A "Toolbox" for the Reduction of Acrylamide in Breakfast Cereals

Acrylamide

Acrylamide is a substance that is produced naturally in foods as a result of high-temperature cooking (e.g. baking, grilling, frying).

> Acrylamide has been found in a wide variety of cooked foods, including those prepared industrially, in catering and at home. It is found in staple foods such as bread and potatoes as well as in other everyday products such as crisps, biscuits and coffee.

Acrylamide in food potentially increases the risk of developing cancer for consumers in all age groups. It is therefore of major importance for the protection of public health that mitigation measures are applied to reduce the levels of acrylamide in food as low as reasonably achievable.

The FoodDrinkEurope Acrylamide Toolbox

Following the discovery of acrylamide in food, the industry and other stakeholders, including regulators, took action to investigate how acrylamide is formed and the possible methods that can be employed to reduce levels of acrylamide in foods using the ALARA principle. FoodDrinkEurope initiated and continues to coordinate efforts and pool results together to update the Acrylamide Toolbox.

What does the Toolbox do?

- Details existing methods to reduce acrylamide in foods
- Allows users to assess and evaluate which reduction measures to use and at which production step
- Assists in implementing Commission Regulation (EU) 2017/2158, , with the aim to achieve levels of acrylamide as low a reasonably achievable

ALARA

ALARA is an acronym for the concept "As Low As Reasonably Achievable". This simply means that a Food Business Operator (FBO) takes appropriate measures to reduce the presence of a given contaminant in a final product to a minimum: taking account of the risk presented, but also taking account of other legitimate considerations, such as potential risks from other contaminants, organoleptic properties and quality of the final product, and the feasibility and effectiveness of controls.
To ensure continuing compliance with the ALARA concept the FBO should monitor the effectiveness of the implemented measures and should reassess these as necessary

What can you do?

- Use this brochure to identify methods that you can use to reduce acrylamide levels.
- You will need to examine your production methods, raw materials, recipes, product quality and national legislation in order to identify the most appropriate "tools".
- Consider that not all methods will apply to your manufacturing needs.
- You will need to assess the effectiveness of the mitigation measures by monitoring and use of the benchmark levels as performance indicators
- When benchmark levels are exceeded, you will need to review the mitigation measures applied and adjust processes with the aim to achieve levels as low as reasonably achievable below the benchmark level.

Acrylamide in Breakfast Cereals

This brochure is designed to help manufacturers of breakfast cereals. For more detailed advice contact CEEREAL (European Breakfast Cereals Association) at scozzi@ceereal.eu.

Read the full toolbox at:
https://www.fooddrinkeurope.eu/publication/fooddrinkeurope-updates-industry-wide-acrylamide-toolbox/

Methods of formation

- Acrylamide is formed via the reaction of asparagine and reducing sugars.
- Acrylamide is formed at temperatures higher than 120°C
- The amount of acrylamide formed depends on:
  - Temperature
  - Baking time
  - Recipe

Methods of Reduction for Breakfast Cereals

The vast range of different recipes, grains, ingredients and processes used in breakfast cereal manufacture means there is no single, simple way to reduce acrylamide formation. For example, wheat-based cereals generally contain more acrylamide than rice or maize based cereals, but each grain has its own distinctive nutritional and eating characteristics. Manufacturers are advised to select those "Tools" that are most suitable to the type of product that they are producing and to contact CEEREAL, the European association for manufacturers of breakfast cereals, for more advice (scozzi@ceereal.eu).

Agronomy: Asparagine	Recipe Design	Process Design
• **The level of free asparagine (Asn) is the key determinant of the formation of acrylamide (AA) in cereal products.** The sugars composition of cereal grains is not a key determinant of AA formation and is therefore not considered relevant in the context of reducing AA. Currently, it is impossible to source grains with controlled low levels of Asn, because of the sources of variation (grain type, single variety, growing conditions on individual fields, climate. FBOs should keep abreast of progress on research to breed new, low asparagine wheat through trade associations and research institutes. • **Agronomy: Avoid an increase in free asparagine levels in cereals as it results in a higher risk of AA formation:** - Farmers should be made aware of the importance of maintaining balanced sulphur levels for cereal cultivation. - Farmers should avoid late and excessive application of nitrogen in consistency with Good Agricultural Practices on fertilization. - Farmers should be guided to use appropriate crop protection measures to prevent fungal infection in consistency with Good Phytosanitary Practices	• **Choice of cereal ingredients.** All of the major grains may be used in breakfast cereals and some grains yield more AA than others within a common process. Products based on maize and rice tend to have less AA than those made with wheat, rye, barley and oats. 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. Using less whole meal/less bran might reduce AA formation (Asn is more concentrated in the bran), however this will significantly reduce the product's nutritional value, change organoleptic properties and product identity. • **Minimise the use of reducing sugars, if added prior to heat-treatment stages, as they can act as precursors to acrylamide formation. In this case, controls over addition rates must be established and implemented at point of addition.** • **Consider inclusions contribution to overall acrylamide levels in products.** Heat-treated dry-added ingredients may contribute to AA. Low roasted almonds contain 10-fold less AA than high roasted almonds. Peanuts and hazelnuts contain less than a fifth of asparagine as compared to almonds so they yield much less AA. Some dried fruit were found with higher AA levels e.g. prune, pears. When baked pieces are used, their recipe should be reviewed following the advice for biscuits.	• **Optimisation of thermal input results in a reduction of AA formation.** An effective combination of temperature and/or heating times minimizes AA 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). • **Do not over bake or over toast; avoid the incidence of burnt product as this may give rise to AA spikes.** • **Identify the key critical heat-treatment step(s) to focus AA reduction/control efforts.** • **Control heating temperatures, times and feed- rates to achieve typical minimum moisture contents after the final heat-treatment steps to help avoid the generation of AA spikes.** • **It is important to measure the moisture content as well, and express AA concentration on a dry mass basis to eliminate the confounding effect of moisture changes.** • **Rework:** Manufacturers should assess the impact of rework on acrylamide and, if significant, focus on reducing or eliminating rework as there might be an impact on AA levels.