

## 2008 CAOBISCO Review of Acrylamide mitigation in Fine Bakery wares and Crisp bread

### Summary and Key findings

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Respondents to the 2008 questionnaire were 23 European manufacturers of fine bakery wares and crisp bread, producing from 5 to over 500,000 tonnes per annum per business, in 85 different manufacturing sites.

Results showed that **the vast majority of** businesses were already using or intended to use the CIAA Toolbox or sector brochure to support their mitigation activity. The key findings can be summarised as follows:

- The CIAA core Toolbox mitigation strategies were validated - especially fructose and other reducing sugar replacement, and ammonium bicarbonate (ABC) replacement.
- New product development (NPD) is an area that is delivering future mitigation through application of the Toolbox within the development process.
- Asparaginase is the current focus of industry activity, with 17 approaches<sup>1</sup> reported and 5 businesses that have already put it into commercial production.
- Seasonal and harvest factors continue to be an important source of uncontrollable natural variation.
- No new mitigation measures were identified since 2006.
- However, there is a continuing conflict between mitigation and health targets on sodium and whole grain.

Responses confirmed that even with investment in development, in many cases an approach was only effective for a specific product and/or market, the changes made were often detrimental to product quality and consumer acceptability and could not be applied across a range of products. Some respondents report a natural variability has been observed in the results, from batch to batch and year to year, making accurate measurement of the effect of the mitigation strategy more difficult.

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<sup>1</sup> Each 'Approach' may represent a series of trials by a business on a dough type, starting with model systems, experimenting with bench scale formulations and processing, continuing to pilot plant and then commercial processing, each step supported by analytical, physical and sensory measurements, concluding with market research for major brands

## Background

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In December 2005, CAOBISCO initiated an Acrylamide Research Project, to create a non-competitive framework for fine bakery wares and crisp bread manufacturers to both share their experiences of application of the CIAA Acrylamide Toolbox information, and to update the Toolbox with new information, ideally reflecting operational conditions. This information was published in May 2006, and formed the basis for advice to manufacturers on how to potentially mitigate acrylamide in their products.

In January 2008 a second questionnaire was circulated to manufacturers and member associations. The purpose was to update the CIAA Toolbox with new potential mitigation measures and also find out how effective the Toolbox recommendations were, when used in a variety of products and manufacturing environments. The value of the industry contribution to the CIAA Toolbox was shown by the numerous mitigation measures recommended after the first review.

Due to the wide variety of products and processes involved, results were categorised and recorded separately by dough type as “short sweet biscuits”, “hard sweet biscuits”, “crackers”, “crispbread”, “gingerbread”, “wafer” and “undefined”.

## Changes since the 2006 review

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- The range of approaches and level of successful commercialisation were broadly similar to 2006.
- Many of the mitigation measures introduced before 2006 were embedded into the product specification.
- The change in legal status of asparaginase has driven trials on a wide range of products, with at least 13 products commercialised and more planned, especially for products containing wholemeal and/or high reducing sugar.
- As potential approaches to mitigate acrylamide in existing products were exhausted, the emphasis has moved towards product development and control on changes to process and products. 21/23 businesses maintained a focus on mitigation through NPD and/or HACCP.
- Some initial approaches from 2006 have not been supported by further evidence, including extended fermentation of doughs, reduced standing time on non-fermented doughs, and reduction in rework.

## Manufacturing Applications

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Information on manufacturing applications of the Toolbox came from **12** respondents, of whom **9** had participated in the 2006 review. All but one of the businesses involved in the two surveys had introduced mitigation measures into their products or business processes.

Since 2003, **175** approaches have been investigated, **58** of these mitigation measures have been applied to products on the market, excluding new products launched which have minimised acrylamide potential through applying the Toolbox measures during development.

Where possible manufacturers have made changes to all commercial products, such as ammonium bicarbonate replacement by sodium bicarbonate, or use of low fructose invert syrup. Most current effort is focussed on mitigation of acrylamide in whole grain and bran products, which are high in asparagine, they continue to be monitored and are subject to ongoing development work.

For the majority of products, companies report that even with significant changes to recipes and/or processes, only modest reductions in acrylamide were achieved, and often at the expense of quality. Some effective approaches have been avoided or used sparingly, because they are in direct conflict with health targets such as salt reduction, and use of whole grains.

The most popular mitigation measure in this 2008 survey was the replacement of ABC as a leavening agent.

Recipe approaches including ABC replacement, reducing sugar modifications and dilution of high asparagine ingredients by more highly refined grains or other cereals accounted for ~2/3rds of the commercialised mitigation measures.

Pre-treatment with asparaginase accounts for the majority of new measures under trial and for 20% of all commercialised approaches, with more expected to be introduced in 2008. This is despite limitations of use in some products and affordability for artisanal businesses.

No new potential measures were identified by this survey.

### **Measures recommended in the CIAA Toolbox, but not confirmed by evidence from this survey:**

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- Crop selection for lower asparagine – no results reported, but may be useful in future.
- Rework reduction – no recent results reported support of 2006 indicative work.
- Calcium and Amino acids – quality issues, but may still be useful in some products.
- Fermentation extended time – not validated as commercially viable.
- Dough resting time reduction – not validated as commercially viable.

### **Application of the Toolbox – Recent Approaches Reported**

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#### **Ammonium bicarbonate replacement**

9/13 approaches were commercialised in sweet biscuits and gingerbread; despite changes to flavour, colour and texture. Sodium salts were added in most approaches.

#### **Fructose/ reducing sugar replacement**

5/11 approaches were commercialised in sweet biscuits; fructose replacement by glucose retained original quality in most products; paler colours were acceptable.

#### **Asparaginase**

5/17 approaches were commercialised, in gingerbread, crispbread and short sweet biscuits. Trials are still underway for all product types, with launches planned, or an

intention to progress once legal in certain non-EU markets. Asparaginase is most appropriate for high moisture dough systems.

### **Thermal input and colour endpoint**

5/15 trials commercialised; crispbread successful through reduced final 'roast', also hard sweet biscuits with lower colour.

Oven profile changes were useful in creating acceptable products with reduced colour.

### **Moisture specification change**

In crispbread, where the product is traditionally very crisp and dry, one more approach has been commercialised without quality loss.

### **Low free asparagine (ASN) cereals –Dilution and agronomy**

2/3 dilution approaches were commercialised: partial replacement of wholemeal rye flour by high extraction rye flour in crispbread; substitution of multi-cereal for bran in a cracker.

Finding commercial cereal grain sources with low ASN has not yet succeeded, and may not be sustainable. Low ASN flour used for gingerbread trials had poor quality characteristics, reflecting the challenges facing manufacturers who need flours to meet exact specifications.

Monitoring of asparagine levels in rye continues, with research into use of sulphur by farmers in its infancy. No conclusive results available.

### **Innovative processing**

No success reported so far.

## **Health Impacts**

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Some effective mitigation methods have been used only for a few specific products, or have not even been considered as potential approaches by some manufacturers, because they are in direct conflict with health targets:

- Replacing ABC by sodium salts is in direct conflict with WHO and EU efforts to reduce hypertension and heart disease through sodium reduction in the diet, and targets set by the UK FSA (typically replacement of ammonium bicarbonate by sodium bicarbonate could add 500mg Na per 100g of product).
- The replacement of wholemeal flour or bran with high extraction refined flour runs counter to the EU HEALTHGRAIN project, which seeks to increase intake of protective whole grain components. Codex recognises that when the use of different flours of varying asparagine content is being considered, manufacturers must balance the choice between nutritional value and the minimisation of acrylamide.
- Work by the EC Joint Research Centre has provided some evidence that Maillard products, that are linked to elevated acrylamide levels, may themselves be health protective, increasing the level of natural antioxidants in the diet.

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