The HEATOX Workshop · Report

Heat-generated food toxicants - Identification, characterisation and risk minimisation

13-14 June 2006
Graz, Austria

www.heatox.org

The Heatox project is supported by the European Commission Research Directorate-General within the Sixth Framework Programme's Thematic Priority 5 "Food Quality and Safety". (Contract no Food-CT-2003-506820 Specific Targeted Research Project). The project does not necessarily reflect the Commission's views or anticipates the Commission's future policy in this area.

European Commission

Food Quality and Safety

The Heatox Workshop was planned and designed by a working group (all partners in the HEATOX project) consisting of:

Kerstin Skog, coordinator HEATOX, University of Lund, Sweden
Michael Murkovic, Technical University of Graz, Austria
Barbara Gallani, The European Consumers' Organisation, BEUC, Belgium
Hans Lingnert, The Swedish Institute for Food and Biotechnology, Sweden
Karl-Erik Hellenäs, National Food Administration, Sweden
Leif Busk, National Food Administration, Sweden
Marco Dalla Rosa, University of Bologna, Italy
Helga Odden Reksnes, National Veterinary Institute, Norway
Hanne Mari Jordsmyr, National Veterinary Institute, Norway

Many of the other participants were also engaged in the planning process.
A special thank to Torbjörn Albert at the National Food Administration in Sweden for preparing the extensive background material for the working groups on home-cooking guidelines and to the students of the Technical University of Graz for all practical arrangements.

The HEATOX Workshop Report was compiled by Hanne Mari Jordsmyr and Helga Odden Reksnes. The report in electronic format can be downloaded from www.heatox.org. A printed version can be ordered from Hanne Mari Jordsmyr, National Veterinary Institute, P.O.Box 8156 Dep. 0033 Oslo, Norway. + 47 23 21 63 66, hanne-mari.jordsmyr@vetinst.no.

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European Commission
Food Quality and Safety

Dear reader,

Dialogue and interaction with stakeholders is an important part of the HEATOX risk communication strategy. The action plan has four stages;

1. Dialogue and interaction with identified stakeholders at their own arenas and through their proper channels.
2. HEATOX Workshop
3. Dialoge and interaction with identified stakeholders, evaluation of process and assessing communication objectives.
4. Production of end deliverables *Guidelines to consumers on healthy homecooking and consumption of cooked foods* (D59), *Manual on strategies to industry and restaurants etc. to minimise acrylamide formation* (D60) and *Guidelines to Good Risk Communication Practice related to heat-induced toxicants* (D61)

The HEATOX Workshop represents the second stage of the HEATOX risk communication action plan and the Workshop has gone further on actions already taken by key stakeholders, for example initiatives taken by the EU Commission, WHO/JECFA, other research projects, CIAA, BEUC etc.

The intention of the Workshop was to gather key persons representing consumer interests, authorities, industry and research to share relevant knowledge and discuss the state of the art of science and technology as well as challenges related to heat-generated food toxicants in general and Acrylamide in particular.

I hope this HEATOX Workshop report will contribute to the knowledge building and knowledge sharing process related to heat-generated food toxicants in general and Acrylamide in particular.

I would like to thank lecturers, chairs and rapporteurs as well as Aquarium discussants for sharing, organising and compiling knowledge and all participants at the workshop for contributing to the important interaction and dialogue between HEATOX scientists and key stakeholders.

November 2006,

Kerstin Skog
Coordinator HEATOX project

The HEATOX Workshop · Programme

Heat-generated food toxicants - Identification, characterisation and risk minimisation

Tuesday 13 June 2006 «The Risk - case Acrylamide»

Chair: Barbara Gallani

12:00	**Lunch**		
13:15	**Welcome**		Kerstin Skog, HEATOX and Michael Murkovic, Faculty for Chemistry, Chemical- and Process Engineering, Biotechnology, TU Graz
13:30	**Introduction**	HEATOX approach to heat-generated food toxicants	Karl-Erik Hellenäs, HEATOX
	Knowledge status AA	Exposure and reduction scenarios	Jacob van Klaveren, HEATOX
	Minimisation options:		
		Industry	Hans Lingnert, HEATOX
		Home-cooking	Kerstin Skog, HEATOX
14:40	**Coffee-break**		
15:00	**Consumer attitudes**	Introduction	Barbara Gallani, BEUC
	Risk Issues in Europe	Risk perception and food safety: where do European consumers stand today?	Carola Sondermann, EFSA
	Risk perception and communication	General issues	Gene Rowe, Institute of Food Research, Norwich
16:00	**Working groups**		*Chairs/rapporteurs:*
		1. Home-cooking guidelines	Lauren Jackson/Anika De Mul
		2. Home-cooking guidelines	Beate Kettlitz/Jonas Mojica-Lazaro and Pelle T. Olesen
		3. Cultural differences	Sigrid Lauryssen/Thomas Bjellås
		4. Industry strategies	Geoff Thompson/Jeroen Knol
		5. Industry strategies	Eleni Alevritou/Arwa Mustafa and Erik Pettersson
	Summary		Chairs/rapporteurs
20:00	**Dinner with Mozart**		

The HEATOX Workshop · Programme

Heat-generated food toxicants - Identification, characterisation and risk minimisation

Continued

Wednesday 14 June 2006 «The Risk Perspective»

Chair: Stuart Slorach
co-chair: Helga Odden Reksnes

	Breakfast		
09:00	**Lecture**	The Acrylamide story	Margareta Törnqvist, HEATOX
10:00	**Aquarium***		
	Putting risk from heat-generated food toxicants into context – **science as basis for effective risk management**	Topics to be discussed: toxicology, exposure, minimisation, risk and benefit, regulatory perspective, comparing risks, risk characterisation, communication, uncertainties, consumer education and consumer interests	The **Aquarium*** group: Wendy Mattews, Angelika Tritscher, David Lineback, Gene Rowe, Barbara Gallani, Richard Stadler, Leif Busk, Jacob van Klaveren and Margareta Törnqvist
11:00	**Coffee-break**		
11:20	**Aquarium* continues**		
	Closing remarks		Stuart Slorach, National Food Administration, Sweden and Kerstin Skog, HEATOX
13:00	**Lunch**		

* The expression **Aquarium** denotes a specially designed type of panel debate where key persons (stakeholders) are invited to discuss important issues, and the supporters of each discussant/stakeholder are put in a position, also physically, occupying a segment of the circle behind «their discussant» where they can advice, question and support «their» representative by oral or short written messages. The discussion, and to some degree, choice of topics are being moderated by a chairperson.

The idea is that the aquarium form allows a more «intelligent» and responsible dialogue than the discussion of the traditional panel form where often the different participants advocate only one aspect of an issue or are confronting each other with different opinions on the same issue without being responsible for reaching agreements or a mutually understood pattern of disagreement.

Ideally a consensus statement or a negotiated platform should be produced in the end.

HEATOX Workshop 13 – 14 June 2006

List of participants:

Abrahamsson Zetterberg	Lilianne	(H) National Food Administration	Sweden
Albert	Torbjörn	(H) National Food Administration	Sweden
Alevritou	Eleni	EKPIZO - Consumers Association the quality of life	Greece
Alexander	Jan	(H) Norwegian Institute of Public Health	Norway
Becalski	Adam	Health Canada, Food Research Division	Canada
Bianchi	Emanuela	Altroconsumo	Italy
Bitterhof	Almut	(H-ExP) European Commission, Health and Consumer Protection Directorate	Belgium
Bjellås	Thomas	(H) Norwegian Institute of Public Health	Norway
Busk	Leif	(H) National Food Administration	Sweden
Dalla Rosa	Marco	(H) Dept. of food science, University of Bologna	Italy
De Mul	Anika	(H) RIKILT - Institute of Food Safety	The Netherlands
Dehne	Lutz	(H-ExP) BfR - Bundesinstitut für Risikobewertung	Germany
Frandsen	Henrik	(H) Danish Institute for Food and vet. Research	Denmark
Gallani	Barbara	(H) BEUC - The European Consumers' Organisation	Belgium
Glatt	Hansruedi	(H) German Institute of Human Nutrition	Germany
Grob	Koni	Official Food Control Authority of the Canton of Zurich	Switzerland
Göbel	Angela	Federal Office of Consumer Protection and Food Safety	Germany
Hamlet	Colin G	RHM Group Ltd	United Kingdom
Haraldsson	Roland	PPM AB	Sweden
Hellenäs	Karl-Erik	(H) National Food Administration	Sweden
Horváth	Gizella	OFE	Hungary
Hubená	Jarmila	Consumers Defence Association of the Czech Republik	Czech Republic
Jackson	Lauren	(H-ExP) U.S. Food and Drug Administration	USA
Jordsmyr	Hanne Mari	(H) National Veterinary Institute	Norway
Kettlitz	Beate	(H-ExP) CIAA	Belgium
Klaveren	Jacob van	(H) RIKILT Institute of Food Safety	The Netherlands
Knol	Jeroen	(H) Wageningen University	The Netherlands
Konings	Erik J.M.	Food and Consumer Product Safety Authority (VWA)	The Netherlands
Lallje	Sam	(H-ExP) Safety and Environmental Assurance Centre, Unilever (ILSI)	United Kingdom
Lauryssen	Sigrid	TEST ACHATS	Belgium
Lineback	David	(H-ExP) JIFSAN, Univ. of Maryland	USA
Lingnert	Hans	(H) SIK – The Swedish Institute for Food and Biotechnology	Sweden
Läänesaar	Linda	Estonian Consumers Union	Estonia
Matthews	Wendy	(H-ExP) Food Standards Agency UK	United Kingdom
Mojica-Lazaro	Jonas	(H) Department of Food Science, University of Leeds	United Kingdom
Murkovic	Michael	(H) Technical University of Graz	Austria
Mustafa	Arwa	(H) Swedish University for Agricultural Sciences – Department of Food Science	Sweden
Olesen	Pelle T.	(H) Danish Institute for Food and vet. Research	Denmark
Petersson	Erik	(H) National Food Administration	Sweden
Petracco	Marino	Illycaffè	Italy
Reksnes	Helga Odden	(H) National Veterinary Institute	Norway
Rowe	Gene	Institute of Food Research	United Kingdom
Samouris	George	KEPKA-Consumers' Protection Center	Greece
Sjöholm	Ingegerd	(H) Lund University, Division of Food Engineering	Sweden
Skog	Kerstin	(H) Lund University, Division of Applied Nutrition and Food Chemistry	Sweden
Slorach	Stuart	National Food Administration	Sweden
Sonderman	Carola	EFSA - European Food Safety Authority	Italy
Spök	Armin	IFZ-Inter-University Research Centre for Technology, Work and Culture	Austria
Stadler	Richard	Nestlé Product Technology Centre	Switzerland
Thompson	Geoff	Danone	France
Thornley	Dell	EMRA - European Modern Restaurant Association	Belgium
Tritscher	Angelica	World Health Organization	Switzerland
Törnqvist	Margareta	(H) Stockholm University	Sweden
Veale	Ruth	BEUC - The European Consumers' Organisation	Belgium
Wenzl	Thomas	(H-ExP) Institute for Reference Materials and Measurements	Belgium

(H): Partner in HEATOX - (H-ExP): Member of HEATOX External Panel

Karl-Erik Hellenäs, National Food Administration:

EUROPEAN COMMISSION
Community Research

FOOD QUALITY AND SAFETY

theheatoxproject

Heat-generated food toxicants,
identification, characterisation and risk minimisation

Graz work-shop

Introduction

www.heatox.org

Karl-Erik Hellenäs
LIVSMEDELSVERKET
NATIONAL FOOD ADMINISTRATION

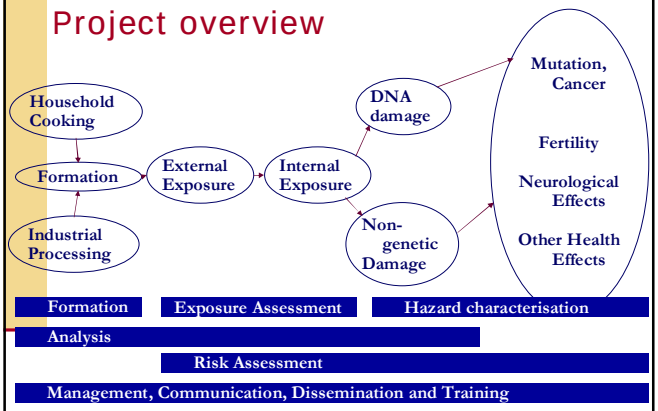
Project format

- Duration: 1 Nov 2003 to 28 Feb 2007
- Commission grant: 4.2 million euro
- 24 partners in 14 countries

Project aim

- Identify, characterize and minimize health risks from heat generated food toxicants

Project overview



Project approach

- Acrylamide in focus
  - but also other known and unknown heat-induced toxicants
    - risk-risk, risk-benefit
- Complementory to other research
  - fill important knowledge gaps
  - tasks where multi-disciplinary approach needed
  - Communication
    - External advisory panel
    - Work-shops

Major project deliverables

- D37 Risk characterisation.
- D59 Guidelines to consumers on healthy home cooking and consumption of cooked foods.
- D60 Manual on strategies to food industries, restaurants, etc., to minimize acrylamide formation.
- D61 Guidelines to good risk communication practise related to heat induced toxicants.

Karl-Erik Hellenäs, National Food Administration:

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FOOD QUALITY AND SAFETY

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Formation and occurence of acrylamide in food

Karl-Erik Hellenäs

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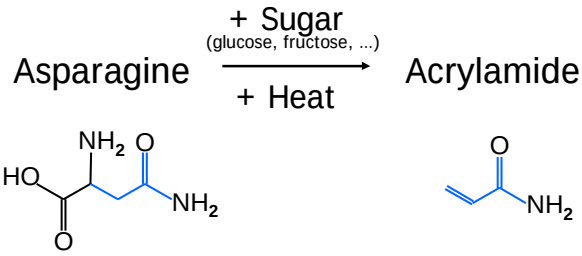
NATIONAL FOOD ADMINISTRATION

Acrylamide formation



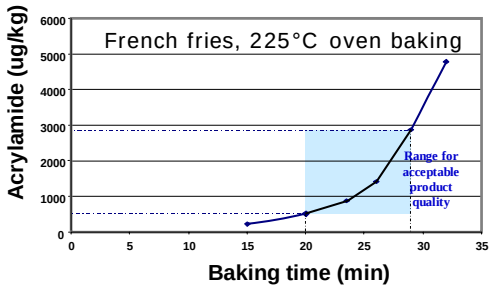
"Maillard reaction"

AA occurrence in food

- Fried and baked foods (>120°C)
- "Dry surface" phenomena - linked to browning
- Carbohydrate rich foods
  - Potato - high (<5000µg/kg)
  - Cereals - medium
  - Meat - low (<50µg/kg)

Critical formation factors

- Precursor availability
  - Limiting factor: Reducing sugars in potato
    Asparagine in cereals
- Heating temperature and time (heat flux)
- Water activity
- pH

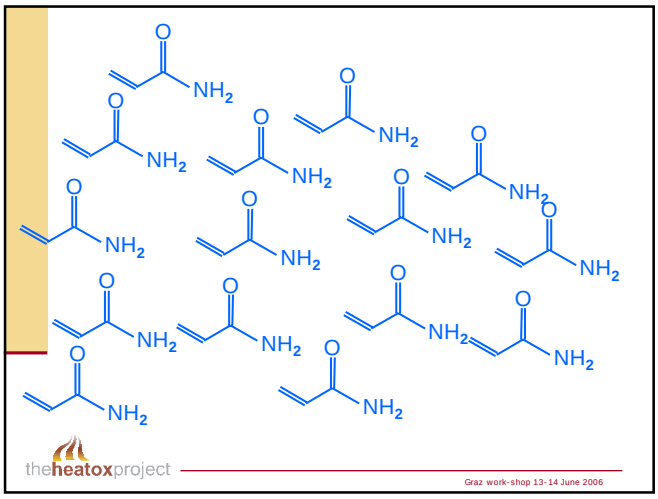


Acrylamide in different foods

Acrylamide concentration (µg/kg)

Food type	median	75% quartile	maximum
French fries	173	339	4653
Potato crisps	570	960	3770
Fine bakery ware	50	134	333
Crispbread	248	514	2838
Breakfast cereals	53	126	1540
Coffee roasted	285	387	112

Data from JRC-irmm data base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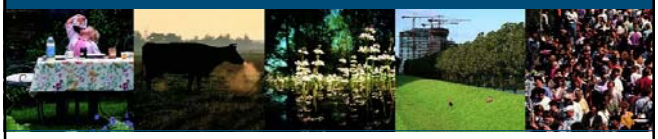
Exposure and reduction scenarios

Jacob van Klaveren and Anika de Mul



Introduction

- What is exposure assessment?
- Need for a harmonized approach?
- Are correlations between intake, biomarkers and effect good enough?
- Margin of Exposure (MoE)
- Is reduction of exposure to acrylamide possible and can we reach an acceptable MoE?
- Can we quantify possible side effects?

How to measure exposure

- Duplicate diet
- Calculation
  ∑ residue x food consumption

Food Consumption

- Food record
- 24 hour recall
- Food frequency questionnaire

Monitoring of acrylamide concentrations

- Acrylamide has been analyzed in Europe in:
  - Austria, Belgium, Czech republic, Denmark, Finland, France, Germany, Ireland, Norway, Poland, Sweden, Switzerland, The Netherlands, United Kingdom
  - Most countries analyzed acrylamide in majority of foods from national market, some countries analyzed specifically foods high in acrylamide, new foods possibly containing acrylamide or studied different varieties.
  - Specially analyzed foods potato cultivars, breast milk, baby food, toasted bread

Source: EU Summary of activities

http://ec.europa.eu/food/food/chemicalsafety/contaminants/acryl_database_en.htm

Acrylamide concentration database

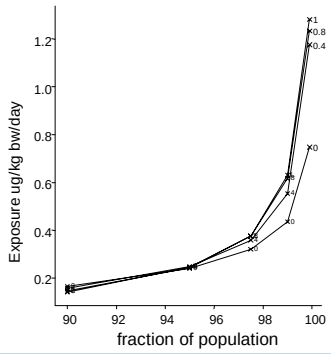
- Joint Research Centre (EU-database concentration)
- June 2006 update; contains 7150 checked values, 5800 with running z-scores
- Check reliability LOD and LOQ, and reported value relative to LOQ
- Calculation of running z-scores

Food frequency questionnaire

	how often				portion
Food category	1 month,	1 week,	2-3 week,	4-5 week, daily	
Snacks				x	
salted snacks				x	
peanuts			?		
crisps			?		
brand x			?		
brand y					

- Long-term intake at the individual level
- Relative cheap and quick (mostly used in epidemiology)
- Not very accurate
- Limited in the number of questions (approax. 150)
- Limited in details
- Used for health item x, is most likely not very usable for health item y

Exposure percentiles as function of brand loyalty



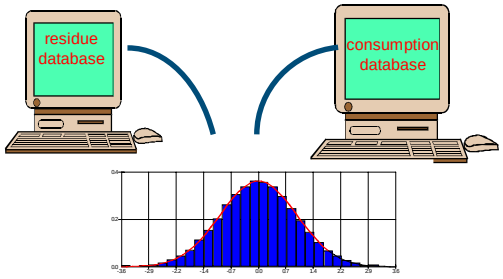
max brand loyalty

no brand loyalty

IISI-paper review of intake within Europe

- Intake levels in several countries *(chemical toxicology 43 363-410)*
  - France mean exposure 0.40 µg per kg bw per day for adults 1.06 for children
  - The Netherlands average 0.98 µg per kg bw per day for children 1-6 years,
  - Sweden average 0.5 µg per kg bw per day for different age groups (Food Chem. Toxicol. 2003(41) 1581-6))
- average 0.3-0.8 µg kg bw per day for long-term intake (WHO)
- some consumers will be exposed to significant higher levels

Probabilistic exposure assessment



99, 99.9, and/or 99.99 percentile

Processing studies done in Heatox

Applied in laboratory setting, it is not known whether this is applicable in the future!

Bread	Yeast leavened bread (infrared/impingement baking)
Coffee	Variety, roasting time
French fries	Shape, extended blanching time, time-temp combination in frying, storage conditions
Crisps	Blanching, storage conditions, frying temperature

Reduction scenarios

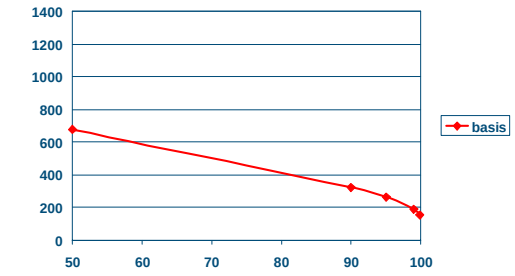
scenario	Original level	Reduction
Bread	-	70%
Coffee	200 µg/kg *	30%
French fries	200 µg/kg	50% / 80%
Crisps	1000 µg/kg	200ng/g and 60 ng/g

Margin of Exposure concept

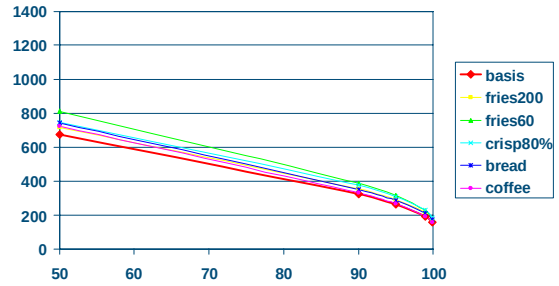
Calculation of the Margin of Exposure (MoE)
(MoE = effect level / intake level)

	person intake		CED/BMDL	MoE
James	0.3	300	1000	
Mary	0.6	300	500	
Tom	1.2	300	250	
Elisa	1.5	300	200	

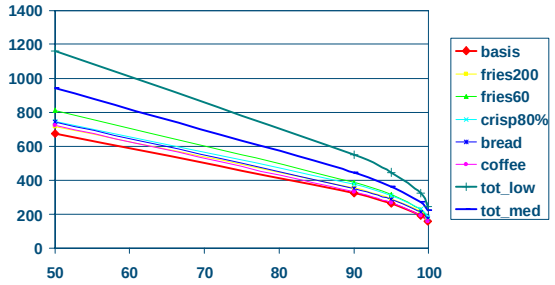
MoE; without any mitigation



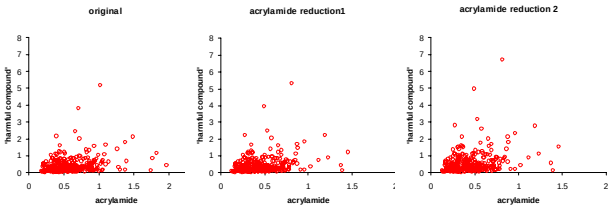
MoE; several mitigation options



MoE; total low scenario



Exposure distribution acrylamide/benefit

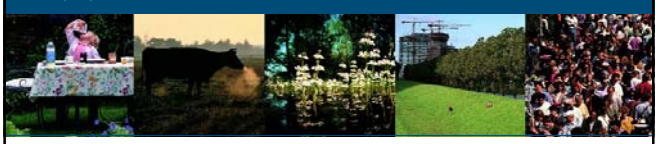


Conclusion

- Exposure assessment is not always as accurate as we think it is, hampers good correlations between intake and biomarkers.
- Average intake in the range of 0,3 – 1 µg/kg body weight per day, higher intakes occur
- Margin of Exposure (MoE) is far away from 10,000
- Reduction of exposure is possible, but MoE's are still much smaller than 10,000
- Models to quantify risk-benefit are available?

Thank you for your attention!

Jacob.vanklaveren@wur.nl



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Minimsation Options - Industry

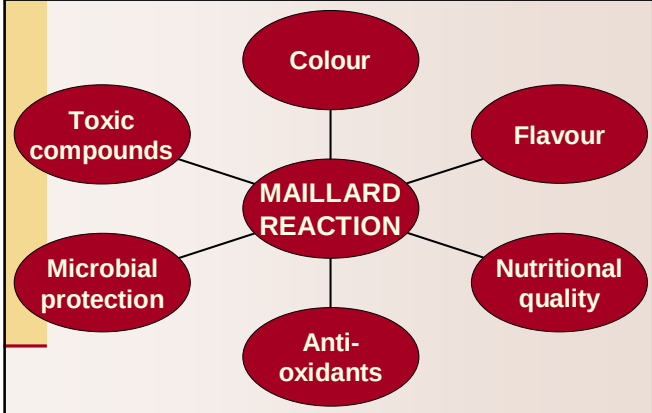
Graz Workshop
13-14 June 2006
Hans Lingnert

Sik

Time Perspective

- April 2002
  Formation mechanism of acrylamide is not known
- June 2006
  More than 600 articles in the HeatoxNews database.
  137 on Formation and Chemistry
  133 on Ways to reduce

The Maillard Reaction?



Acrylamide Minimisation

A balancing act!

- **Total product quality**
  The consumer is the judge
- **Risk/benefit considerations**
  Should be scientifically based

Minimisation strategies

- Reduce the content of reactants
  Asparagine, Sugars
- Influence the reaction
  Reaction pathways, Extent of reaction
- Promote degradation of acrylamide formed

Reduce the content of reactants

- Selection and control of raw materials
- Pre-treatment (washing, blanching, sifting, ...)
- Fermentation
- Enzyme treatment

Influence the reaction

- Processing conditions
  - Temperature
  - Time
  - Moisture
  - pH
- Recipe; Ingredients
  - Amino acids
  - Acids
  - Baking agents

Promote degradation of acrylamide formed

- Acrylamide content may be reduced at prolonged heating
  - Coffee roasting
- Food components reacting with acrylamide?

HEATOX contributions

- Reaction kinetics
  - Modelling of acrylamide formation as a function of processing parameters
  - Kinetics behind the formation and loss of acrylamide in low moisture systems
- Potato products
  - The influence of potato variety/cold storage on acrylamide production in potato crisps
  - A fry simulator for frying of French fries developed
  - Studies on low pH treatment and vacuum frying for potato crisps

HEATOX contributions

- Bread
  - Prolonged yeast fermentation reduce the acrylamide formation
  - Modified (steam) or new (IR, impingement) baking processes may reduce the acrylamide levels in bread
- Coffee
  - Relationships aspargine, sugars (various coffee varieties) roasting time and temperature evaluated

The CIAA Acrylamide Toolbox

The voice of the European food and drink industry

Agronomic	Recipe	Process	Final Preparation
- Sugars - Asparagine	- NH_4HCO_3 - pH - Minor ingredients - Dilution - Rework	- Fermentation - Thermal input - Pre-treatment	- Color endpoint - Texture/flavour - Product storage/ shelf life/ consumer prep.

- ✓ **Guidance to assist in reducing AA levels in food**
- ✓ **Not meant as a formal prescriptive manual**
- ✓ **« Live » document**

CIAA

The CIAA Toolbox

Category	Toolbox Compartment: Agronomical	Recipe	Processing	Final Prep.
Potato Products	● Sugar	◑	◕ Thermal input Pre-treatment	● Color endpoint
Bread/Biscuits/ Bakery wares	● Asparagine	◕ NH_4HCO_3	◕ Fermentation Moisture	◕ Color endpoint
Breakfast cereals	● Asparagine	◑	◑	◔
Coffee	◔	◔	◑ Dark roasting	◕ Storage

◔: Low or no impact ●: High impact

Guidelines for minimisation

- Should take the continuous development of new knowledge into account
- Should recognize that each product and process needs its own solution
- Should offer a systems approach rather than fixed solutions
- The Toolbox
- The HACCP concept?

The HACCP Concept

1. Identifying hazards (hazard analysis)
2. Identifying the critical control points where control is essential to prevent the hazard or to reduce it to acceptable levels
3. Establishing critical limits at critical control points
4. Establishing effective monitoring procedures at critical control points
5. Establishing corrective actions when monitoring indicates that a critical control point is not under control
6. Establishing procedures to verify that the measures outlined are working effectively
7. Establishing documents and records to demonstrate the effective application of the measures outlined

(EU Guidance Document)

Kerstin Skog, Lund University:

Home-cooking and acrylamide

Kerstin Skog

Department of Food Technology, Engineering and Nutrition

LUND UNIVERSITY

Attempts to reduce acrylamide may have impact on

- Product quality
  - Nutritional value
  - Microbiological safety
  - Sensory properties - flavour, taste, texture
- Formation beneficial compounds

Risk – benefit approach

Crisp breads

- Fermented crisp breads contain less acrylamide than non-fermented
- Consumption of crisp breads is still considered as health promoting

Bread

- Prolonged fermentation of the dough reduces AA content in the final bread
  - reduced free asparagine content
- Applying glycine on the surface of the dough decreased acrylamide content in the bread and enhanced browning

Rice

- Low dietary intake of fried rice
- Acrylamide is found in fried rice, but at lower concentrations than in fried potatoes
  - Rice has less asparagine and less sugar
- Cereals have most of the asparagine in the bran layer, thus probably less acrylamide is present in fried white rice (but less dietary fibre)

Vegetables

- Acrylamide is formed in most types of foods during frying, baking and roasting
  - the amounts depend on how much asparagine and sugar are present
- Acrylamide levels are generally low in heated vegetables
- Consumption of fried vegetables has probably no significance for the total intake of acrylamide

Factors that can influence AA formation in "fried" potatoes

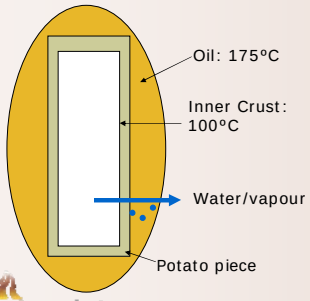
- Varieties - Storage conditions
  - Reconditioning at room temperature
- Pre-treatment
  - Blanching – soaking
  - Boiling before roasting and pan-frying
  - Adding citric acid, vinegar, rosemary
- Cooking
  - Type of equipment
  - Type/reuse of cooking oil
  - Size and shape of potatoes
  - Temperature and Time (Colour, Crispness)
  - Reheating

Storage

- Cultivars vary, weather conditions have large impact even for the same cultivar
- Sugar and asparagine levels differ between varieties
- Cold storage induces sugar formation
- The influence of storage is different between varieties
  - Some varieties are adapted to cold storage
- Storage at 8-10 degrees Celsius – less sugar
  - However, this shortens the shelf life of potatoes
- Reconditioning = Keeping cold-stored potatoes at room temperature before use
  - reduces the sugar and thus the formation of acrylamide

What happens during deep-frying?

Crust formation



Potato contain 80% water (no fat)
French fries 50% water (>10%fat)

Acrylamide is formed in the latter part of the cooking

Acrylamide – Cooking method

- *Not in boiled or micro-waved potatoes*
- in deep-fried, roasted, pan-fried potatoes
- higher levels when cooked from frozen (sometimes)
- acrylamide formation depends on the heat transfer, if it is hard or soft fried, not directly on the frying method as such
- the quality of the oil is of little significance
- thin or small pieces have larger surface area/volume than thick or big pieces and generally contain more acrylamide

Pre-treatment to reduce AA

- Blanching or soaking removes asparagine and sugar from the surface and results in lower acrylamide levels
- Parboiling reduces acrylamide formation
  - up to 40% less in roasted potatoes
- Citric acid, vinegar, rosemary
  - acceptable product?

Two-stage cooking

- Varying the temperature during cooking - a way to reduce acrylamide?
- Higher heat in the beginning to get a nice crust and colour and lower heat in the end, when most of the acrylamide is formed
  - Accuracy of domestic temperature controls?

Acrylamide and colour

- Colour codes to minimise acrylamide content?
- Strong relationship between colour in bread crust and acrylamide content
- Within one potato variety -
  the darker the crust, the more acrylamide
- Large differences between potato varieties in cooking time to obtain similar colour
- Not all samples 'cooked' at lighter colour
- Preferences for color and final moisture
  - a consumer acceptable product

Thank you for your attention

www.heatox.org

Barbara Gallani

Introduction at Heatox Workshop in Graz, June 06

BEUC is a partner in the Heatox project, working in particular on Deliverables 59 and 60, which cover the communication of the research results to consumers and industry. We strongly believe in the importance of making the results of any research project widely available to the scientific community and most importantly relevant and understandable for consumers and citizens.

Heatox is a particularly important project and a lot of expectations have been created around its contributions to scientific knowledge, since the Commission has clearly stated that any decisions on how to manage the acrylamide risk would be made after the end of the Heatox project.

A lot more about acrylamide is how know thanks to the researchers who, across a number of EU countries, are working together to assess the risk and to develop minimisation strategies. This afternoon we will hear two presentations: one on perception of risk and one on how consumers deal with uncertainties. We will then split into five working groups covering three topics and, mindful of all the information that has been presented to us so clearly by the different speakers, in the course of the afternoon we will discuss how Heatox researchers and partners can work, in the last six months of the project, on some of the most pressing consumer and industry concerns. We will also be asked to suggest ways of delivering the results of the research in a format that is constructive and easy to use by regulators, industry and consumers.

Some of the ideas for the workshop and questions for the working groups were developed at the end of November 2005 by 30 or more consumer representatives from all over Europe. During a workshop which focussed on acrylamide it became very clear that:

- There is a need for clearer information on how to reduce the levels of acrylamide during home-cooking. Clearer messages on storage, cooking and diet need to be developed and conveyed to consumers through a number of different and trustworthy channels.
- The main hurdle is the communication of uncertainties and the notion of balance between risks and benefits. These are difficult concepts that need to be communicated to consumers in a honest way and not used to dilute good safety messages and, ultimately responsibilities.
- It is necessary to know how the different minimisation strategies in place are (or are no)t working in order to develop the most appropriate regulatory approaches. There is a need for transparent monitoring programmes by both national authorities and industry.

Carola Sondermann, European Food Safety Authority (EFSA):

Risk perception and food safety: where do European consumers stand today?

Carola Sondermann
EFSA Senior Press Officer

Outline

- Objective
- Methodology
- Risk perceptions
- Views on public authorities' action
- Sources of Information

Objectives

- Assess how consumers in the EU perceive health-related risks and in particular food safety.
- Identify key concerns with respect to food safety
- Assess consumers' views regarding action of public authorities
- Assess consumers' trust in key information sources

► Eurobarometer jointly commissioned by EFSA and DG SANCO

Methodology

Fieldwork: September 2nd – October 6th 2005

Countries covered: 25 Member States

Target group: In each Member State, national and other EU citizens aged 15+

Methodology: Face-to-face interviews conducted in peoples' homes

Number of interviews: 24,643 interviews conducted by TNS Opinion & Social network

Main findings: Food Safety

- Consumer perception of food is positive; food safety not top-of-mind
- Food primarily associated with taste, pleasure and hunger
- Major food crises of past (eg BSE, dioxins) not cited by consumers as being top concerns today
- High level of awareness re EU food safety regulations (> 60%)
- Opinions divided re progress made in food safety (country differences)
- Overall, public authorities' actions judged appropriate, in particular:
  - Decisions re food risks are science-based (nearly 6 out of 10)
  - Information re food risks (1 out of 2)
- Need for impactful risk communications:
  - Over 40% who hear of food risks in media either ignore story or worry and do nothing

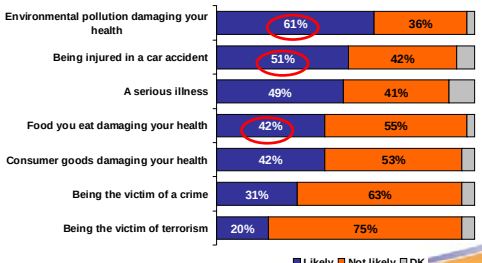
Risk perceptions

- Risks in general
- Association with food
- Attitudes to food purchasing
- Food-related risks
- National concerns about food

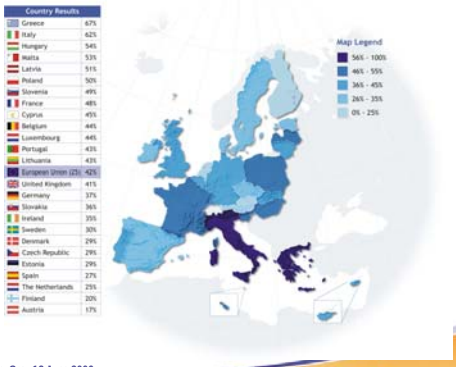
Risk perceptions

Risks in general

Question: **I will read out a list of potential risks. For each of them please tell me how likely you think they are to happen to you personally**.



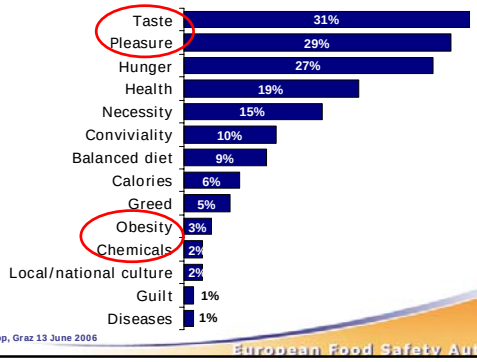
« The food you eat damaging your health »



Risk perceptions

Association with food - spontaneous

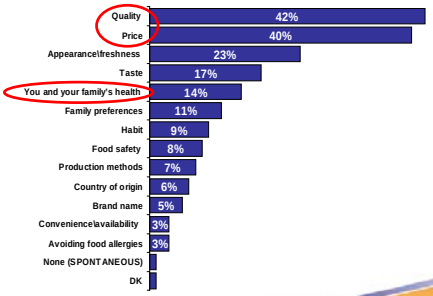
Question: When thinking about food, what words first come to mind? (MULTIPLE ANSWERS POSSIBLE) %EU



Risk perceptions

Attitudes to Food Purchasing

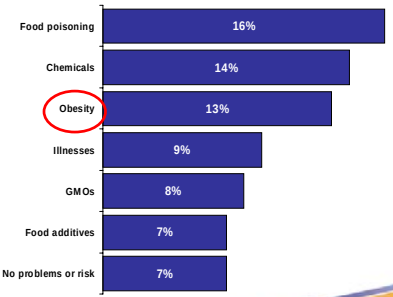
Question: When you go shopping for food, what would you say are the most important factors that influence your choice?



Risk perceptions

Food-related risks - spontaneous

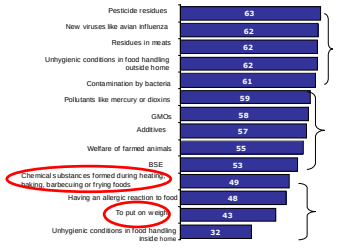
Question: What are all the things that come to mind when thinking about possible problems or risks associated with food?



Risk perceptions

Food-related risks - prompted

Question: For each of the following issues, please tell me if you are very worried, fairly worried, not very worried or not at all worried by it? AVERAGE WORRY "INDEX"

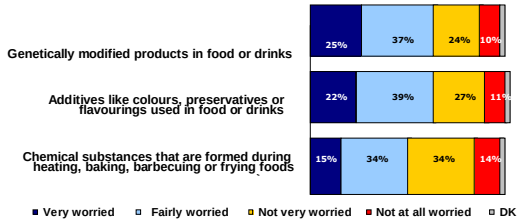


+100=very worried, +67=fairly worried, +33=not very worried, 0=not at all worried (DK responses omitted)

Risk perceptions

Food-related risks

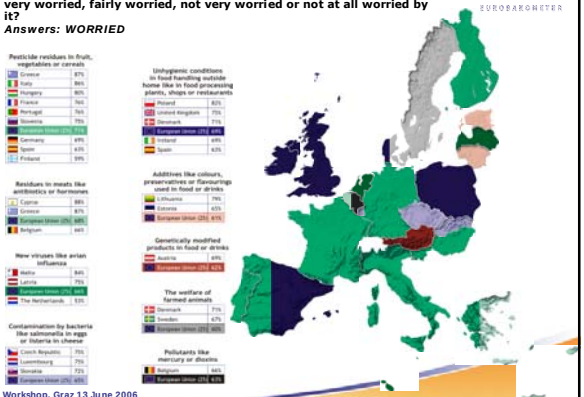
Question: For each of the following issues, please tell me if you are very worried, fairly worried, not very worried or not at all worried by it? AVERAGE WORRY "INDEX



Risk perceptions

Question: For each of the following issues, please tell me if you are very worried, fairly worried, not very worried or not at all worried by it?

Answers: WORRIED



Risk perceptions

- Awareness of EU regulations
- Citizens' health as a priority
- Food-related actions - laws
- Level of action
- Evolution in food safety

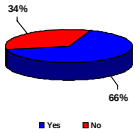
Risk perceptions

Awareness of EU regulations

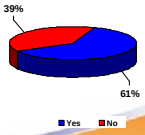
Question: For each of the following items, have you ever heard about any European Union regulations?

HEALTH WARNINGS ON CIGARETTE PACKS

CONSUMER RIGHTS



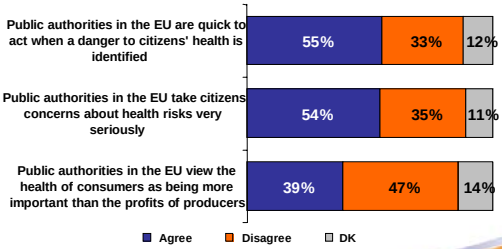
FOOD SAFETY



Risk perceptions

Citizens' health as a priority

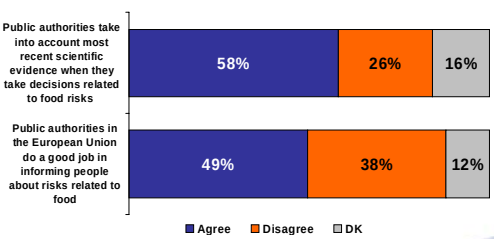
Question: For each of the following statements, would you say that you totally agree, tend to agree, tend to disagree, totally disagree?



Public authorities' action

Food-related actions

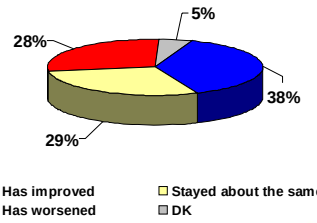
Question: For each of the following statements, would you say that you totally agree, tend to agree, tend to disagree, totally disagree?



Public authorities' action

Evolution in Food Safety

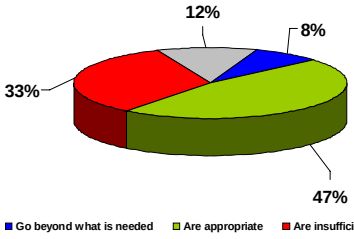
Question: Compared to ten years ago, would you say that, overall, food safety has improved, stayed about the same or has gotten worse?



Public authorities' action

Level of action

Question: Would you say that usually public authorities' actions in the European Union with regards to food safety risks...?



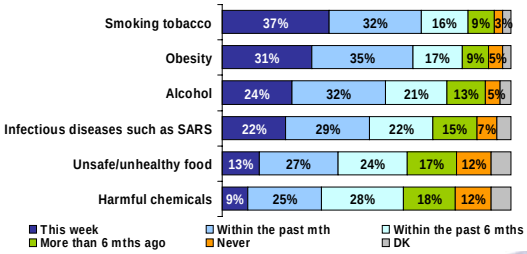
Sources of Information

- Media exposure to health risks
- Reaction to story
- Preferred sources

Sources of Information

Media exposure to health risks

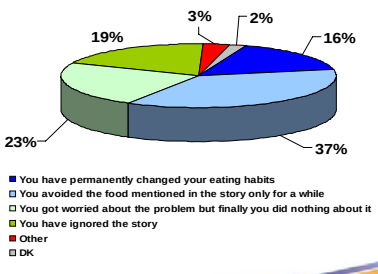
Question: Please tell me how recently you have heard or seen something in the media about the following health risks.



Sources of Information

Reaction to story

Question: Please tell me how you reacted to the last story you heard about a type of food being unsafe or bad for your health.



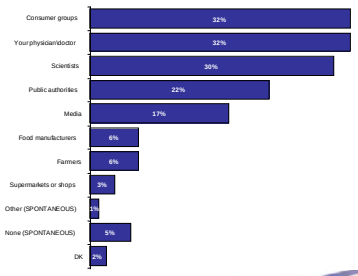
Most trusted communicators on food-related issues

- Consumer groups
- General practitioners
- Scientists

Sources of Information

Preferred sources

Question: Suppose a serious food risk were found in fish or chicken. Who would you trust the most to inform you about this risk?



Conclusion

- Europeans are worried about health-related risks
- Food has positive connotations of taste and pleasure and concerns regarding health and food safety are not top-of-mind
- Consumers identify a wide range of concerns and tend to worry most about factors which are beyond their control
- Clearly identifiable groups are more liable to worry about risks
- In order to be effective, communication on risks may need to be tailored to meet specific needs of target audiences
- Public authorities should seek to engage and involve consumers' most trusted information sources

Thank you !

Gene Rowe, Institute of Food Research (IFR):

ifr **Institute of Food Research**

Risk perception and communication: General issues

Dr. Gene Rowe
Risk and Consumer Science
Institute of Food Research

Presentation structure

- Public perception of risk
  - Why public perceptions are important
  - How people perceive risks
  - Are people wrong or just misunderstood?
- Communication issues
  - Rationale for communication
  - Issue of public participation
- Perception of food risk management
  - What is good and what is bad
- Implications for the Acrylamide case?

Public perception of risk

- A variety of controversies in Europe over the last few decades have shown the power of public opinion (and consequent behaviour)
- For example:
  BSE, Salmonella in eggs, combined MMR vaccine
- These cases have been marked by official estimates that risks associated with hazards are low (at least initially!), but considerable public anxiety
- Results of public concerns have been significant (e.g. economically), such as reduced consumption of beef and eggs, and reduced take-up of vaccine

Contemporary Example: Growing GM crops commercially in the UK

- Recent scientific review in UK (2003) has concluded risks are minimal
- HOWEVER there is evidence of great public concern (public perceives risks as greater), demonstrated by:
  - Direct action against GM crops by environmental activists
  - Refusal of certain retailers to sell 'GM foods'
  - Media campaigns against 'Franken-foods'
  - Also, international tensions e.g. refusal of several African countries to accept aid shipments; tensions between USA and Europe
  - Results from Government-sponsored debate and various opinion polls confirm public concern

The Outcome

- Government has limited powers as any ban would have international consequences, because of the lack of scientific or legal justification
- Instead, Government based policy on result of FSE of 3 crops (2003), and gave permission to grow one of these - the Chardon LL maize
- BUT, it published two sets of guidelines on new regulations relating to genetically modified organisms, covering tighter labelling of GM products and monitoring for environmental effects…
- Bayer, the German biotech company, withdrew its application to grow a variety of GM maize, saying the crop was **not economically viable**, given constraints imposed upon it by the government.
- None of the major biotechnology companies applied to the European Union to grow GM crops in the UK in 2005 - well below the peak for 2001, which saw 159 applications [New Scientist, 24 April, 2004].
- **Public ultimately have the power!**

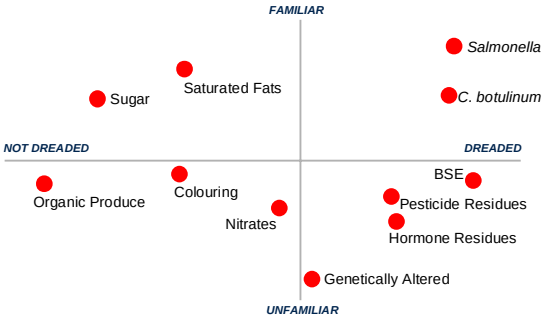
How do people perceive risks?

- **Quantitatively**, research has suggested that 'laypersons' tend to perceive risks as greater than 'experts', for a variety of potential hazards, e.g. chemical, ecological/environmental, nuclear waste
- However, closer look at data suggests that demographic and socio-economic differences explain the expert-lay differences (uncontrolled factors)
- That is:
  - Males perceive risks as less than females
  - Better educated perceive risks as less than less well educated
  - Also evidence that wealth (income), age, and ethnicity are correlated with degree of perceived risk

How do people perceive risks? (2)

- **Qualitatively**, research has suggested that 'laypersons' tend to perceive risks in a multi-dimensional manner, unlike the expert assessment of risk related simply to likelihood of human harm/death
- Psychometric research reveals generally 2 'dimensions' of risk: one related to 'dread' (event is dreaded, likely to cause harm, likely to harm future generations), the other to 'novelty' or 'familiarity' (known to scientists/the public) (see example)
- However, some contention about interpretations, e.g. Sjoberg suggests there is a 'tampering with nature' dimension
- Results may also vary according to nature of hazard…

Assessing Perception of Food Hazards



Fife-Schaw and Rowe (2000)

How do people perceive risks? (3)

- Other research identifies other key factors that impact on risk perception, such as presence or absence of benefits and control over exposure
- For example, some evidence GM foods perceived negatively because they have no perceived benefits (so why buy/eat it?), and less willing to tolerate it because no perceived control over exposure (not labelled, and mixed with non-GM ingredients, etc.)
- Uncertain relationship between the various factors (e.g. probability of harm, benefits, control, uncertainty, naturalness)
- Absence of theory means difficult to predict outcomes, e.g. public response to acrylamide??

So… are the public wrong, or simply misunderstood?

- There ARE cognitive limitations that affect how we judge risks and uncertainties e.g.
  - over-estimation of small numbers (scaling problems)
  - optimistic bias (risks more likely to others than self)
  - availability bias (probability judged by easy availability of information…)
  - anchoring and adjustment (drawn to initial numbers and find difficult to adjust sufficiently)
  - base rate fallacy (ignoring base rates in the face of individuating information)
  - supra-additivity (probabilities of mutually exclusive/ exhaustive options summed to > 1.0)

  ETC ETC…

- BUT… people also have different values and concerns…
- e.g. ‘foot and mouth’ crisis in UK: interpreted as public health problem by UK Government… but public perceived it as an animal welfare problem, hence concern at mass slaughter!

So… sometimes wrong, but often also misunderstood!

Risk Communication Rationale

- If the public have different risk perceptions to the scientifically informed position, AND this difference is due IN PART to misinformation, this IMPLIES a need to communicate appropriate information to the public
- The ‘deficit model’ assumes perceptions largely (entirely) due to lack of knowledge - the aim of RC thus to convince (unknowledgeable) public of ‘real’ risks according to expert assessment
- More enlightened view acknowledges scientific uncertainty in the official position, and the relevance of values, and sees the role of RC as providing consumers with the information necessary to enable them to make informed decisions

Risk Communication Research

- Regardless of philosophy, the idea is we just need to find the right presentational manner in order to PERSUADE/INFORM the public
- Research has attempted to find the magic presentational formula to do this e.g. using risk scales, comparing graphical vs numerical vs non-numerical information
- However, RC not very successful. Why are the public not convinced about the safety of GM foods and crops? Why do people still smoke? Why do people still ‘drink and drive’? Why are people refusing MMR?

Risk Communication Problems

- Public reaction to risk communication is influenced by factors in addition to the **content** of the information itself, such as **trust** in the source providing the information
- Unfortunately, communication sources (e.g. Government, industry) often untrusted:
  - seen as having vested interests
  - being wrong in the past (e.g. remember BSE!)
- Importantly, UNCERTAINTY is recognised by public (scientists don’t have all the facts, so they MIGHT be wrong, and anyway, this implies that risk pronouncements have degree of value judgments, and are those of the experts, politicans, etc.)

Public Engagement Paradigm

- ‘Public engagement’ as new paradigm: a way to counter distrust, and to admit public values i.e. don’t just communicate at public, but also collect views and hold debates
- Methods used include use of workshops, conferences, ‘citizens’ juries’…
- Increasing drift to this paradigm, e.g. UK GM ‘public debate’
- In spite of assumptions that engagement will improve trust, decrease dispute, lead to better decisions (etc.)

Perceptions of food risk management

- Recent research looking at perceptions of FRM part of an EU-funded project (SAFEFOODS)
- Focus groups, interviews, and surveys (5 different European countries)
- Consumers' evaluations of FRM quality related to number of factors, including:
  - Presence of established systems of control
  - Proactive (as opposed to reactive) management
  - Trust in honesty of managers
  - Trust in expertise of managers
  - Quality/presence of adequate information
  - Degree of personal responsibility (voluntariness of hazard)

Conclusion

- Public perceive risks/ uncertainties in a complex manner
- Risk Management needs to take this into account, because the public (consumers) hold much power
- 'Effective' risk communication is not simply a case of presenting 'facts' to public and convincing them
- Before communication, it's important to understand what people know and what they want to know
- Communication should be targeted accordingly, and come from trusted sources
- The 'public engagement' paradigm is one possible solution (response to public lack of knowledge *and* lack of trust?), but its 'effectiveness' is uncertain
- There are many research questions still to answer!

Implications for the Acrylamide case?

- Risk perception:

Dread risk?	No	(lo)
Unknown?	?	??
Involuntary?	No	(lo)
Future generations?	No	(lo)
Unnatural?	No	(lo)
Benefits?	Yes	(lo)

Prediction: not a hazard people will be particularly concerned about (as matters currently stand)…

But what do you think…?

HEATOX Workshop 13 – 14 June 2006

Working groups:

Group 1	**Chair:**	**Rapporteur:**	
Home-cooking	*Lauren Jackson*	*Anika De Mul*	
Bitterhof	Almut	(H-ExP) European Commission, Health and Consumer Protection Directorate	Belgium
Bianchi	Emanuela	Altroconsumo	Italy
Samouris	George	KEPKA-Consumers' Protection Center	Greece
Horváth	Gizella	OFE	Hungary
Frandsen	Henrik	(H) Danish Institute for Food and vet. Research	Denmark
Dalla Rosa	Marco	(H) Dept. of food science, University of Bologna	Italy
Skog	Kerstin	(H) Lund University, Division of Applied Nutrition and Food Chemistry	Sweden
Rowe	Gene	Institute of Food Research	United Kingdom
Busk	Leif	(H) National Food Administration	Sweden
Group 2	**Chair:**	**Rapporteurs:**	
Home-cooking	*Beate Kettlitz*	*Jonas Mojica-Lazaro and Pelle T. Olesen*	
Göbel	Angela	Federal Office of Consumer Protection and Food Safety	Germany
Matthews	Wendy	(H-ExP) Food Standards Agency UK	United Kingdom
Hubená	Jarmila	Consumers Defence Association of the Czech Republik	Czech Republic
Läänesaar	Linda	Estonian Consumers Union	Estonia
Veale	Ruth	BEUC - The European Consumers' Organisation	Belgium
Hellenäs	Karl-Erik	(H) National Food Administration	Sweden
Törnqvist	Margareta	(H) Stockholm University	Sweden
Albert	Torbjörn	(H) National Food Administration	Sweden
Grob	Koni	Official Food Control Authority of the Canton of Zurich	Switzerland
Group 3	**Chair:**	**Rapporteur:**	
Cultural differences	*Sigrid Lauryssen*	*Thomas Bjellås*	
Slorach	Stuart	National Food Administration	Sweden
Spök	Armin	IFZ-Inter-University Research Centre for Technology, Work and Culture	Austria
Tritscher	Angelica	World Health Organization	Switzerland
Glatt	Hansruedi	(H) German Institute of Human Nutrition	Germany
Sonderman	Carola	EFSA - European Food Safety Authority	Italy
Lallje	Sam	(H-ExP) Safety and Environmental Assurance Centre, Unilever (ILSI)	United Kingdom
Abrahamsson Zetterberg	Lilianne	(H) National Food Administration	Sweden
Group 4	**Chair:**	**Rapporteur:**	
Industry strategies	*Geoff Thompson*	*Jeroen Knol*	
Thornley	Dell	EMRA - European Modern Restaurant Association	Belgium
Petracco	Marino	Illycaffè	Italy
Hamlet	Colin G	RHM Group Ltd	United Kingdom
Dehne	Lutz	(H-ExP) BfR - Bundesinstitut für Risikobewertung	Germany
Gallani	Barbara	(H) BEUC - The European Consumers' Organisation	Belgium
Konings	Erik J.M.	Food and Consumer Product Safety Authority (VWA)	The Netherlands
Klaveren	Jacob van	(H) RIKILT Institute of Food Safety	The Netherlands
Sjöholm	Ingegerd	(H) Lund University, Division of Food Engineering	Sweden
Group 5	**Chair:**	**Rapporteurs:**	
Industry strategies	*Eleni Alevritou*	*Arwa Mustafa and Erik Pettersson*	
Stadler	Richard	Nestlé Product Technology Centre	Switzerland
Haraldsson	Roland	PPM AB	Sweden
Lineback	David	(H-ExP) JIFSAN, Univ. of Maryland	USA
Wenzl	Thomas	(H-ExP) Institute for Reference Materials and Measurements	Belgium
Becalski	Adam	Health Canada, Food Research Division	Canada
Lingnert	Hans	(H) SIK – The Swedish Institute for Food and Biotechnology	Sweden
Alexander	Jan	(H) Norwegian Institute of Public Health	Norway
Murkovic	Michael	(H) Technical University of Graz	Austria

The HEATOX Workshop · Working group

Prepared for the HEATOX Workshop by National Food Administration and BEUC

Home-cooking Guidelines

Questions to discuss

- Is there anything to add to the state of the art as described below and as presented during the introductory parts of the workshop?
- Is the scientific basis adequate for issuing guidelines to consumers on healthy home-cooking and consumption of cooked foods?
- Could HEATOX fill any gaps the last six months?
- Is the material available useful as advice to consumers?
- How should HEATOX structure the end deliverable *Guidelines to consumers on healthy home-cooking and consumption of cooked* (D59) in order to make it as useful as possible?
- What is the role of consumer organisations and industry in the dissemination of the HEATOX results?

Acrylamide in heated food – short general literature overview

Contents:

Toxicology

Hazard

Acrylamide is nerve toxic at high doses.

Furthermore, large studies in rat and mouse have shown that acrylamide increases the tumour frequency in different organs. Studies on cells show that it is damaging DNA, which indicates that there is no threshold effect, i.e. there is no dose of acrylamide so low that it does not increase the risk of cancer.
The WHO International Agency for Research on Cancer, IARC, classifies acrylamide as probably carcinogenic to humans (Class 2A). Other substances classified as probably carcinogenic to humans are Ultraviolet radiation A, B and C and the pesticide Chloramphenicol.

Risk

The risk for a human to get cancer is roughly 1 out of 3 during lifetime. The risk to get cancer by eating **50 microgram acrylamide/day** is estimated to be 1-10 in 1,000.
Acrylamide is common in many different foodstuffs e.g. pommes frites, coffee, bread, etc, and a cancerogen effect is not likely to be detected in any epidemiological study. Taken as a whole the cancer risk caused by acrylamide in food is probably higher than many other substances in food, e.g. benz(a)pyrene, aflatoxin and benzene.
To regulate a cancer-inducing substance without thresholds effects, authorities usually have applied a maximum level that gives an estimated risk of 1 cancer in 100,000 - or 1 in 1,000,000 - during lifetime exposure.

Risk evaluation

EFSA (The European food Safety Authority) suggests *Margin of Exposure* as a helping instrument for risk manager. Substances with a *Margin of Exposure* of 10,000 or higher, can be considered as of low concern from a public health point of view, and might be reasonably considered as a low priority for risk management actions.

The expert group evaluation of JECFA (Joint FAO/WHO Expert Committee on Food Additives) concluded in February 2005 that with an average intake of 1 microgram acrylamide/kg bodyweight and day the *Margin of Exposure* is 300. The group considered this margin to be low for a substance that is DNA-harming and carcinogenic.
At the same meeting the Margin of Exposure for PAH was estimated to 25,000.

Occurrence in food

- Acrylamide is a chemical that is found in large amounts in foods rich in starch cooked at high temperatures; i.e. fried, baked, deep fried. High in potato, some crisp bread and biscuit; Medium in breakfast cereals; Low in meat and white bread. It is also found in other food at lower amounts, e.g. tinned (canned) including food for children.
- Only traces are found in boiled food.
- Acrylamide is formed during the Maillard reaction, which is a browning reaction between sugar and amino acids that gives appealing odours and tastes to foods like bread and French fries. Acrylamide is formed mainly by the reaction between sugar and the amino acid asparagine, the asparagine that is free and not bound in proteins.

Intake

The major contributing foods to the mean total exposure for most countries were:

- Potato chips (US=French fries), 16-30 %
- potato crisps (US=chips), 6-46 %
- coffee, 13-30 %
- pastry and sweet biscuits (US=Cookies), 10-20 %
- bread and rolls/toasts, 10-30 %

Others foods items contributed less than 10 % of the total exposure according to JECFA evaluation.
Canned food and porridges make a significant intake for small children.
Bread and coffee have low acrylamide content, but the intake is big as these foods are eaten a lot. (see “General links” below, FDA: Exploratory data)

Total daily intake

Some studies:
Belgium: The estimated dietary intake of acrylamide per person given as the
5th percentile: 0.19 microgram/*kg bodyweight* and day
50th percentile: 0.51 microgram/*kg bodyweight* and day
95th percentile: 1.09 microgram/*kg bodyweight* and day
Germany: 0.3 to 0.8 microgram/*kg bodyweight* and day. Higher for children.
Netherlands: The mean acrylamide exposure of the NFCS participants was 0.48 microgram/*kg bodyweight* and day.
Sweden: The estimated dietary intake of acrylamide per person (total population)
5th percentile: 9.1 microgram/day
50th percentile: 27 microgram/day
95th percentile: 62 microgram/day
(mean 31 microgram/day).

An average daily intake of 35 microgram corresponds to 0.5 microgram per kg body weight and day (bodyweight 70 kg).

Ways to reduce occurrence

Formation factors

Thermal input (cooking time and temperature)
Amount of precursors (presence of asparagine + sugars in raw foods)
Water content
pH (acidity)
Other substances interfering with formation or promoting degradation of acrylamide

Ways to reduce

Raw materials:
- Selection and development of varieties,
- optimised cultivation and storage conditions, etc.

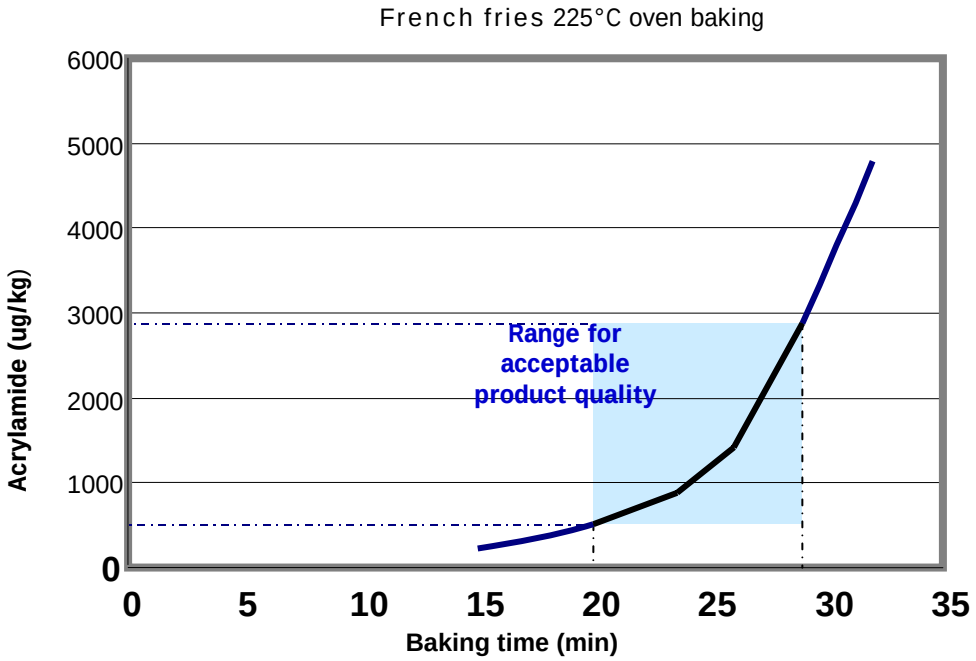
Recipe and additives:

- Amino acids, (added glycine to dough competes with asparagine in reaction with sugar, but gives darker product and might influence taste)
- pH-lowering compounds, etc. (soaking in citric acid solutions reduces acrylamide, but might influence taste)

Pre-treatment and process conditions:
- Washing, soaking or blanching,
- Fermentation or enzyme treatment, (removing asparagine with asparginase)
- Pre/post-drying, (dryness prolongs shelf life. In potato crisps post-drying can reduce frying time, while still maintaining shelf-life)
- thermal input and profile, etc. (Lower temperature and longer time might reduce acrylamide formation)

Consumers: Ways to reduce acrylamide in home cooking

Listed examples of advice from different countries. Links to advice on page below.



Potato products (these examples are taken from web pages listed below)

Temperature and colour

1 For homemade fries, pay careful attention to the oil temperature. Remember, acrylamide is related to high temperature cooking. Health Canada
2 Deep fry French fries to a golden colour at temperatures not exceeding 170-175°C. Do not cook any longer than necessary, and avoid dark-coloured French fries. Health Canada

3 Scharfes Anbraten von Kartoffel- und Getreideprodukten und eine zu starke Bräunung vermeiden.
4 Möglichst mit Margarine braten, um eine Überhitzung zu vermeiden.
5 Bratkartoffeln besser aus gekochten Kartoffeln zubereiten. Rohe Kartoffeln etwa eine Stunde wässern.
6 Die Temperatur beim Backen mit Umluft sollte 180 Grad Celsius, beim Backen ohne Umluft 200 Grad Celsius nicht überschreiten.
7 Backpapier verwenden
8 Pommes, Blechkartoffeln, Plätzchen und Pizza nicht zu stark bräunen.
In der Fritteuse sollten 175 Grad Celsius nicht überschritten werden. Pommes in kleinen Portionen so lange frittieren, bis die Pommes goldbraun und nicht verbrannt sind.
Dicke Pommes bevorzugen und gleichmäßig auf dem Backblech verteilen. was-wir-essen.de

9 Bak aardappelen en aardappelproducten niet bruin, maar goudgeel.
10 Volg de aanwijzingen op de verpakking van aardappelproducten en frites en bak ze niet langer dan nodig is. Frituurvet is goed op temperatuur bij 175-180 Â°C.
11 Frites geschikt voor de oven bevatten meer suikers. Als deze worden gefrituurd, wordt het acrylamidegehalte onnodig hoog. Bak deze fritessoorten daarom alleen in de oven en niet langer dan de aanwijzingen op de verpakking.
12 Gaar aardappelen voor het bakken niet in de magnetron. Voedingscentrum, Netherlands

13 Ved tilberedning av mat hjemme bør forbrukere unngå hardsteking av maten og forøvrig følge stekeanvisningen på pakningene nøye. Matttilsynet, Norway

14 Bei zu starker Erhitzung von Lebensmitteln können eine Reihe von gesundheitlich bedenklichen Stoffen wie Acrylamid entstehen und wertvolle Inhaltsstoffe zerstört werden. Um dies zu vermeiden, sollten Lebensmittel nicht zu lange und nicht bei zu hoher Temperatur zubereitet werden: vergolden statt verkohlen.
15 Der Frittierprozess ist sorgfältig zu beobachten und muss rechtzeitig beendet werden. BAG, Schweiz

16
A. Öl bei ca. 170 °C halten. In heisserem Öl bilden sich schnell überfrittierte Stellen mit sehr hohen Acrylamidgehalten. Wichtig: Die Temperaturangabe der Fritteuse regelmässig mit einem Thermometer prüfen!
B. Portionen von etwa 50–100 g Kartoffeln pro Liter Öl in der Fritteuse: Die Öltemperatur soll etwas sinken, aber ca. 145 °C nicht unterschreiten. Grössere Mengen in Portionen frittieren, wobei das Öl zwischen jeder Portion wieder aufgeheizt werden muss.
C. Acrylamid bildet sich erst am Ende des Frittierprozesses, wobei ab einem bestimmten Moment die Gehalte sehr schnell ansteigen (abhängig von der Menge Frittiergut). Die Pommes frites dürfen nicht überfrittiert werden: Sorgfältig beobachten! Gute Pommes frites mit wenig Acrylamid sind goldgelb und haben leicht gebräunte Spitzen (Aroma). Die allgemeine Bräunung hat noch nicht eingesetzt. Kantonalen Labors Zürich

Storage temperature
17 Do not store potatoes below 8ºC. Low temperature storage can increase the components that contribute to acrylamide formation. Health Canada
18 Bewaar aardappelen niet in de koelkast of in een koude kelder. Om te voorkomen dat aardappelen uitlopen, is het af te raden grote voorraden te bewaren. Voedingscentrum
19 Ungekochte Kartoffeln gehören nicht in den Kühlschrank! Kartoffeln sollen vor Licht geschützt und nicht unter 10°C aufbewahrt werden. BAG, Schweiz

20 Lagerung: Kartoffeln dürfen nicht unter ca. 8 °C gelagert worden sein (Problem der Keimhemmung bei Langzeitlagerung). Ungekochte Kartoffeln nicht im Kühlraum oder Kühlschrank lagern. Auch geschälte und geschnittene Kartoffeln nicht länger als ca. 24 Stunden kalt lagern. Kantonalen Labors Zürich

Preparation
21 Wash or soak fresh cut potatoes in water for several minutes before frying. This can reduce the components that contribute to acrylamide formation. Health Canada

22 Schnitt: Keinen allzu feinen Schnitt wählen (mindestens 7 mm). Kleine und unregelmässige Kartoffelstücke aussortieren (diese bräunen zu schnell).
23 Wässern: Die geschnittenen Kartoffeln mit kaltem oder boilerheissem Wasser überdecken und mindestens ca. 15 min. stehen lassen.
24 Blanchieren: 2–3 Minuten bei 140 °C vorfrittieren verbessert die Knusprigkeit. Kantonalen Labors Zürich

25 Rösti preparation:
A. Gekochte Kartoffeln vor der Verarbeitung mindestens mehrere Stunden im Kühlschrank lagern, damit sie fester werden und die Rösti eine bessere Struktur erhält. Für die gekochten Kartoffeln ist kalte Lagerung kein Problem denn Kochen inaktiviert die Enzyme, welche Zucker frei setzen.
B. Die geraffelten Kartoffeln salzen und würzen, bevor sie in die Bratpfanne gegeben werden. Sie sollen in der Pfanne nicht mehr gemischt werden, weil sonst das für den Bratprozess wichtige Fett in den Kartoffelkuchen verloren geht.
C. Mit genügend Fett oder Öl (20-30 g/Portion) braten: Das Fett verteilt die Hitze und verhindert damit die Bildung schwarzer Stellen; die Bräunung wird gleichmässiger.
D. Mässige Erhitzung vermindert die Acrylamidbildung. Anfangs darf die Temperatur ziemlich hoch sein (Acrylamid entsteht erst nach der ersten Krustenbildung), z.B. Stufe 8 auf einer Skala von 10, sollte aber nach etwa 3 min auf 6 reduziert werden. Nach 10-12 min wird der Kartoffelkuchen gekehrt (notfalls mit Hilfe eines Tellers) und nochmals 8-10 min auf der anderen Seite gebraten.

E. Nach dem Kehren bewirkt die Zugabe von etwas Fett (ca. 10 g) vom Pfannenrand her eine schönere Randbildung.
F. Starke Bräunung verhindern!
G. Die Zubereitung aus gekochten Kartoffeln ergibt meistens weniger Acrylamid als jene aus rohen Knollen, aber die Unterschiede sind moderat. Kantonalen Labors Zürich

Other
26 Kartoffelsorte: Kartoffeln mit gelbem Fleisch, hohem Stärkegehalt, aber wenig Fructose und Glucose auswählen (z.B. Agria, Granola, Eba). Kantonalen Labors Zürich

Cereal products

Toasting bread

27 Toast to the lightest colour acceptable. Health Canada
28 Toast nur leicht anrösten. was-wir-essen.de

Baked goods

29 The crust of toast or bread will have higher levels of acrylamide than the remainder, even though these levels are lower than those in french fries and potato chips. Where appropriate, you may wish to remove crusts. Health Canada
30 Brot, Pizza und Kuchen nicht zu stark bräunen. was-wir-essen.de

Other food products

Coffee

Consumers: Ways to reduce acrylamide in consumption

Listed examples of advice from different countries. Links to advice on page below.

31 Alternativen zu belasteten Lebensmitteln: Pfannkuchen, Bratlinge und Gratins, Kartoffeln dünsten oder kochen, zum Knabbern eignen sich ungeröstete Nüsse, Studentenfutter und Obststücke was-wir-essen.de
32 Wer sein persönliches Risiko reduzieren möchte, sollte seine Acrylamid-Aufnahme so weit wie möglich senken, d. h. Lebensmittel mit einem hohen Gehalt an Acrylamid, wie Kartoffelchips, Pommes, Kartoffelpuffer sowie Kaffee, löslicher Kaffee und Getreidekaffee nur noch in geringen Mengen aufnehmen. was-wir-essen.de

33 eet gevarieerd en niet te veel chips, zoutjes en patat. Voedingscentrum, Netherlands

34 Mattilsynet opprettholder rådet om å spise variert og balansert, samt redusere inntak av stekt og fritert mat. Mattilsynet anbefaler fortsatt storspisere av chips og pommes frites å redusere inntaket. Det samme gjelder stordrikkere av kaffe. Norway

35 Eine ausgewogene Ernährung mit reduziertem Fettanteil und reich an Früchten und Gemüse bietet zusammen mit sportlicher Betätigung die besten Voraussetzungen für eine gute Gesundheit. BAG Schweiz.

36 You do not need to change your diet or the way in which you cook your food – but you should continue to eat a healthy, balanced diet.// The Agency is not advising people to stop eating any particular foods. However, the Agency advises that as part of a balanced diet you should limit the amount of fried and fatty foods you eat, including chips and crisps. FSA, UK.

37 Until more is known, FDA continues to recommend that consumers eat a balanced diet, choosing a variety of foods that are low in trans fat and saturated fat, and rich in high-fiber grains, fruits, and vegetables. FDA, USA.

Risk management options

Some examples

- **Ban:**
  chloramphenicol, a cancerogenic pesticide like (IARC Group 2A)

- **Maximum limit:**
  aflatoxin, a cancerogenic toxin from mold,
  3-MPCD, a process contaminant occurring in soya sauce,
  dioxins, an industrial contaminant slow in degradation (persistent).

- **labelling**
  for example
  - Warning labels - smoking or alcohol.
  - **Threshold labelling** required above certain levels - caffeine in soft drinks.

- **Voluntary actions by industry**
  - for example: benzene in soft drinks. See FSA, UK:
  http://www.food.gov.uk/news/newsarchive/2006/mar/benzene
- - minimizing acrylamide strategy in Germany

- **Consumption and cooking advices by national authorities**
  - Consumption advice to pregnant women on mercury in fish
  - Cooking advice on PAH: "Don't grill or toast too much"
  - Cooking instructions on home appliance or food package

EU has already two maximum limit levels for acrylamide concerning food:

1. Limit of migration into or on to food from materials in contact with food: Not Detected at Detection Limit: 10 micrograms/kg)
2. Drinking water: Maximum limit 0,1 microgram/litre.

California proposed a different approach to tackling carcinogenic substances in food under the so-called Proposition 65:
Warning labels on certain food containing acrylamide, and a maximum level of 200 microgram acrylamide/kg on bread and cereals.
(This proposal is withdrawn from 8 April. A new proposal will be published within 60 days. See link below.)

National monitoring programmes to date

Germany: Minimierungskonzept/minimisation strategy by the authorities and industry.
http://www.bvl.bund.de/cln_027/nn_493378/DE/01__Lebensmittel/03__UnerwStoffeUndOrganismen/04__Acrylamid/00__Minimierungskonzept/minimierungskonzept__node.html__nnn=true
(to translate that web page into English, you can use this web page:
http://babelfish.altavista.com/babelfish/tr)

Sweden: Certain food groups will be monitored by the Food Administration 2006-2009, to see if acrylamide levels are decreasing.

Links to advices on acrylamide
(examples)

Canada, Health Canada: march 2005
english: Acrylamide - What you can do to reduce exposure
http://www.hc-sc.gc.ca/ahc-asc/media/nr-cp/2005/2005_stmt-dec_acrylamide2_e.html
francais: Acrylamide - Comment réduire l'exposition
http://www.hc-sc.gc.ca/ahc-asc/media/nr-cp/2005/2005_stmt-dec_acrylamide2_f.html

Germany, Was-wir-essen.de:
Acrylamid tipps
http://www.was-wir-essen.de/sonstiges/schadstoffe_a.php
Foren Acrylamid: Fragen och expertantworten
http://www.was-wir-essen.de/fusetalk/categories.cfm?catid=9

Netherlands, Voedingscentrum: Acrylamide, Algemene adviezen
http://www.voedingscentrum.nl/voedingscentrum/Public/Dynamisch/voedselveiligheid/%28milieu%29verontreiniging/acrylamide/algemene+adviezen.htm

Norge, Matportalen: Spørsmål og svar om akrylamid
http://matportalen.no/Matportalen/Saker/1052216588.16

Switzerland:
deutch: Bundesamt für Gesundheit: Empfehlungen für die Konsumentinnen und Konsumenten
http://www.bag.admin.ch/themen/ernaehrung/00171/00460/01839/index.html?lang=de
francais: Office fédéral de la santé public: Recommandations destinées aux consommateurs
http://www.bag.admin.ch/themen/ernaehrung/00171/00460/01839/index.html?lang=fr
Kantonales Labor Zürich:
- Hintergründe und Tipps für eine gute und acrylamidarme Rösti
- Tipps zur Zubereitung von acrylamidarmen Pommes frites
- STOP.Acrylamid - Acrylamid in Pommes frites
http://www.klzh.ch/infomaterial/index.cfm

United Kingdom: FSA consuming advice
http://www.eatwell.gov.uk/healthissues/factsbehindissues/acrylamide/

USA, FDA: Acrylamide Questions and Answers
http://www.cfsan.fda.gov/~dms/acryfaq.html

CIAA Acrylamide Toolbox 23 Sep 2005 Rev 6
http://www.ciaa.be/documents/positions/The%20CIAA%20Acrylamide%20Toolbox.pdf

General links on acrylamide

www.heatox.org

IARC, UN International Agency for Research on Cancer:
Monographs and Classification Groups,
Group2A - Probably Cancerogenic to humans

JECFA's (Joint FAO/WHO Expert Committee on Food Additives) website on acrylamide
http://www.fao.org/ag/agn/jecfa/acrylamide_en.stm

EFSA on Margin of Exposure: Proposed harmonisation of risk assessment methodology
http://www.efsa.eu.int/press_room/press_release/1204_en.html

Swedish National Food Administration
Acrylamide in food
http://www.slv.se/templates/SLV_DocumentList.aspx?id=4089

The European Commission DG Sanco website on Acrylamide in food
http://ec.europa.eu/comm/food/food/chemicalsafety/contaminants/acrylamide_en.htm

Acrylamide Information Base of Research Activities in the EU, compiled by the European Commission
http://ec.europa.eu/comm/food/food/chemicalsafety/contaminants/acryl_database_en.htm

IRMM/JRC: Acrylamide monitoring database with Evaluated data (Excel 980kB) from 5200 products analysed June 2005.
http://www.slv.se/templatesHeatox/Heatox_Page.aspx?id=8436

Acrylamide Infonet, The FAO/WHO Acrylamide in Food Network - operated by JIFSAN
http://acrylamide-food.org/index.htm

CFSAN, FDA, USA
http://www.cfsan.fda.gov/
Exploratory data
http://www.cfsan.fda.gov/~dms/acrydat2.html

California, OEHHA: Acrylamide and Proposition 65
http://www.oehha.org/prop65/acrylamide.html

The HEATOX Workshop · Basic background

Prepared for the HEATOX Workshop by National Food Administration and BEUC

Some answers to the questions raised at the BEUC Working Group on Home-Cooking held in Brussels in November 2005

What do consumers need to know about acrylamide and how can they minimise its formation in the kitchen? The following points were raised/discussed:

1. Importance of time and temperature in home-cooking. Checking temperature is not practical in the kitchen - could colour indications be used instead? What is the best advice on the level of browning (when to remove from the heat)?

   Acrylamide is formed in the latter part of the cooking. Often, but not always, there is a good correlation between colour and acrylamide level. Advice based on colour can be produced for French fries and toasted bread, for example.

2. There is a need for clear advice on potatoes: storage, difference between using fresh or frozen potatoes, differences between qualities and varieties of potatoes.

   - To reduce potential acrylamide formation during cooking, potatoes should be stored above 8 degrees Celsius. This shortens the shelf life of potatoes.
   - Keeping cold-stored potatoes at room temperature at home for a week before use reduces the sugar to some extent and consequently the formation of acrylamide during cooking. This process is called reconditioning.
   - Sugar levels vary between varieties, as does the effect of storage on the sugar levels.
   - **The influence of storage is quite different between varieties. There are usually a lot of varieties within a country, and almost every country has its own varieties.**

3. In general, when cooking, is it better to cook from fresh or frozen? Bake or fry? Prepare thick or thin chips? Blanching?

   It is difficult to provide straight answers to these questions since there are a lot of variables involved.
   - Fresh or frozen has no significance.
   - Baked or fried has no direct significance, more so if it is hard or soft heat-treated.
   - Thin or small pieces give more acrylamide than thick or big pieces, since the surface area is larger in relation to volume.
   - Blanching or soaking removes asparagine and sugar from the surface and gives lower levels to a varying degree, but method and food product matter.

4. Is a two-stage cooking (low heat to cook with subsequent browning on higher heat) recommended?

   - **According to CIAAs Toolbox 5.2.2 it has little effect.**
   - Varying the temperature during cooking might be a way to reduce, but there is no general rule. With potato crisps industry has reduced acrylamide levels by applying high heat in the beginning and lower heat in the end, where most of the acrylamide is formed.

5. Bread dough: If yeast-leavened bread is let to stand for a longer period does this have an influence on the level or acrylamide?

   Prolonged fermentation of the dough lessens the free asparagine content and thereby the acrylamide content in the final bread.

6. What are the levels of acrylamide in vegetables other than potatoes?

   In principle acrylamide is formed in all foods that are fried or baked depending on how much asparagine and sugar are present. Few, if any, vegetables have so high levels and/or are consumed in such amount, that it has any significance for the total intake.
   Look at the list from FDA.

7. Does deep or shallow frying make any difference?

   - **You will probably not get the same product.**
   - Acrylamide formation depends on the heat transfer, if it is hard fried or soft fried, not directly on the frying method as such.

8. Does the quality of the oil make a difference?

   It is of little significance.

9. Is there an issue with fried rice and frying boiled potatoes?

   - Acrylamide is also formed when frying boiled potatoes.
   - **Fried rice not a big issue. Acrylamide is formed when rice is fried, but to a less extent than in potatoes. Rice has less asparagine and less sugar.**

10. Is there a difference between brown or white rice?

    Possibly. Usually cereals have most of the asparagine in the bran layer. More research is needed, but probably not justified due to low dietary intake.

11. What are the main issues with crispy breads?

- **Fermented crisp breads have significantly less acrylamide the non-fermented.**
- Consumption of crisp breads is still considered as health promoting.

Group 1 – Home-cooking Guidelines

Questions for discussion

1. What is the role of consumer organizations and industry in the dissemination of the HEATOX results? Clarification- Industry refers to primary producers and food manufacturers

Food Industry

A. Food industry may have a role educating the consumer---information on food label.

B. The label should give cooking instructions so that acrylamide levels are reduced.

C. Guidelines for French fry products- manufacturer of French fries may include instructions on label how to cook French fries in a manner as to decrease acrylamide formation. For example, cook (bake or fry) to a golden color rather than brown color.

D. Raw potato producers- package of potatoes may suggest which recipes or cooking methods for a particular potato variety or cultivar- e.g. potatoes with high reducing sugar levels should be cooked at lower temperatures (e.g. boiled potatoes).

E. Label should indicate level of color of cooked food (via a picture or with words) rather than temperatures/times since level of surface browning correlates highly with acrylamide levels in some products.

F. Picture on front of food package may be used to show food cooked in a manner as to decrease acrylamide levels- e.g. French fries pictured on the front of a package should show golden French fries rather than a brown fries.

G. A question was raised about whether the food industry is willing to put cooking instructions on the label.

H. Food industry may want to include cooking instructions on label if they are worded properly, i.e. produce a more healthy product rather than reduce the level of acrylamide (or carcinogen).

I. May be useful indicate on label a link to consumer organization website that gives advice on ways to reduce acrylamide formation during cooking. In this way, industry and consumers can work together on this message.

J. Cooking guidelines, as presented on the food package, should also be given on food service products (e.g. for restaurants/food service operations/catering operations).

Consumer organizations

A. Information from HEATOX project should be distilled down to guidelines (written by scientists). These guidelines should be disseminated by the consumer group(s).

B. Information from consumer groups should be disseminated to:

a. consumers
b. restaurants/catering
c. supermarkets
d. schools, including home economics programs in public schools and cooking schools

2. How should HEATOX structure the end deliverable "Guidelines to consumers on healthy home-cooking and consumption of cooked foods (D59) in order to make it as useful as possible?

A. Make sure the guidelines are concise and clearly written (1-2 pages, maximum) with pictures
B. Guidelines should be divided by commodity (e.g. potato products, bread products, etc.)
C. There should be more detailed information in a longer document if the consumer has a desire to find out more about acrylamide and how to reduce levels in the diet. This could consist of a link to a website that has the more in depth document.
D. There should be an introductory statement in the guidelines that consumers should eat a varied diet with an abundance of fruits and vegetables (basic dietary guidelines) followed by more detailed/specific information on how to reduce acrylamide intake.
E. There may be a need to develop guidelines that are country/culture specific.

3. Is the material available useful as advice to consumers?
A. Information as presented in the HEATOX Workshop folder is useful and sound, but needs to be summarized and condensed.
B. The information needs to be put into a more consistent format.
C. Pictures should be included, but there may be problems with consistency when printing using different printers, etc.
D. There is a need to show, via pictures or diagrams, which foods contain acrylamide how much each of these foods contribute to total daily intake of acrylamide.
E. At this point of time, scientists can not comment on what constitutes a safe level of intake of acrylamide.

4. Could HEATOX fill any gaps in the last six months?
A. A major knowledge gap is how consumers prepare their food and how much of acrylamide intake is due to home-prepared foods.
B. A survey is needed on home prepared foods:
    a. How do consumers prepare their foods at home?
    b. How often do you prepare each of the foods that contribute to acrylamide intake?
C. More information is also needed on the amount of variation in acylamide levels in home-prepared foods.
D. It is not likely that these research gaps can be filled in the last months of the HEATOX project.

5. Is the scientific basis adequate for issuing guidelines to consumers on healthy home-cooking and consumption of cooked foods?
A. Information in HEATOX folder has all information known to-date about acrylamide formation in food and could be condensed and summarized as guidelines for consumers.
B. Some unclear information, e.g. about size and shape of French fries and how these factors affect acrylamide formation needs to be clarified.
C. Is there a need to reduce acrylamide levels in all food products?
D. Unclear if there be guidelines for consumption of acrylamide-containing foods since some high-fiber foods also contain acrylamide.

E. It may be premature to make special dietary recommendations to children concerning acrylamide.

6. Is there anything to add to the state of the art as described below and as presented during the introductory part of the workshop?

A. More information is needed about home food preparation

a. Which foods (containing acrylamide) are prepared at home and how often.

b. Cooking methods used to prepare foods at home (e.g. fried, baked, cooked to high degree of surface browning, etc.)

B. More information may be needed on acrylamide bioavailability---e.g. coffee vs. coffee w/ milk

Slides:

Consumer organization and industry role in dissemination HEATOX' results

- Basic labelling info, with colour picture
- Framed positively
- Involvement of consumer with information on labels

- Information to:
  - Restaurants (preparation)
  - Supermarkets (storage/ preparation)

- HEATOX document → consumer organisation → consumer

How should HEATOX structure of end deliverable *'guidelines to consumers on healthy home cooking and consumption of cooked foods'*

- short 1 page with pictures
- With link to detailed document (5pages)
  - Country / culture specific
- Include:
  - Basic dietary guidelines
  - Product specific

Is the available material useful as advice to consumers?

- Condens, summarize, it looks sound information

Gaps

- Home cooking survey on cooking practice

Group 2 – Home-cooking

Practices that can influence AA formation

- Storage of potatoes (home)
- Preconditioning at room temperature (home)
- Boiling before roasting and panfrying(both)
- Blanching – soaking (industry)
- Adding citric acid, vinegar, rosemary (both)
- Reheating (home)
- Type of cooking oil (home)
- Reuse of cooking oil (home)
- Type of equipment (home)

What to look at?

- Storage conditions (potatoes)
- Cooking
    - Colour
    - Temperatur
    - Time
    - Organoleptic properties; Crispness etc.

Recommendations of the working group on home-cooking guidelines

- Encourage authorities and academia to focus research out relative exposure from home cooking, eating out and processed food
- Identify all research activities in the home cooking area
- Co-operation with catering sector?
- Carry-over learning from the Toolbox

- Risk/benefit in the home cooking area to be considered
- Toolbox for authorities, consider national specificities, therefore as a deliverable:
- National advice
- Raw material: Potatoes, cereals

- Look at potatoes first, because they are more home-cooked, (sugar variety)
- Cereals also (asparagine)

The HEATOX Workshop · Working Group

Prepared for the HEATOX Workshop by the National Veterinary Institute and BEUC

Working group on Cultural differences

Eating habits and patterns vary throughout Europe. So does the way to prepare food. This will influence the dietary intake impact of heat-generated food toxicants in the diet.

- What knowledge has been gathered on a European level which could be relevant to issue?
- How do cultural differences influence the communication processes related to heat-generated food toxicants?
- Should HEATOX take cultural differences into account when structuring the guidelines and strategies and if yes, how could this be done?
- How should HEATOX structure the end deliverables in question (Guidelines to consumers on healthy home cooking and consumption of cooked foods (D59) or Manual on strategies to industry and restaurants etc. to minimise acrylamide formation (D60) in order to make them as useful as possible?

Group 3: General conclusions - cultural differences

What knowledge has been gathered on a European level which could be relevant to the issue?
The exposure levels in countries are very similar, and not all food types has been included into the exposure assessments (ex. coffee). Also, some particular national food stuffs has not been included

More insight into consumer habits and to the exposure levels concerning the different particular national food items are needed in order to conclude something on the cultural difference.

Each country must add levels of more particular food stuffs

How do cultural differences influence the communication processes related to heat generated toxicants
There exists different communication processes. It is important to know whom the consumer trust. These communication channels could be: Authorities, newspaper, flyers, consumer organization etc to name a few channels. They all have variable trust from the consumers dependent on the country. There might be large cultural differences in the context of communication. What would be the effective means of communication?

Information should be tailored according to different authorities

Should HEATOX take cultural differences into account in the in guidelines and strategies. If yes, what and how.
What the most important foodstuffs to focus on is cultural dependent. (Coffe in Norway, bisquits in germany, fries in England etc). It could be important to identify what food items which contributes the most to the dietary exposure in the respective country. There is a need of more data on particular food items (see question 1)

How to structure the end deliverables to make them as usefull as possible.
For public - Make HEATOX information public available.
Strategies for industry – we could complement the AA toolbox
Restaurants - make information available, but the National authorities have the responsibility in this area to give guidelines to the restaurant.

Flip chart:

1. More insight into food culture
2. Means of com.
3. Cultural Dependent Food
4. Different strategies to different groups

The HEATOX Workshop · Working Group

Prepared for the HEATOX Workshop by The Swedish Institute for Food and Biotechnology and National Food Administration

Industry Strategies

State of the art

It is today agreed that the dominating formation mechanism for acrylamide in food is the reaction of free asparagine with reducing sugars. This reaction is part of the Maillard reaction system (amino acid – sugar reactions), which is of vital importance to quality development (colour, flavour, etc.) during heat processing of many food products. A major challenge for food industry is, therefore, to be able to reduce the acrylamide levels without unacceptably influence other quality aspects.

Research performed and reported on more detailed reaction mechanisms and reaction kinetics forms a basis for applied research and practical experiments on mitigation options. A large amount of such studies have been performed by academia as well as by food industry and there are several examples on resulting successful reduction strategies within industry. The successful solutions are highly product specific, but may be categorized into some common basic principles:

- *Influence on the content of reactants* (asparagine and sugars). This may be done by choice or control of raw materials, pre-treatment (washing etc.), fermentation, enzymatic reactions.
- *Influence of the reaction pathways or the extent of reaction*. This may be done by controlling processing conditions (temperature, time, moisture, pH) or by influencing the "reaction mixture" through recipe or ingredients.
- *Influence on the further fate of acrylamide formed*. This is, so far, a minor option, but it is known that the acrylamide levels may be reduced by increased thermal input (*e.g.* roasting of coffee). It has also been discussed whether acrylamide may react with other food components.

There are several reports on mitigation studies in the scientific literature and there is a broad range of experience built up within industry. It is generally agreed that there is no single, general solution to reduce the acrylamide levels. The possibilities may even differ within the same food category. The total quality and risk/benefit aspects must always be taken into account and the optimal solution has to be found for each food product.

From this understanding CIAA has developed a "Toolbox" to assist food companies in their efforts to reduce the acrylamide levels in their specific products and processes. The Toolbox gives brief descriptions of mitigation options that have been proposed (by the research community as well as by industry) and in many cases also implemented by food manufacturers. The idea is that this will allow individual food companies to assess and evaluate which interventions steps identified so far may be relevant in their specific cases. The intention from CIAA is that the Toolbox shall be a "living document" with a catalogue of tested concepts that will be updated as new findings are communicated.

Questions to discuss

- Is there anything to add to the state of the art as described above and as presented during the introductory parts of the workshop?
- Is the scientific basis adequate for minimisation strategies within industries, restaurants, etc.?
- Could HEATOX fill any gaps the last six months?
- Is the material available useful as advice to food companies, restaurants, etc.?
- How should HEATOX structure the end deliverable *Manual on strategies to industry and restaurants etc. to minimise acrylamide formation (D60)* in order to make it as useful as possible?

Group 4 – Industry strategies

1. Anything to add to the state of the art?

- More precise dietary exposure – home cooking vs restaurants vs processed foods.Heatox?Needs doing, but not possible in 6 months.
- Need to model mitigation studies from a risk/benefit perspective.Model possible impact on exposure vs 'other' effects (nutritional,antioxidants...).Could enable goals to be set.

2. Is scientific basis adequate for minimisation strategies?

- CIAA Toolbox is a very good approach.Need to have two types of monitoring.
  - Monitoring of acrylamide levels by authorities
  - Monitoring of application of Toolbox of and by industry.
- CIAA Toolbox needs to be translated into different languages and put into a '**qualitative**' HACCP format, although critical limits cannot be set, rather guidance as to which elements might be critical/worth trying for each product catagory.
- Needs to be made available to SMEs

3. Last six months of Heatox?

- Should bring closely together Heatox scientists,Industry scientists and Govt. Scientists so as to ensure that all available knowledge can be included in the CIAA Toolbox.Simply making information available on the web is not enough, needs proactive approach from Heatox.
- Avoid duplication

Group 5 – Industry strategies

1. Structure of D60?

- Background to the problem
- Understandable language
- General guidelines & framework
- "Living" document
- Estimation of reduction

2. Is the available material useful?

- More user-friendly
- Adaptable for different needs and different products

3. Could HEATOX fill any gaps?

- No scientific
- Compile the available data
- Taylor the information for the end user

4. Is the scientific basis adequate?

- Scale-up problems
- AA↓ Other compounds? By altering the process to decrease AA, other toxic compounds might on the contrary increase
- Addition of Asparaginase and other measures to decrease acrylamide formation
- Consider approach versus economical feasibility

5. Anything to add?

- Not much to add

Group 5, additional questions:

1. Can industry provide some examples of best practice and corresponding results?

   To be answered

2. Are similar strategies adopted by industry address the EU or do they vary from country to country?

   Answer: Concerted strategy

3. How the CIAA Toolbox reach every food company in every member state.

   Answer: CIAA works with national authorities and professional food associations translating it into national languages etc.

4. How acrylamide as a known hazard could be incorporated in the HACCP system?

   Answer: Difficult, there is no need indeed as CIAA Toolbox is used. But we cannot rely on the colour of the food as golden colour foods found to have high AA levels (comment from the Deep Fryers Industry)

5. Have Deep Fryers Industry made changes to their equipment in order to minimise AA?

Answer: Yes, but users need to be trained.

6. Any legislative measures taken?

Answer: In the US idea was rejected → no adequate scientific basis
In Europe, Switzerland has adopted an “Act” (not compulsory) according to which AA above a limit should be labelled.

7. What is the extent of use of the CIAA Toolbox and what effect is this having on AA levels?

To be answered

8. Any feedback from CIAA Toolbox use?

Answer: Yes, constantly, they will be elaborated and put to CIAA website.

Margareta Törnqvist, Stockholm University:

The Acrylamide Story

Margareta Törnqvist
Dept. of Environmental Chemistry
Stockholm University

Dept. of Environmental Chemistry

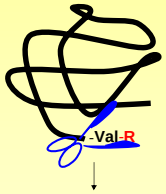
How the construction of a railway tunnel through the Hallandsås ridge led to the discovery of acrylamide in food

Research line: Risk estimation of chemical carcinogens

- ✓ Most known carcinogenic chemicals which are genotoxic are electrophiles (RX).
- ✓ Approach based on experience from radiobiology and radiological protection philosophy.
- ✓ Measurement of internal dose of the genotoxic agent as a basis for risk estimation procedures.

How measure short-lived electrophiles (**RX**) in vivo? As stable adducts to Hb in blood

Hemoglobin + **RX**



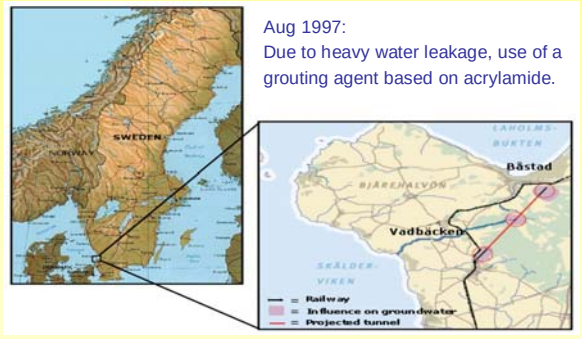
Val-**R** **(adduct)**

Analysis (GC-MS/MS)

- **RX** reacts with nucleophilic sites in hemoglobin (Hb) and form **adducts.**
- **Adducts** accumulate over the life span of the of red blood cells.
- **Adducts** to N-terminal valine could be specifically detached, isolated, and analysed by mass spectrometry.
- **Adduct level:** a measure of average dose of **RX** in blood during preceding months.

Törnqvist et al., Anal. Biochem. 154 (1986) 255
Törnqvist et al., J. Chrom. B, 778 (2002) 279

Railway tunnel construction at Hallandsås



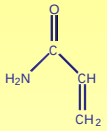
Aug 1997:
Due to heavy water leakage, use of a grouting agent based on acrylamide.

Hallandsås: An uncontrolled exposure situation

- Ca. 1500 tons grouting agent were used during Aug – Sept 1997.
- End of Sept: Acute situation with fish death and paralysis of cows.
- Leakage of acrylamides: Into rivulets, ground water, wells etc.
- State of emergency. Establishment of risk zones, destruction of milk and milk products, cattle taken away.
- Heavy media coverage and actions by residents in the area.
- Buyers' resistance to food products (e.g. potato) from this area.

Hallandsås: How clarify leakage of/exposure to the grouting agent?

Acrylamide



- Chemically reactive and toxic compound.
- Potential exposure of tunnel workers and residents, and of animals.
- Exposure through inhalation, skin and ingestion (food and drinking water).
- Free acrylamide undergoes reactions in the body and are excreted relatively fast (after 2 days less than 1 promille remains).

Analysis of blood from animals: Acrylamide cause of fish death and paralysis of cows?

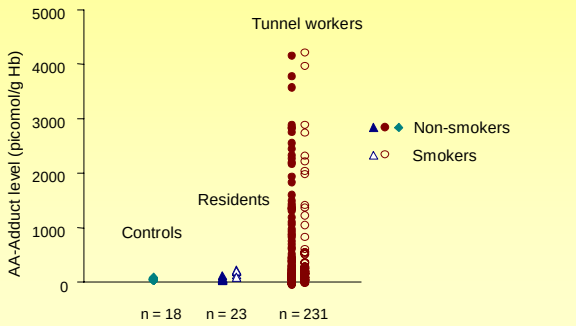
Level of acrylamide adducts (nanomol/g Hb)

	Poisoned	Controls
Cows	35 - 45	< 0.005
Rainbow trout	3.9 - 4.6	< 0.0005

⇒ *Acrylamide identified as the cause.*
What about exposure to humans?

Collab.: J. Härdig, SVA; K. Forslund et al., SLU

Exposure of residents and workers at Hallandsås? Measurement of Hb adducts from acrylamide (AA)



Hagmar et al.,
Scand. J. Work Environ. Health 27 (2001)

Measurement of Hb adducts as a tool for assessment of health risks

Adduct level in blood

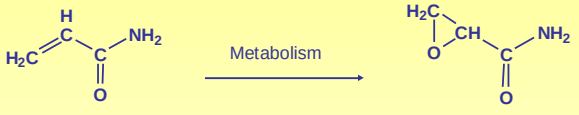
Reactivity
Pharmaco-kinetics

Internal dose and uptake

Toxic potency
Risk model

Health risk

Health risks of acrylamide

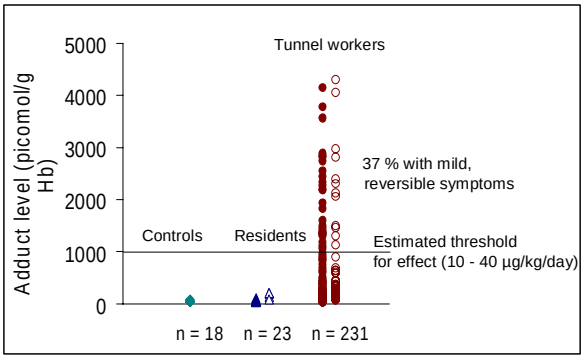


Acrylamide — Glycidamide

Neurotoxic
Dose-response:
No-effect threshold

Genotoxic,
cancer risk-increasing?
Dose-response:
Linear no-threshold

Hallandsås: Hemoglobin adducts from acrylamide and neurotoxic symptoms



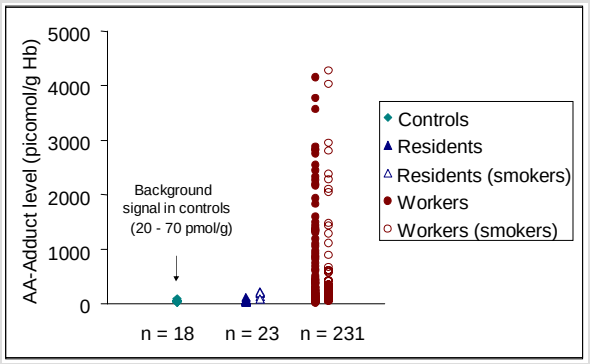
Tunnel workers at Hallandsås: Cancer risk estimation and risk communication

Estimated average life-time cancer risk:
Exposed workers: 30.05 %

Comparison with known cancer risks:
Normal background risk: 30 %
Smokers: ~ 40 %

Estimated number of cases among 200 exposed workers:
Background risk: 60 (47 – 74)
Among exposed: 60.1 (47 – 74)

Background signal corresponding to the AA-adduct in persons without known exposure to AA



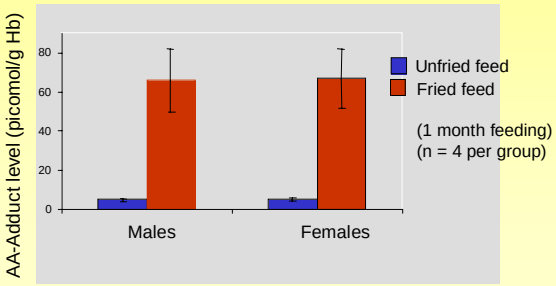
Background level of adduct from acrylamide in unexposed persons? Importance?

If acrylamide was the origin of the adduct signal observed in unexposed persons, this was estimated to correspond to:

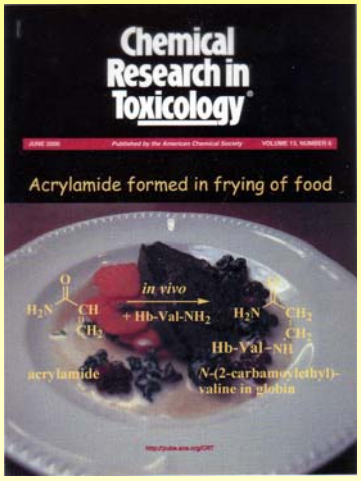
- A general, relatively high exposure source of acrylamide.
- A daily uptake of acrylamide of ca. 80 micrograms/person.
- A relatively high cancer risk.

Hypothesis
Adduct level low in wild animals, high in smokers:
Source: Heating of food?

Test: Fried/Unfried feed to rats Adduct levels in Hb from acrylamide

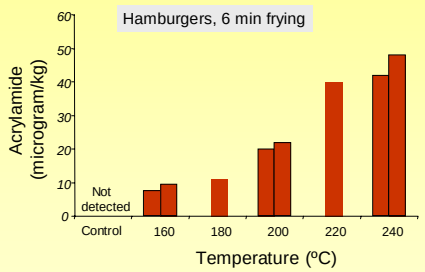


Tareke et al. (2000) Chem. Res. Toxicol. 13, 517-522



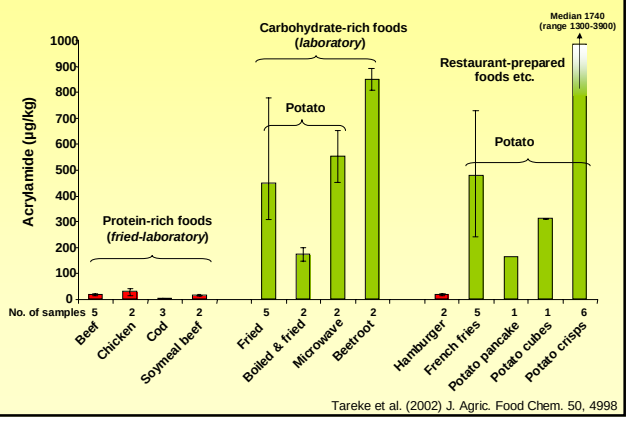
Tareke et al. (2000) Chem. Res. Toxicol. 13, 517-522

Formation of acrylamide in food?



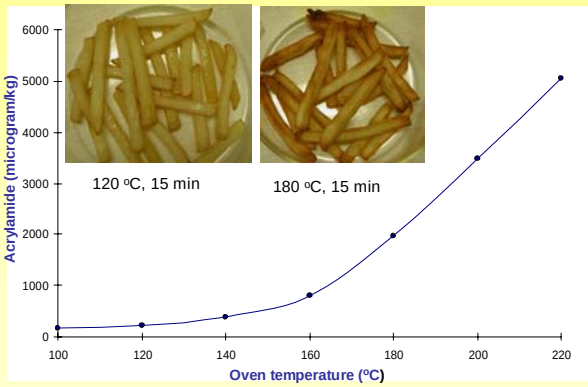
Tareke and Törnqvist, Vår föda, 2001
Tareke et al. (2002) J. Agric. Food Chem. 50, 4998

In which food could acrylamide be formed?

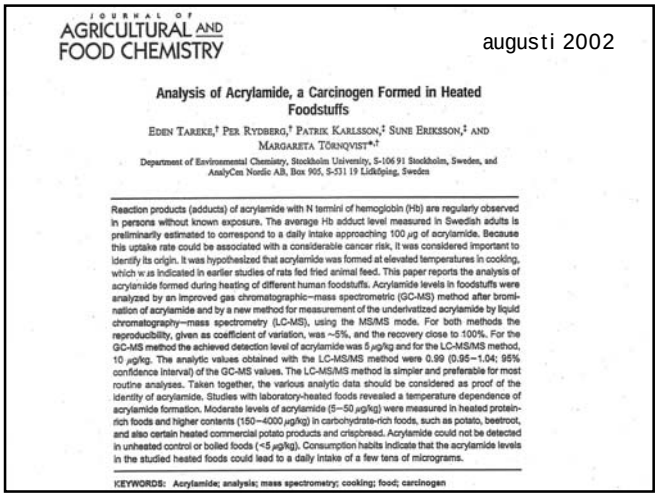


Tareke et al. (2002) J. Agric. Food Chem. 50, 4998

Heating temperature and acrylamide formation



Tareke et al. (2002) J. Agric. Food Chem. 50, 4998



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augusti 2002

Analysis of Acrylamide, a Carcinogen Formed in Heated Foodstuffs

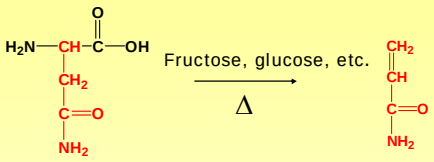
EDEN TAREKE,† PER RYDBERG,† PATRIK KARLSSON,‡ SUNE ERIKSSON,‡ AND MARGARETA TÖRNQVIST*,†

Department of Environmental Chemistry, Stockholm University, S-106 91 Stockholm, Sweden, and AnalyCen Nordic AB, Box 905, S-531 19 Lidköping, Sweden

Reaction products (adducts) of acrylamide with N termini of hemoglobin (Hb) are regularly observed in persons without known exposure. The average Hb adduct level measured in Swedish adults is preliminarily estimated to correspond to a daily intake approaching 100 µg of acrylamide. Because this uptake rate could be associated with a considerable cancer risk, it was considered important to identify its origin. It was hypothesized that acrylamide was formed at elevated temperatures in cooking, which was indicated in earlier studies of rats fed fried animal feed. This paper reports the analysis of acrylamide formed during heating of different human foodstuffs. Acrylamide levels in foodstuffs were analyzed by an improved gas chromatographic−mass spectrometric (GC-MS) method after bromination of acrylamide and by a new method for measurement of the underivatized acrylamide by liquid chromatography−mass spectrometry (LC-MS), using the MS/MS mode. For both methods the reproducibility, given as coefficient of variation, was ~5%, and the recovery close to 100%. For the GC-MS method the achieved detection level of acrylamide was 5 µg/kg and for the LC-MS/MS method, 10 µg/kg. The analytic values obtained with the LC-MS/MS method were 0.99 (0.95−1.04; 95% confidence interval) of the GC-MS values. The LC-MS/MS method is simpler and preferable for most routine analyses. Taken together, the various analytic data should be considered as proof of the identity of acrylamide. Studies with laboratory-heated foods revealed a temperature dependence of acrylamide formation. Moderate levels of acrylamide (5−50 µg/kg) were measured in heated protein-rich foods and higher contents (150−4000 µg/kg) in carbohydrate-rich foods, such as potato, beetroot, and also certain heated commercial potato products and crispbread. Acrylamide could not be detected in unheated control or boiled foods (<5 µg/kg). Consumption habits indicate that the acrylamide levels in the studied heated foods could lead to a daily intake of a few tens of micrograms.

KEYWORDS: Acrylamide; analysis; mass spectrometry; cooking; food; carcinogen

Precursors of acrylamide soon identified



- Acrylamide is formed in the Maillard reaction, with asparagine as dominating precursor.
- High concentrations of asparagine as free amino acid in potato.

Mottram et al. (2002) Nature 419, 448; Stadler et al. (2002) Nature 419, 449
(Rydberg et al., (2003) J. Agricult. Food. Chem. 51, 7012)

Preliminary cancer risk estimation of AA in food

Exposure and in vivo doses

- Average intake of AA.
- Internal doses of glycidamide from AA in food?

Cancer risk estimates

- Glycidamide, the major cancer risk-increasing factor?
- Dose-response at low doses?
- Species-extrapolation from rat (cancer tests) to humans?
- Cancer risk model?
  (20 x difference in risk coefficient between models)

Intake of acrylamide from food

- Estimated average daily intake in adults:
  ca. 0,5 µg/kg body weight - ca. 35 µg in total[1-3]
  (prel. estimate from Hb adducts, 80 µg).
- In Sweden[1] the contribution to the intake is estimated as:
  coffee 40 %, potato products 35 %, bread and cakes 20 %.

1. Svensson et al., 2003; 2. Dybing och Sanner, 2003; 3. Konings et al., 2003

Cancer risk from dietary acrylamide: Something to bother about? Preliminary estimates.

The cancer risk is preliminary estimated to correspond up to about 1 % of the normal background cancer incidence.

Collective risk

Number of cancer cases per year in Sweden	~ 45 000
If 1 % contribution from acrylamide in food	~ 500

Individual risk

Average (normal) risk for cancer disease	~ 30 %
In absence of acrylamide (if 1 % contribution)	~ 29.7 %
Cf. Hallandsås, exposed workers	~ 30.05 %

Comments

- Exposure to AA in the general population is rather even.
- Most probably it will not be possible to reduce dietary AA to very low levels.
- AA is not the only cancer risk increasing agent formed in heating of food.
- Background exposure observed from many genotoxic compounds, e.g. simple epoxides and aldehydes.
- AA in food is a challenge with regard to cancer risk estimation and with regard to risk communication.

Acknowledgements

Acrylamide in food:
Eden Tareke, Per Rydberg, SU
Sune Eriksson, Patrik Karlsson, AnalyCen, Lidköping

Toxicological studies and estimation of health risks:
Risk model: Lars Ehrenberg, SU, Fredrik Granath, Karolinska Institute
Glycidamide: Birgit Paulsson, SU, Jan Grawe, Uppsala

Hallandsås study and human dietary study:
Human studies: Lars Hagmar et al., Lund University, E. Wirfält, Malmö
Animal studies: J. Härdig, SVA, Uppsala
K. Forslund, A.-C. Godin et al., SLU, Uppsala

E. Bergmark, A. Kautiainen, A.-L. Magnusson, SU.

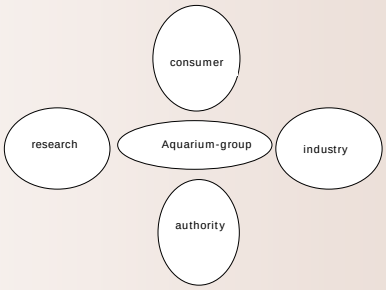
Aquarium designed by Helga Odden Reksnes, National Veterinary Institute:

HEATOX Aquarium

- Wendy Mattews (A)
- Angelika Tritscher (R)
- David Lineback (R)
- Gene Rowe (C)
- Barbara Gallani (C)
- Richard Stadler (I)
- Leif Busk (A – H)
- Jacob van Klaveren (R – H)
- Margareta Törnqvist (R - H)

Moderators: Stuart Slorach and Helga Odden Reksnes

Aquarium scene



Aquarium discussion

- an «intelligent» and responsible dialogue among representatives of key stakeholders focusing on important issues of common interest resulting in some sort of consensus statement or a negotiated platform as basis for further work

Aquarium should

- *intensify and focus* the discussion
- enhance responsibility among the stakeholders
- invite the discussants to listen to each other, not confronting every argument with a counterargument or presenting a series of parallel monologues
- result in short statements (agreed (?) upon conclusions and/or statements about disagreements/dilemmas)

Rules

- The supporters are not allowed to interrupt the discussion.
- Written messages can be sent both ways between discussants and their supporters.
- Time outs are possible – can be asked by the discussant, the moderator or co-moderator – this gives the discussant an opportunity to confer with supporters.

Role of moderators

- define time frames and enforce them
- secure attention to given subject
- encourage balanced participation in the discussions
- initiate interaction with supporters
- suggest conclusions agreed or disagreed upon by the group
- write down/up short sentences expressing the views of the group (or fractions)

Aquarium output

General questions for the Aquarium

- **Do we have enough data?**
  - only enough analytic data on Acrylamide
  - industry: OK
  - homecooking and catering/restaurants: NO
- **What are the most important issues/questions HEATOX could focus on during its last six months in order to produce useful guidelines to consumers and minimisation strategies for industry?**
  - Homecooking toolbox on Acrylamide to the used for Authorities and consumer org. etc.
    - General recommendations
    - Cultural differences must be considered
    - Generic advice related to all heat-generated food toxicants
    - Critical points related to Acrylamide
  - Comment and add HEATOX data to CIAA Toolbox

Specific questions

- **Each discussant was encouraged to raise one relevant issue for the discussion in the Aquarium. Issues raised:**
  - Targeting of different audiences
  - Improvement of risk analysis framework
  - Management dilemmas (Leif Busk's experiment)
  - Consumers eat food, not Acrylamide – how do we advice consumers?
  - How do we judge individual components?
  - Approaches to home cooking
  - Putting risk into perspective –do we have enough data – how should the results be communicated?
  - Quantification of exposure
  - Improvement of risk estimates

theheatoxproject

24 partners in 14 countries

Heat-generated food toxicants: Identification, Characterisation and Risk Minimisation

Heating food gives many advantages – it adds taste, colour and texture and minimises harmful germs. However, modern science has shown that heating foods also can generate potentially hazardous compounds.

The focus of the **HEATOX** project is health risks associated with hazardous compounds, for example acrylamide, in heat-treated carbohydrate-rich foods.

Expected results

Recommendations to consumers, restaurants and the food industry on how to minimise the amounts of heat-generated toxicants in foods, while ensuring product quality from a nutritional and sensory point of view. Increased knowledge on the possible risks of heat-generated food toxicants.

The **HEATOX** project is international in scope, involving 24 partners in 14 countries.

Partners

- Lund University (*Sweden*) Coordinator
- Graz University of Technology (*Austria*)
- The University of Reading *(UK)*
- Swedish University of Agricultural Science *(Sweden)*
- University of Bologna *(Italy)*
- Swedish Institute for Food and Biotechnology (*Sweden)*
- Wageningen University (*The Netherlands*)
- Central Science Laboratory *(UK)*
- Swedish National Food Administration (*Sweden)*
- Institute of Chemical Technology (*Czech Republic*)
- Agrotechnology and Food Innovations *(The Netherlands)*
- University of Barcelona (*Spain*)
- TÜBÝTAK-Marmara Research Center *(Turkey)*
- Stockholm University *(Sweden)*
- Danish Institute for Food and Veterinary Research (*Denmark*)
- National Institute of Public Health (*Norway*)
- RIKILT Institute of Food Safety *(The Netherlands)*
- German Institute for Human Nutrition (*Germany*)
- University of Leeds *(UK)*
- BEUC, European Consumers' Organisation *(Belgium)*
- National Veterinary Institute (*Norway*)
- University of Zürich *(Switzerland)*
- University of Chile *(Chile)*
- Queen's University Belfast (UK)

The HEATOX project will deal with several questions regarding heat-generated food toxicants

In which foods are they mainly found?
How are they formed?
Do they constitute a health risk?
How can we measure/control the amounts produced?
How much is consumed?
What are the effects on the human body?
How can they be avoided?
Is there a cooking method to be recommended?

Main objectives

To assess health risks that may be associated with hazardous compounds in heat-treated food

To find approaches of minimising the formation of heat-generated toxicants, thereby producing safe, nutritious and high-quality foods

To focus the work on new and recently discovered genotoxic compounds in carbohydrate-rich foods

To perform hazard characterisation

To assess the exposure of heat-generated toxicants

To perform risk assessment and communicate the results of the project

The HEATOX Workshop

The intension of the HEATOX Workshop is to gather key persons representing consumer interests, authorities, industry and academy to discuss the state of the art of science and technology related to heat-generated food toxicants.

Coordinator:
Lund University
Kerstin Skog

Project Officer:
European Commission
Jürgen Lucas

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European Commission
Food Quality and Safety