen application;

– to follow Good Phytosanitary Practices in order to ensure the application of good practices on crop protection measures to prevent fungal infection.

FBOs shall carry out controls to verify the effective application of the aforesaid requirements.

Product design, processing and heating

1. FBOs shall ensure that bread is baked to a lighter colour endpoint to reduce acrylamide formation taking into account individual product design and technical possibilities.
2. FBOs shall extend the yeast fermentation time taking into account the product design and the technical possibilities.
3. FBOs shall lower thermal input by optimising baking temperature and time insofar possible.
4. FBOs shall provide baking instructions for bread that is to be finished at home, in bake-off areas, retail shops or in catering establishments.
5. FBOs shall substitute ingredients that have the potential to raise acrylamide levels in the final product where this is compatible with product design and technical possibilities, that includes for instance the use of nuts and seeds roasted at lower rather than higher temperatures.
6. FBOs shall replace fructose with glucose particularly in recipes containing ammonium bicarbonate (E503) where the product design allows and insofar possible. That includes, for instance, replacing invert sugar syrup and honey, which contain higher levels of fructose, with glucose syrup.
7. In products with low moisture content, FBOs shall use asparaginase to reduce asparagine insofar possible and taking into account product recipe, ingredients, moisture content and process.

SECTION C

MITIGATION MEASURES TO BE APPLIED BY FOOD BUSINESS OPERATORS (FBOs) WHICH PERFORM RETAIL ACTIVITIES, AND/OR DIRECTLY SUPPLY ONLY LOCAL RETAIL ESTABLISHMENTS

1. FBOs producing potato products shall apply the following mitigation measures:

– French fries and other cut (deep fried) potato products:

  – Potato varieties with lower sugar content shall be used, when available and insofar as compatible with the desired food product to be obtained. In this respect the provider shall be consulted for best suited potato varieties.

  – Potatoes shall be stored at a temperature higher than 6°C.

– Before the frying process:

  Except for frozen potato products for which cooking instructions shall be followed, one of the following measures shall be taken with raw French fries to reduce the sugar content, where possible and insofar as compatible with the desired food product to be obtained:

- Washing and soaking preferably for 30 minutes up to 2 hours in cold water. Rinse the strips in clean water and remove excess of water before frying.
- Soaking for a few minutes in warm water. Rinse the strips in clean water and remove excess of water before frying.
- Blanching of potatoes results in lower levels of acrylamide and therefore where possible, it is appropriate to blanch potatoes.

– When frying French fries or other potato products:

- Frying oils and fats shall be used which allows to fry quicker and/or at lower temperatures. Cooking oil suppliers shall be consulted for the best suited oils and fats.
- Frying temperatures shall be below 175°C and in any case as low as possible taking into account the food safety requirements.
- Frying oils and fats quality shall be maintained by skimming frequently to remove fines and crumbs.

For the cooking of French fries, it is appropriate that the FBOs make use of available colour guides providing guidance on the optimal combination of colour and low levels of acrylamide. It is therefore appropriate that a colour guide providing guidance on the optimal combination of colour and low levels of acrylamide is visibly displayed at the premises to the staff preparing the food.

2. FBOs producing bread and fine bakery wares shall use the following mitigation measures in the baking process:

– Insofar possible and compatible with the production process and hygiene requirements:

- the extension of yeast fermentation time;
- the moisture content of the dough for the production of a product with low moisture content, shall be optimised;
- the lowering of oven temperature and the extension cooking time.

Products shall be baked to a lighter colour endpoint and dark roasting of crust shall be avoided in case the dark colour of the crust is the result of the strong roasting and not related to the specific composition or nature of the bread resulting in a dark crust.

3. When preparing sandwiches, the FBOs shall ensure that sandwiches are toasted to the optimal colour avoiding burn spots. It is appropriate that colour guides developed for specific product types, when available, providing guidance on the optimal combination of colour and low levels of acrylamide are used when producing these specific products. When using pre-packed bread or bakery products which are to be finished, cooking instructions are followed.

The abovementioned colour guide providing guidance on the optimal combination of colour and low levels of acrylamide shall be visibly displayed at the premises to the staff preparing the specific food.

SECTION D

MITIGATION MEASURES TO BE APPLIED BY FOOD BUSINESS OPERATORS, WHICH PERFORM RETAIL ACTIVITIES AND/OR DIRECTLY SUPPLY ONLY LOCAL RETAIL ESTABLISHMENTS AND WHICH OPERATE IN FACILITIES UNDER DIRECT CONTROL AND THAT ARE OPERATING UNDER ONE TRADEMARK OR COMMERCIAL LICENSE, AS A PART OF, OR FRANCHISE OF, A LARGER, INTERCONNECTED OPERATION AND UNDER THE INSTRUCTIONS OF THE FOOD BUSINESS OPERATOR THAT CENTRALLY SUPPLIES THE FOOD

1. General requirements

In addtion to the the mitigation measures as mentioned under section C above, FBOs falling under this section shall apply the additional mitigation measures provided for in this section D.

FBOs shall accept products falling within the scope (section A) only from FBOs that have implemented all mitigation measures set out in section B.

FBOs shall keep a record of the applied risk mitigation measures.

FBOs shall perform sampling and analysis to determine the level of acrylamide in foods in accordance with the requirements set out in section E and shall record the results of the sampling and analysis.

If the sampling and analysis results indicate that the levels are not below the benchmark levels of acrylamide set out in section F, FBOs shall review without delay the mitigation measures. and adjust processes and controls with the aim to achieve levels of acrylamide as low as reasonable achievable below the benchmark levels set out in section F. FBOs shall hereby take into account the safety of foodstuffs, specific production and geographic conditions or product characteristics.

2. French fries and other cut (deep fried) potato products

FBOs shall

– follow the instructions on storage of provided by the FBOs or the suppliers or provided for in the relevant mitigation measures in section B;

– work with Standard Operational Procedures and calibrated fryers equipped with computerised timers and programmed to standard settings (time-temperature);

– monitor the level of acrylamide in finished products to verify that the mitigation measures are effective in keeping acrylamide levels below the benchmark level.

3. Bakery products

FBOs shall:

– monitor the level of acrylamide in finished products to verify that the mitigation measures are effective in keeping acrylamide levels below the benchmark level.

4. Coffee

FBOs shall:

– ensure that the level of acrylamide in supplied coffee is lower than the benchmark level specified in section F taking into account however that this may not be possible for all coffee types depending on blend and roast characteristics. In these cases a justification is provided by the supplier.

SECTION E

SAMPLING AND ANALYSIS REQUIREMENTS FOR THE MONITORING

FBOs referred to in section B and D shall establish a programme for their own sampling and analysis of the levels of acrylamide in the foodstuffs.

(I) Sampling

(1) The sample shall be representative for the sampled batch.

(2) FBOs shall ensure that they undertake representative sampling and analysis of their products for the presence of acrylamide to verify the effectiveness of mitigation measures, i.e. the levels of acrylamide are consistently below the benchmark levels over time.

(3) FBOs shall ensure that a representative sample of each product type is taken for analysis of acrylamide concentration. A "product type" includes groups of products with the same or similar ingredients, recipe design, process design and/or process controls where these have a potential influence acrylamide levels in the finished product. Monitoring programmes shall prioritise product types that have the demonstrated potential to exceed the benchmark level and shall be risk-based where further mitigation measures are feasible.

(II) Analysis

(1) FBOs shall provide sufficient data to enable an assessment of the level of acrylamide and of the likelihood that the product type might exceed the benchmark level.

(2) The sample shall be analysed in a laboratory that participates in appropriate proficiency testing schemes (which comply with the 'International Harmonised Protocol for the Proficiency Testing of (Chemical) Analytical Laboratories'[3] developed under the auspices of IUPAC/ISO/AOAC) and uses approved analytical methods for detection and quantification. Laboratories shall be able to demonstrate that they have internal quality control procedures in place. Examples of these are the 'ISO/ AOAC/IUPAC Guidelines on Internal Quality Control in Analytical Chemistry Laboratories'[4].

Wherever possible the trueness of analysis shall be estimated by including suitable certified reference materials in the analysis.

(3) The method of analysis used for the analysis of acrylamide must comply with the following performance criteria

3 M. Thompson et al, Pure and Applied Chemistry, 2006, 78, pp. 145-196.

4 Edited by M. Thompson and R. Wood, Pure and Applied Chemistry, 1995, 67, pp. 649-666.

Parameter	Criterion
Applicability	Foods within the scope (section A)
Specificity	Free from matrix or spectral interferences
Field blanks	Less than Limit of Detection (LOD)
Repeatability (RSD_r)	0.66 times RSD_R as derived from (modified) Horwitz equation
Reproducibility (RSD_R)	as derived from (modified) Horwitz equation
Recovery	75-110 %
Limit of Detection (LOD)	Three tenths of LOQ
Limit of Quantification (LOQ)	For benchmark level < 125 µg/kg: ≤ two fifths of the benchmark level (however not required to be lower than 20 µg/kg) For benchmark level ≥ 125 µg/kg: ≤ 50 µg/kg

(4) Analysis of acrylamide can be replaced by measurement of product attributes (e.g. colour) or process parameters provided that a statistical correlation can be demonstrated between the product attributes or process parameters and the acrylamide level.

(III) Frequency of sampling

(1) FBOs shall, undertake sampling and analysis at least annually for products that have a known and well-controlled acrylamide level. FBOs shall carry out higher frequency sampling and analysis of products having the potential to exceed the benchmark level and shall be risk-based where further mitigation measures are feasible.

(2) Based on this assessment referred to in point II(1) of this Section, the FBOs shall specify appropriate frequencies for analysis for each product type. The assessment shall be repeated if a product or process is modified in a way that could lead to a change in the acrylamide level in the final product.

(IV) Mitigation

If the analytical result, corrected for recovery but not taking into account the measurement uncertainty, indicates that a product has exceeded the benchmark level, or contains acrylamide at a level higher than anticipated (taking into account previous analyses, but lower than the benchmark level), then the FBOs shall carry out a review of the mitigation measures applied and shall take additional available mitigation measures to ensure that acrylamide level in the finished product is below the benchmark level. This must be demonstrated by the undertaking of a new representative sampling and analysis, after the introduction of the additional mitigation measures.

(V) Information to competent authorities

FBOs shall make the analytical results obtained from the analysis every year available on request to the competent authority together with descriptions of the products analysed. Details of mitigation measures taken to reduce levels of acrylamide below the benchmark level shall be provided for those products exceeding the benchmark level.

SECTION F

BENCHMARK LEVELS REFERRED TO IN SECTIONS ABOVE

The “benchmark levels' are performance indicators used to verify the effectiveness of mitigation measures and are based on experience and occurrence for broad food categories. The benchmark level cannot be directly used as reference to evaluate if a product can be placed on the market or not.

When the benchmark levels are exceeded, food business operators shall review without delay the mitigation measures applied and adjust processes and controls with an aim to achieve levels of acrylamide as low as reasonable achievable and below the benchmark levels set. This must be demonstrated by undertaking new representative sampling and analysis after the introduction of additional mitigation measures.

The benchmark levels have been established for broad food categories. It is to be acknowledged that for specific foods within such a broad food category there could be specific production, geographic or seasonal conditions, or product characteristics for which it is not possible to achieve the benchmark levels despite the application of all relevant mitigation measures. In such situations, the food business operator should be able to show evidence that they applied the relevant mitigation measures.

Where levels of acrylamide exceed the benchmark levels, this does not necessarily mean that the food has to be withdrawn or recalled from the market. If considered necessary, a risk assessment has to be carried out to determine whether the food exceeding the benchmark level has to be withdrawn or recalled from the market.

Benchmark levels for the presence of acrylamide in food referred to in section above are as follows (currently under review in the EU):

Food	**Benchmark level [µg/kg]**
French fries (ready-to-eat)	500
Potato crisps from fresh potatoes and from potato dough Potato-based crackers Other potato products from potato dough	750
Soft bread (a) Wheat based bread (b) Soft bread other than wheat based bread	 50 100
Breakfast cereals (excl. porridge) - bran products and whole grain cereals, gun puffed grain - wheat and rye based products (*) - maize, oat, spelt, barley and rice based products (*) (*) non-whole grain and/or non-bran based cereals. The cereal present in the largest quantity determines the category.	 300 300 150
Biscuits and wafers Crackers with the exception of potato based crackers Crispbread Ginger bread Products similar to the other products in this category	350 400 350 800 300
Roast coffee	400
Instant (soluble) coffee	850
Coffee substitutes (a) coffee substitutes exclusively from cereals (b) coffee substitutes from a mixture of cereals and cichory (c) coffee substitutes exclusively from cichory (*) the benchmark level to be applied to coffee substitutes from a mixture of cereals and cichory takes into account the relative proportion of these ingredients in the final product.	 500 (*) 4000
Baby foods, processed cereal based foods for infants and young children excluding biscuits and rusks[5],	40
Biscuits and rusks for infants and young children[6]	150

[5] As defined in Regulation (EU) No 609/2013 of the European Parliament and of the Council of 12 June 2013

[6] As defined in Regulation (EU) No 609/2013 of the European Parliament and of the Council of 12 June 2013

APPENDIX IV

LIST OF PARTICIPANTS

CHAIR

India

Dr. Usharani Dandamudi
Department of Food Safety and Analytical Quality Control Laboratory,
CSIR-Central Food Technological Research Institute, Mysuru, India

Co-CHAIR

Saudi Arabia

Dr. Mohammed Almutairi
Director of Food Chemistry Laboratory
Saudi Food and Drug Authority

BRAZIL

Larissa Bertollo Gomes Pôrto
Health Regulation Specialist
Brazilian Health Regulatory Agency

Ligia Lindner Schreiner
Food Risk Assessment Manager
Brazilian Health Regulatory Agency

Carolina Araújo Vieira
Health Regulation Specialist
Brazilian Health Regulatory Agency

CANADA

Luc Pelletier
Scientific Evaluator, Bureau of Chemical Safety
Food and Nutrition Directorate, Health Products and Food Branch, Health Canada

Rosalie Awad
Section Head, Bureau of Chemical Safety
Food and Nutrition Directorate, Health Products and Food Branch, Health Canada

CHINA

Yongning WU (Official Representative)
Professor, Chief Scientist
NHC Key Laboratory of Food Safety Risk Assessment, China National Center for Food Safety Risk Assessment (CFSA)

Yi SHAO
Professor
Division II of Food Safety Standards, China National Center for Food Safety Risk Assessment (CFSA)

Pingping ZHOU
Professor
Division II of Risk Assessment, China National Center for Food Safety Risk Assessment (CFSA)

Shuang ZHOU
Professor
NHC Key Laboratory of Food Safety Risk Assessment, China National Center for Food Safety Risk Assessment (CFSA)

Xin LIU
Professor
School of Food Science and Engineering
Wuhan Polytechnic University

COSTA RICA

M.Sc. Carolina Cortés Herrera
Researcher and Teaching Assistant, Technical Manager, Chemistry Laboratory of the National Center for Food Science and Technology

Ana Cristina Briones
Coordinator of the National CCCF

Amanda Lasso Cruz
Committee Technical Advisor of the National Codex Contact Point
Ministry of Economy, Industry and Commerce

EGYPT

Noha Mohamed Atia
Food Standards Specialist
Egyptian Organization for Standardization and Quality

EUROPEAN UNION

Mr. Frans VERSTRAETE
Deputy Head of Unit
European Commission / Directorate General for Health and Food Safety/ European Union

HONDURAS

Maria Sevilla
Technical Manager for Food Safety
SENASA

INDIA
M Muralidhara
Retired Chief Scientist
CSIR- CFTRI, Mysuru

Sandeep K. Sharma
Senior Scientist
CSIR-IITR, Lucknow

Shreya Pandey
Vice Chair
FICCI Codex Cell

Dilip Kumar Reddy Navuluri
Senior Manager – Regulatory Affairs
ITC Limited

Mamta Budhiraja
Senior Manager- Regulatory Affairs, India, and India region
PepsiCo India Holdings Pvt. Ltd.

INDONESIA
Yeni Restiani
Team Leader for Standardization and Assessment of Raw Materials, Food Categories, and Product Information
Indonesian Food and Drug Authority

JAPAN
Tetsuo Urushiyama
Ministry of Agriculture, Forestry and Fisheries

Kensuke Katsuta
Associate Director
Ministry of Agriculture, Forestry and Fisheries

Yui Sato
Associate Director
Ministry of Agriculture, Forestry and Fisheries

REPUBLIC OF KOREA
Kim Jooyeon
Researcher
Food Safety Policy Division
MFDS

MALAYSIA
Shazlina Mohd Zaini
Food Technologist

Rodiyah Mohamed
Food Technologist

NEW ZEALAND
Ms. Jeane NICOLAS
Specialist Adviser Toxicology
Ministry for Primary Industries, New Zealand

NIGERIA
Dr. Abimbola Uzomah
Professor Food Science & Technology
Federal University of Technology Owerri

PERU
Libia Liza
Punto de contacto

PHILIPPINES
Mr. Phelan G. Apostol
Food-Drug Regulation Officer III
Food and Drug Administration
Department of Health

Mr. Neri O. Camitan
Chief Science Research Specialist
Food Development Center
Department of Agriculture

SINGAPORE
Dr. Wesley Yu
Specialist Team Lead (Organic Contaminants)
Singapore Food Agency

Ms. Ng Hwee-Ee
Assistant Director
Singapore Food Agency

Dr. Er Jun Cheng
Acting Branch Head
Singapore Food Agency

SPAIN
Violeta García Henche
Head of Service in the Area of Management of Chemical Risks
Spanish Agency for Food Safety and Nutrition

THAILAND
Ms. Chutiwan Jatupornpong
Standards Officer, Office of Standard Development
National Bureau of Agricultural Commodity and Food Standards

UNITED KINGDOM
Helen Twyble
Senior Policy Advisor
Food Standards Agency/UK

Ian Smith
Policy Advisor
Food Standards Agency/UK

UNITED STATES
Victoria Incorvati
Chemist
FDA

Lauren Robin
Branch Chief
FDA

Quynh-Anh Nguyen
Biologist
FDA

Alexandra Ferraro
International Issues Analyst/US Delegate
U.S. Codex Office/ United States

INTERNATIONAL CONFECTIONERY ASSOCIATION (ICA)
Allie Graham
Vice President
Food & Nutrition Policy

Eleonora Alquati
Senior Regulatory and Scientific Affairs Manager

Food Industry Asia (FIA)
Jelene Teo
Regulatory Affairs, Senior Executive

FOODDRINKEUROPE
Alejandro Rodarte
Senior Manager Food Safety, Research Innovation

International Commission for Uniform Methods of Sugar Analysis (ICUMSA)
Institute of Food Technology (IFT), PEP