# Acrylamide in Food - Mitigation Options

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JIFSAN Workshop, April 13-15 2004

# Structure

- The challenge
- Which are our main possibilities?
- What progress has been made so far?

  *Some food categories*

  - *Potato products*
  - *Cereal based products*
  - *Coffee*
- How should we proceed?
- Conclusions

# The challenge

- Reduced acrylamide level
- Retained (or improved) product quality
  - flavour
  - colour
  - texture
  - safety
  - …

**Each product and process needs its own solution!**

**It is not possible to generalize!**

# Mitigation possibilities…

1. **The raw materials**

   Selection of favorable raw materials

   Development of new raw materials

   Influence on cultivation conditions

   - Low asparagine content
   - Low sugar content
   - Optimal amino acid balance?
   - Content of protective component?

# Mitigation possibilities…

2. **Pre-treatment procedures**

   Minimization of the content of reactants

   - Washing / Extraction
   - Enzymatic reactions
   - Chemical reactions

# Mitigation possibilities…

3. **Recipe modifications; additives**
   - Components competing with asparagine in the Maillard reaction
   - Components binding or inactivating asparagine or sugars
   - Components binding acrylamide or influencing its further reactions
   - Additives influencing pH

# Mitigation possibilities…

4. **Process optimization**

   Main parameters to control

   - Temperature
   - Time
   - Moisture
   - pH?

# Mitigation possibilities…

5. **Actions on final product**
   - Sorting out of overheated items
   - Controlled degradation / transformation /evaporization of acrylamide

# Potato products

1. **Raw materials**
   - Sugar content limiting factor
   - Raw material selection of key importance
   - Potato storage time and conditions decisive

   - Potential for new cultivars?
   - Growing locations; climate conditions etc. of importance?
   - Influence of fertilizers?

# Potato products

2. **Pre-treatment**
   - Blanching
   - Enzymatic treatment?

3. **Additives**
   - Citric acid; acetic acid
   - Amino acids
   - Salt

# Potato products

4. **Process optimization**
   - Lower temperature in final phase of frying
   - Careful control of the final moisture content

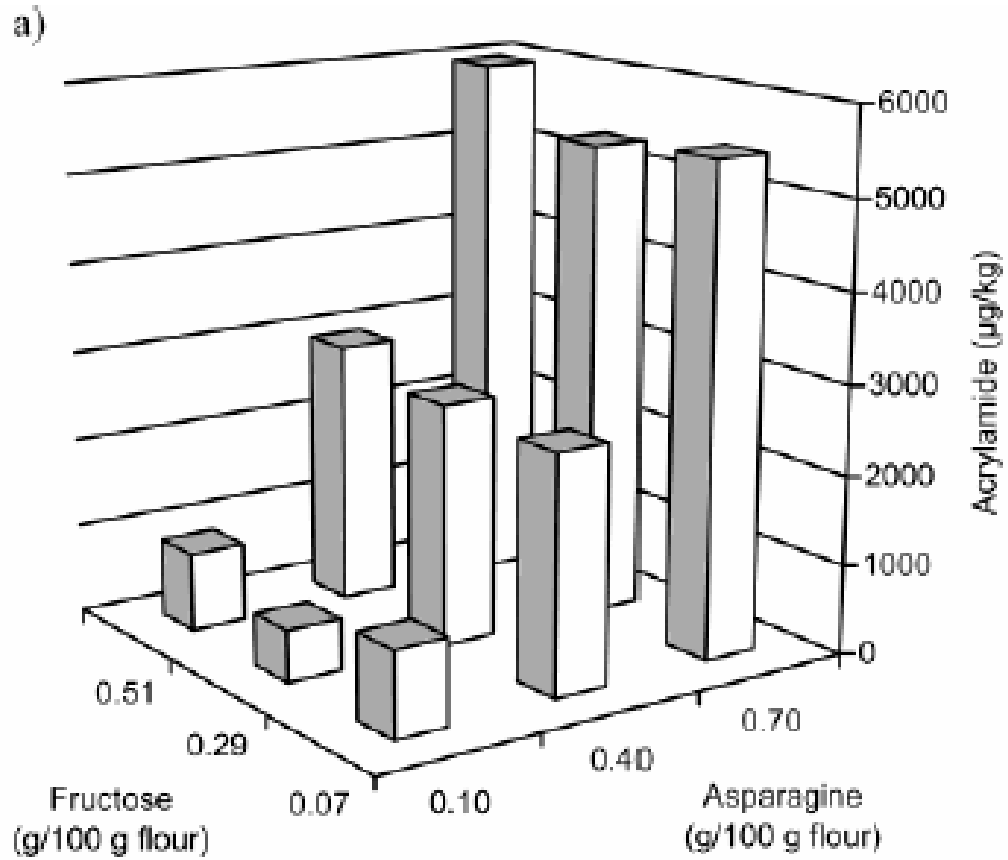
5. **Product treatment**
   - Removing dark crisps

# Cereal based products

**Bread**

- Acrylamide concentrated to the crust
- Asparagine limiting factor in flour for bread baking

# Effect of added aparagine and fructose on acrylamide content in bread crust




Surdyk et al. J.Agr.Food Chem. 2004

# Cereal based products

**Bread**

- Acrylamide concentrated to the crust
- Asparagine limiting factor in flour for bread baking
- Survey of free asparagine content in raw materials and in cereal fractions
- Dough fermentation may affect
- Baking conditions may be influenced

# Cereal based products

**Crisp bread**

- Yeast leavened bread have considerably lower levels than bread baked with baking powder
- Control of final moisture content
- No evident conclusions regarding various time-temperature conditions

# Cereal based products

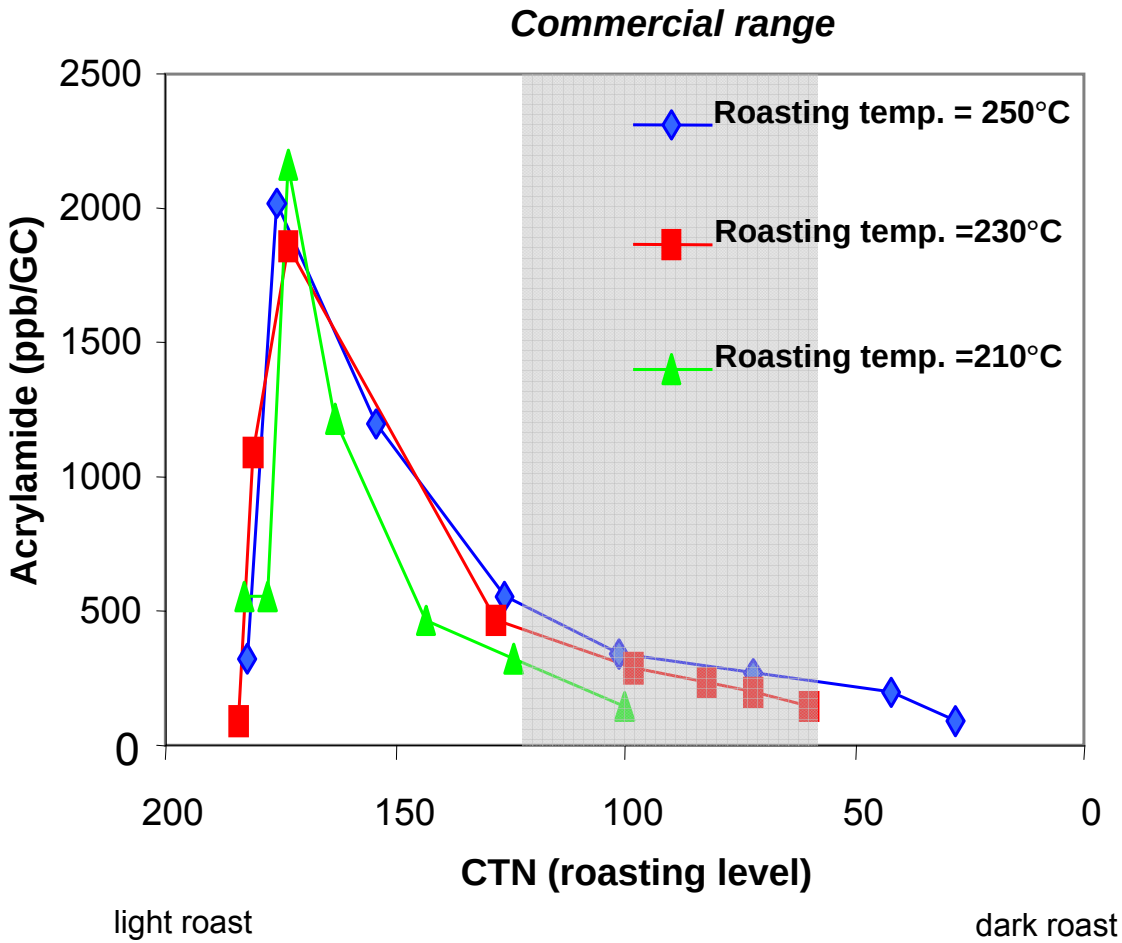
**Breakfast cereals**

- Complex product group
- Many different raw materials
- Various processes
- Specific solutions sought for each product, looking at
  - Raw materials
  - Process conditions

# Coffee

- Acrylamide formed very early in the roasting process, concentration is then declining during processing

# Acrylamide development in coffee during roasting




From CIAA

# Coffee

- Acrylamide formed very early in the roasting process, concentration is then declining during processing
- Roasting temperature has little effect
- Lower acrylamide levels in the darker roasted coffee
- Acrylamide not stable in finished product

# How to proceed?

- Raw material mapping (total free amino acid profiles)
- Improved, fundamental understanding of reaction kinetics

  *In particular*

  - *The role of water*
  - *Degradation mechanisms and kinetics*
- Improved process evaluations
- Consideration of alternative processing technologies

**Continued interaction science – industrial practice**

# Conclusions

- A broad perspective is needed for successful mitigation solutions.
- The challenge is to reduce the acrylamide content while retaining the product quality
- We have seen significant progress already during these two years when basic knowledge has developed in parallel with the evolution of practical solutions
- We now enter a phase when we can foresee a large output of fundamental, science based knowledge
- This must form the platform for further applications and improvements