



**European Coffee Federation**



## **Sector Code of Practice for Managing Acrylamide Formation in Coffee**

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## **Contents**

|      |                                                                                                                             |    |
|------|-----------------------------------------------------------------------------------------------------------------------------|----|
| I.   | PREAMBLE AND GENERAL MANDATORY REQUIREMENTS.....                                                                            | 3  |
| II.  | INTRODUCTION.....                                                                                                           | 4  |
| III. | DESCRIPTION OF THE PRODUCT AND PROCESS.....                                                                                 | 4  |
| IV.  | MITIGATION MEASURES FOR MANDATORY ASSESSMENT BY FBOs FOR COFFEE                                                             |    |
|      | Agronomy.....                                                                                                               | 5  |
|      | Recipe.....                                                                                                                 | 5  |
|      | Processing.....                                                                                                             | 5  |
|      | Monitoring and Verification.....                                                                                            | 6  |
|      | PRPs to cover product development, compliance with specifications at<br>production and verification through monitoring..... | 6  |
| V.   | PROPOSED TEMPLATE AS AN EXAMPLE TO DOCUMENT THE COP<br>ASSESSMENT .....                                                     | 8  |
| VI.  | DEFINITIONS .....                                                                                                           | 10 |

## Sector Code of Practice for Managing Acrylamide Formation in Coffee

### I. PREAMBLE AND GENERAL MANDATORY REQUIREMENTS

This Code of Practice (CoP) has been developed for the control of acrylamide levels in coffee, in the light of 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, which applies since 11 April 2018.

The CoP provides a framework for Food Business Operators (FBOs) to manage acrylamide within companies Food Safety Management Systems, by mandatorily assessing and validating the mitigation measures described in part IV of this document. It necessarily provides the required flexibility to be relevant to all FBOs in the coffee sector from SMEs to large manufacturers and to consider the spectrum of different products requiring product specific solutions, taking into account:

- the range of food business operators to be covered from very small to large companies,
- the limitations to control precursor levels in key raw materials,
- the range and degree of variability in raw materials/ingredients used,
- the processing equipment / technology used,
- the range of the different processing conditions applied per product type to achieve the quality requirements in the diversity of finished products,
- the range and degree of variability of finished product specification with regard to physical and sensorial characteristics.

Since Acrylamide emerged as an issue in 2002, Food Business Operators (FBOs) of concerned sectors have provided guidance on techniques that are known to be under development and on those mitigation measures that have been found to be practical in a commercial environment. This resulted in the FoodDrinkEurope 'Acrylamide Toolbox' for the reduction of acrylamide, first published in 2005, supported by the EU and national authorities, representing the most complete collection of knowledge on Acrylamide formation and mitigation across a variety of foodstuffs.

This coffee specific CoP is based on the latest FoodDrinkEurope '2018 Acrylamide Toolbox'. Manufacturers and relevant trade associations shall continue the work undertaken to date on the FoodDrinkEurope Acrylamide Toolbox and additionally:

1. Take the necessary measures to ensure the Code of Practice, as described later in this document, is implemented by coffee manufacturers so as to reduce acrylamide levels to as low as reasonably achievable (ALARA).
2. Monitor acrylamide levels to assess the effectiveness of this Code of Practice.
3. Recommend to analyze samples at accredited laboratories (ISO 17025) applying a coffee specific recognized method such as ISO 18862 (LC-MS/MS and GC-MS)
4. Document the assessment process following, for example, the template provided in Part III.
5. Continue raising awareness of small and medium-sized enterprises (SMEs).
6. Review and update the Toolbox every two years.

## II. INTRODUCTION

- ✓ Acrylamide is a substance found in a wide range of everyday foods, including coffee, and is formed naturally as a result of cooking methods, particularly at relatively high temperatures such as frying, roasting and baking.
- ✓ Acrylamide mainly forms from the Maillard reaction between sugars and amino acids that are naturally present in many foods. Although acrylamide in foods was discovered in 2002, it has been present as long as humans have been preparing cooked, baked and fried foods.
- ✓ The European coffee industry has conducted research into the formation of acrylamide and factors influencing it.
- ✓ Results on coffee have led to the conclusion that only very limited process options are available to reduce the acrylamide level without affecting the quality/consumer acceptance of the product.
- ✓ Whilst acknowledging that no single applicable measure for substantially reducing acrylamide levels in coffee is currently available, the Code of Practice summarizes steps that can be kept under control like blend composition, roasting conditions and product monitoring.
- ✓ Part III gives details of the product and process. Part IV contains mitigation measures based on Good Manufacturing Practices. Part V provides a proposed template as one example to document the assessment as part of the implementation of this Code of Practice.

## III. DESCRIPTION OF THE PRODUCT AND PROCESS

- ✓ Organoleptic properties of coffee are finely tuned by a careful selection of green coffee beans, blending, roasting conditions and processing technologies. Flavor and aroma are crucial to the identity of the products and any blend and or technology changes to the existing products will have major impact on the organoleptic properties and subsequently consumer acceptance.
- ✓ The European coffee industry investigated the chain from green coffee to the coffee beverage for the factors affecting the acrylamide level. As in other food products, acrylamide in coffee forms from sugars and amino acids (predominantly asparagine) in the Maillard reaction. However, the content of acrylamide in coffee reaches a peak early in the roasting process, reflecting occurrence of both formation and destruction of acrylamide during roasting. Levels of acrylamide in the fully roasted product are a small fraction of the peak reached earlier. Within the sensorial range as accepted by consumers, only relatively small reduction of acrylamide levels appears achievable. No single applicable measure for substantially reducing acrylamide levels in coffee is currently available.
- ✓ Coffee is also known to be a source of compounds, such as polyphenols and melanoidins, which beneficial health effects are under scientific evaluation. Any mitigation efforts must also take into account the potential loss of desired food constituents and consequently changes in the risk/benefit characteristics of coffee.

#### IV. MITIGATION MEASURES FOR MANDATORY ASSESSMENT BY FBOs FOR COFFEE

##### AGRONOMY

- ✓ Reducing sugars and moisture in raw material (green coffee) do not show a correlation with acrylamide in the finished product.
- ✓ Although asparagine levels in raw material (green coffee) vary between different botanical species and origins, there is a poor correlation with the free asparagine in raw material and final acrylamide content in the finished product.

##### RECIPE

- ✓ On average, products based on Robusta beans tend to have slightly higher acrylamide levels than those made with Arabica beans. Therefore, within given sensorial limitations, blend composition shall be considered in product design and new product developments, when appropriate.

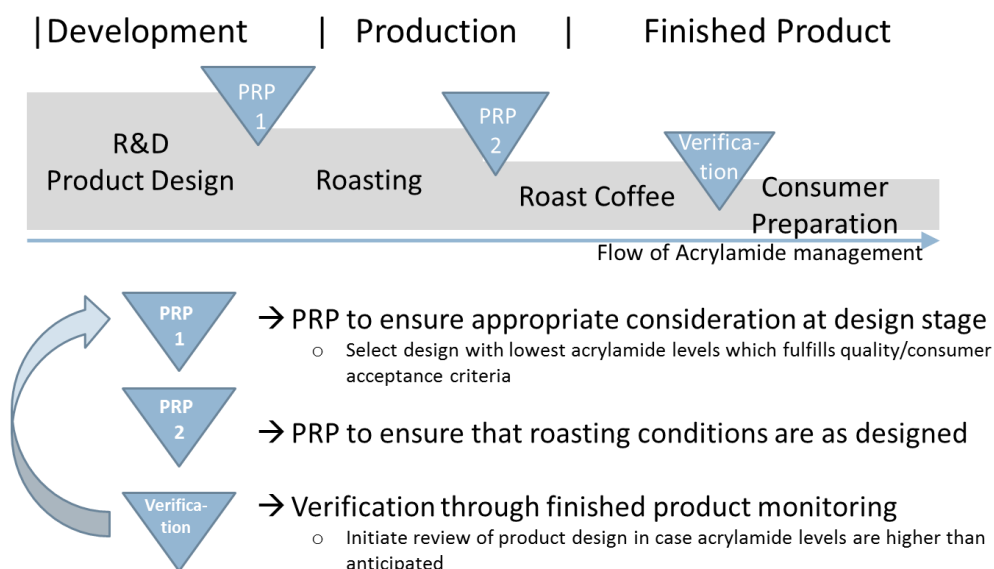
##### PROCESSING

- ✓ The applicability of asparaginase enzyme treatment of the green coffee is limited. The European coffee industry and enzyme suppliers have worked together to assess the use of asparaginase to destruct asparagine, one of the major precursors of acrylamide. The green coffee bean is a very dense, hardly permeable raw material and additional processing steps (steam treatment and soaking in a water bath) are required for the enzyme to be effective. However, the steam treatment/enzyme treatment process has potential relevance only for a very modest fraction of coffee production. It affects the taste profile in a way that is not compatible with the desired sensory properties of the majority of coffee blends. Asparaginase treatment therefore cannot be expected to achieve serious acrylamide mitigation percentages in overall coffee manufacturing.
- ✓ Manufacturers shall identify the critical roast conditions to achieve the target flavour profile. For the selected roast degree, the roast time shall be set as long as feasible to favour acrylamide conversion reactions.
- ✓ In general, extending the roast time by using lower roasting temperatures or darker roasting, tend to reduce the acrylamide level. Roasting faster results in higher acrylamide levels, when roasted to the same roast colour.
- ✓ Roasting to a darker colour cannot be considered as a universal option, because beside undesirable organoleptic properties change, it may also be associated with other effects such as increased furan generation or enhanced denaturation of naturally occurring potentially beneficial coffee compounds such as polyphenols and melanoidins.
- ✓ Control of roast conditions shall be incorporated into a Pre-requisite Programme (PRP) as part of Good Manufacturing Practice.
- ✓ A supplementary factor affecting the level of acrylamide in soluble coffee appear to be the high temperature processing applied during typical manufacturing to extract coffee soluble matter from roast and ground matrix. Manufacturers need to understand the impact this has on acrylamide, taking into consideration that currently no measures are available to mitigate acrylamide at this step.

## MONITORING AND VERIFICATION

- ✓ Acrylamide levels in finished products shall be monitored to verify that the control of the design and processing steps measures are effective in keeping acrylamide levels to ALARA. Acrylamide testing shall be carried out by application of an officially published standard method appropriate for coffee analysis (e.g. ISO 18862, EN 16618 or DIN 10785).
- ✓ Products which have been analyzed as part of the monitoring and consistently exceed the benchmark levels as per Commission Regulation EU 2017/2158 of 20 November 2017, shall be subject of a review to confirm and document that all effective and reasonable mitigation measures are appropriately applied. In such cases, manufacturers shall review the product design according to the CoP options.
- ✓ Manufacturers shall ensure that adaptations to the product design are in line with the ALARA principle.

## PRPs TO COVER PRODUCT DEVELOPMENT, COMPLIANCE WITH SPECIFICATIONS AT PRODUCTION AND VERIFICATION THROUGH MONITORING:



The approach of implementing relevant PRPs to manage acrylamide:

- is consistent with the approach of managing other contaminants (e.g. mycotoxins and heavy metals)
- provides the basis to consider acrylamide appropriately at the product development stage – where product specifications are defined and are required for achieving consumer acceptance as well as determining acrylamide levels.
- ensures production under defined conditions.
- allows verification through monitoring and feedback loop if appropriate.

## V. PROPOSED TEMPLATE AS AN EXAMPLE TO DOCUMENT THE CoP ASSESSMENT

## COFFEE ASSESSMENT FORM

## Product Description

|                                                                                                                                                                                                                                                                                                      |       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Roasted coffee <input type="checkbox"/> Instant (soluble) coffee <input type="checkbox"/><br>Other coffee products (please specify) .....<br><input type="checkbox"/> Large/medium scale manufacture<br><input type="checkbox"/> Small scale manufacture<br><br>Product / Product Group Description: | Date: |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|

| No. | Relevant Measures                                                                                                                                                                                                                                    |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | <b><u>PRP – Product design:</u></b> <ul style="list-style-type: none"> <li>– define product specifications which are required for achieving consumer acceptance with lowest acrylamide levels</li> </ul>                                             |
| 2   | <b><u>PRP – Production:</u></b> <ul style="list-style-type: none"> <li>– ensure that roasting conditions are as designed.</li> </ul>                                                                                                                 |
| 3   | <b><u>Finished product monitoring:</u></b> <ul style="list-style-type: none"> <li>– verification through finished product monitoring;</li> <li>– initiate review of product design in case acrylamide levels are higher than anticipated.</li> </ul> |

## Measures Selected to Reduce Acrylamide Formation and how linked to the Food Safety Management System

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b><u>Application: Product design validation</u></b></p> <p><b>1. Have the following parameters been considered in product design?</b></p> <ul style="list-style-type: none"> <li>– Blend composition Yes <input type="checkbox"/> No <input type="checkbox"/> if not why? .....</li> <li>– Degree of roasting Yes <input type="checkbox"/> No <input type="checkbox"/> if not why? .....</li> <li>– Roasting parameters Yes <input type="checkbox"/> No <input type="checkbox"/> if not why? .....</li> <li>– Other measure? .....</li> </ul> <p>Acrylamide level found.....µg/kg</p> <p>Method of analysis (tick one):</p> <p><input type="checkbox"/> LC/MS-MS <input type="checkbox"/> GC/MS      Accredited laboratory (ISO 17025):      <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Standard (please specify e.g. ISO18862 or EN16618) ..... <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Any other information: .....</p> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**2. Production verification**

Are the following parameters as designed?

- Blend composition Yes ☐ No ☐ if not why? .....
- Degree of roasting Yes ☐ No ☐ if not why? .....
- Roasting parameters Yes ☐ No ☐ if not why? .....
- Other measure? .....

**3. Monitoring: Finished product random checking**

**Batch/lot No:**

Acrylamide level found.....µg/kg

Method of analysis (tick one):

- ☐ LC/MS-MS ☐ GC/MS      Accredited laboratory (ISO 17025): ☐ Yes ☐ No
- Standard (please specify e.g. ISO18862 or EN16618) ..... ☐ Yes ☐ No

Sampling Point (tick one):

- ☐ Single retail ☐ Production site

Age of the product at point of analysis?.....

**Additional information:**

Is the finding within the normal range for the product (for this FBO)?

- ☐ Yes ☐ No

Did you take action to reduce acrylamide levels within PRPs?

- ☐ Yes ☐ No

Additional comments of the FBO that may be of interest as regards acrylamide reduction

.....  
 .....



### Measures that are judged not to be applicable in the context of the ALARA Concept

*Evaluation and justification*

## VI DEFINITIONS

### The Concept of ALARA

“ALARA” is an acronym for the concept “As Low As Reasonably Achievable”.

ALARA means that a Food Business Operator (FBO) shall take every reasonable measure to reduce the presence of a given contaminant in a final product taking into account other legitimate considerations.

To ensure continuing compliance with the ALARA concept, the FBO shall monitor the effectiveness of the implemented measures and shall review them as necessary.

### ALARA as Applied to Acrylamide

In the context of acrylamide and other process contaminants, which are the result of naturally occurring chemical reactions in heated foods and for which there are currently no levels that regulators have agreed upon as being ‘safe’, ALARA means that the FBO shall make every reasonable effort (based upon current knowledge) to reduce levels in final product and thereby reduce consumer’s exposure. ALARA could for example mean that an FBO changes parts of a process or even a whole process if technologically feasible.

The tools identified within the FoodDrinkEurope Toolbox are potential measures designed to limit acrylamide levels in final product through interventions at various stages of production (agronomical, recipe, processing, and final preparation). They are based upon scientific knowledge and practical application in specific circumstances.

As technology develops, new and better tools for acrylamide reduction may become available. As part of a continuous process FBOs shall, on a regular basis, review what tools are available in the code of practice, and consider whether they can implement these tools into their processes or their product.

If a FBO chooses not to implement an available tool, then the onus shall be placed upon that same FBO to demonstrate why its application is believed to be unreasonable or ineffective.

Considerations may include:

- potential impact that use of a known acrylamide mitigation tool will have upon levels of acrylamide in the final product
- potential impact that use of a known acrylamide mitigation tool may have upon the formation of other process contaminants (e.g. furan) and/or reduction in control of other hazards e.g. microbiological
- feasibility of implementing the identified controls, e.g. legal compliance, commercial availability of the mitigation tool, occupational health hazards, timescales and costs associated with upgrading or replacing plant equipment.
- impact that use of a known acrylamide mitigation tool will have on organoleptic properties and other quality aspects of the final product as well as product safety (the ideal method would have no adverse effects)
- known nutritional benefits of using certain ingredients in preference to others, e.g. use of whole grain cereals instead of refined cereals.