

# codex alimentarius commission



FOOD AND AGRICULTURE  
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Agenda Item 5

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## JOINT FAO/WHO FOOD STANDARDS PROGRAMME CODEX COMMITTEE ON CONTAMINANTS IN FOODS

Third Session

Rotterdam, The Netherlands, 23 March – 27 March 2009

### DRAFT CODE OF PRACTICE FOR THE REDUCTION OF ACRYLAMIDE IN FOOD (N06-2006)

*Comments at Step 6 in response to Circular Letter (CL2008/24-CF) submitted by Japan, Sweden,  
Switzerland, Uruguay and CIAA*

#### JAPAN

##### General Comments

The Government of Japan supports the advancement of the Draft Code of Practice for Reduction of Acrylamide in Food to Step 8 with some modifications in the text of the draft Code.

In the boxed texts about production stage and reduction measures, some texts are not consistent with the relevant main text. Japan would like to propose amendments as contained in the annex to this comment.

##### Specific Comments

##### General consideration and constraints in developing preventative measures

Add "Benzene" to the bullet (i) of paragraph 5

“i. When preventative measures for acrylamide are considered, checks should be made to ensure that they will not result in an increase in other process contaminants. These include N-nitrosamines,<sup>44</sup> polycyclic aromatic hydrocarbons,<sup>45</sup> chloropropanols,<sup>46</sup> ethyl carbamate,<sup>47</sup> furan,<sup>48</sup> heterocyclic aromatic amines and amino acid pyrolysates<sup>49</sup> and benzene. ”

\*A candidate of reference: D.W. Lachenmeier, H. Reusch, C. Sproll, K. Schoeberl, T. Kuballa, (2008). Occurrence of benzene as a heat-induced contaminant of carrot juice for babies in a general survey of beverages. Food. Addit. Contam., 25, 1216-1224.

**Para. 6.** Japan proposes to amend the text as follows:

6. Formal safety assessments, efficacy-in-use demonstration and regulatory approval may be needed for potential new additives and processing aids such as asparaginase. ~~Some Two~~ companies are ~~now~~ producing asparaginase for use in food products and ~~some countries have approved it as a processing aid as of September 2007, the following information was available on the regulatory status of these enzymes. The US FDA has stated that it does not object to the companies' conclusions that their enzyme preparations are Generally Recognized as Safe (GRAS) under the intended conditions of use. In Europe, approval has been received for asparaginase in France and Denmark as a processing aid.~~

*Rationale:* It was agreed that inclusion of scientific references such as names of persons, specific regional/national legislations and other sources of information (e.g. website address) in the final Codex texts

should be avoided as much as possible as scientific facts would become outdated, while Codex texts, once adopted, should remain relevant for some time and replacing or updating scientific references regularly could be difficult. (Para. 70 in ALINORM 08/31/41)

**Para. 18.** Japan would like to propose to far-infrared heating as another technical option capable for reducing acrylamide levels in the last sentence as follows:

18. ... Par cooking, far-infrared heating and dry steam treatments used to make low fat crisps may also reduce acrylamide.

*Rationale:* Effectiveness of far-infrared heating for reducing acrylamide and fat in potato snacks is demonstrated in commercial scale. The technique has already been used in a commercial practice Japan and Australia. (*Patent No JP 2005-245389, A*)

**Para. 20.** Japan proposes the following insertion to make the text more precise:

20. “Oven” French fry manufacturers should ensure that their on-pack cooking instructions are consistent with the need to minimise acrylamide formation including cooking to a golden-yellow colour and avoiding overcooking. Where frying is one of the on-pack suggestions for “Oven” French fries, the recommended frying temperature should not be greater than 175 °C. The cooking instructions should also mention that consumers should reduce the cooking time when cooking small amounts.

**Para. 26.** Japan proposes to make the whole sub-paragraph v. to be a new paragraph, para. 26 bis.

*Rationale:* Sub paragraph v. does not specify a type of possible leavening agents but provides general considerations and constraints in replacing leavening agents.

## RECOMMENDED PRACTICES TO INDUSTRY FOR THE MANUFACTURE OF POTATO PRODUCTS (E.G. FRENCH FRIES, POTATO CRISPS, POTATO SNACKS).

THE MITIGATION MEASURES DISCUSSED IN THE FOLLOWING SECTIONS ARE NOT LISTED IN ORDER OF PRIORITY. IT IS RECOMMENDED THAT ALL REDUCTION MEASURES ARE TESTED TO IDENTIFY THE MOST SUCCESSFUL FOR YOUR OWN PRODUCT.

Production Stage	Reduction Measures
Raw Materials	<ul style="list-style-type: none"> <li>Choose potato cultivars with low concentrations of reducing sugars (target less than 0.3% sugar on a fresh weight basis for crisps and 0.4% for French Fries; subject to regional and seasonal variability).</li> <li>Test incoming deliveries of potatoes for levels of reducing sugars, or fry test them (aim for a light golden colour).</li> </ul> <ul style="list-style-type: none"> <li>Avoid using potatoes stored below 6 °C.</li> <li>Control storage conditions from farm to factory and in cold weather, protect potatoes from cold air.</li> <li>Avoid leaving deliveries of potatoes that have been standing outside (unprotected) in freezing conditions for long periods of time, e.g. overnight.</li> <li>Recondition potatoes that have been stored at low temperatures over a period of a few weeks at higher temperatures (e.g. 12 – 15 °C).</li> <li>Fry test potatoes that have been stored at low temperatures for long periods of time.</li> </ul>
Control / addition of other ingredients	<ul style="list-style-type: none"> <li>In the case of potato-based snacks produced from doughs, where possible, replace some of the potato with other ingredients with lower reducing sugar/asparagine content e.g. rice flour.</li> <li>Avoid addition of reducing sugars (e.g. as browning agent, spice carrier or coating).</li> </ul> <ul style="list-style-type: none"> <li>The addition of asparaginase has been shown to reduce asparagine and thus acrylamide in potato dough based products.</li> </ul> <ul style="list-style-type: none"> <li>Treatment of French fries with sodium pyrophosphate and treatment of potato products with di- and trivalent cations e.g. calcium salts before processing can contribute to the reduction of acrylamide. Food</li> </ul>
Food Processing and heating	<p><b>French Fries:</b></p> <ul style="list-style-type: none"> <li>Blanch potato strips in water to lower levels of reducing sugars before cooking. Lowering the pH with addition of sodium acid pyrophosphate during the latter stages of blanching can reduce levels further.</li> <li>Cut thicker strips; 14x14mm strips have been shown to have lower acrylamide levels than fine cut strips (8x8mm).</li> <li><del>Fry at no higher than 175 °C and cook to golden yellow. If appropriate, par fry french fries.</del></li> </ul> <p><b>Potato crisps:</b></p> <ul style="list-style-type: none"> <li>Optimise <del>thermal input (e.g. time, temperature and cooker settings) to produce a crisp product with a golden yellow colour.</del></li> <li>If available, consider vacuum frying to process high reducing sugar potatoes.</li> <li>Rapid cooling is recommended if flash frying is being used.</li> <li>Carry out in line colour sorting to remove dark crisps.</li> </ul>

**RECOMMENDED PRACTICES TO INDUSTRY FOR THE MANUFACTURE OF CEREAL BASED PRODUCTS (E.G. BREAD, CRISPBREAD, BISCUITS/BAKERY WARES, BREAKFAST CEREALS).**

*THE MITIGATION MEASURES DISCUSSED IN THE FOLLOWING SECTIONS ARE NOT LISTED IN ORDER OF PRIORITY. IT IS RECOMMENDED THAT ALL REDUCTION MEASURES ARE TESTED TO IDENTIFY THE MOST SUCCESSFUL FOR YOUR OWN PRODUCT.*

Production Stage	Reduction Measures
Raw Materials	<ul style="list-style-type: none"> <li>• Sulphur deficient soil should be avoided, or well fertilised.</li> </ul>
Control / addition of other ingredients	<p><b>General:</b></p> <ul style="list-style-type: none"> <li>• Consider the type of flour to be used. High extraction flours contain significantly less asparagine than wholemeal flours. However, lowering the wholemeal content will reduce the nutritional benefits of the final product.</li> <li>• Consider part replacement of wheat flour by rice flour.</li> </ul>
	<p><b>Biscuits/bakery wares:</b></p> <ul style="list-style-type: none"> <li>• When ammonium containing raising agents are used, consider replacements with other raising agents e.g. potassium and sodium containing raising agents.</li> <li>• <del>In the production of gingerbread</del> Replace fructose with glucose.</li> <li>• The addition of asparaginase has been shown to reduce asparagine and thus acrylamide in hard, wheat-dough based products such as cookies and crackers.</li> <li>• <u>Investigate the effect of minor ingredients in manufacturers' recipes.</u></li> </ul>
	<p><b>Bread:</b></p> <ul style="list-style-type: none"> <li>• Avoid using reducing sugars in the recipe.</li> <li>• The addition of calcium salts, e.g. calcium carbonate may reduce the formation of acrylamide.</li> </ul>
Food Processing and heating	<p><del>General</del><b>Biscuits/bakery wares:</b></p> <ul style="list-style-type: none"> <li>• Do not over bake.</li> </ul>
	<p><b>Bread:</b></p> <ul style="list-style-type: none"> <li>• Adjust the time-temperature profile of the baking process, i.e., decrease temperatures of the final stages when product reaches low moisture phase.</li> <li>• Extend fermentation times of bread doughs.</li> </ul>
	<p><b>Crispbread:</b></p> <ul style="list-style-type: none"> <li>• Control the final moisture content.</li> <li>• In non-fermented crispbread control the <del>process-oven</del> temperature and <del>time profiles</del><u>oven speed</u>.</li> </ul>
	<p><del>Breakfast cereals:</del></p> <ul style="list-style-type: none"> <li>• <del>Do not over bake or over toast. Manage the toasting to achieve a uniform colour for the product.</del></li> </ul>

## SWEDEN

### *General comments*

Sweden welcomes the possibility to make some final comments. Suggested changes are given below.

The suggestions are in line with the Swiss proposals presented for us in advance. The Swiss document includes an elaborated argumentation and background data to the proposals. Additional comments are given by us in this letter. In particular we would like to refer to the results of the HEATOX project, an EC funded research project including 21 partners from 16 different European countries ([www.heattox.org](http://www.heattox.org)).

### Remarks and proposals

#### *1. Target values for sugar concentration in potatoes*

The maintenance of low sugar levels in potato raw material is of undisputable importance for the mitigation of acrylamide in fried potato products. The effort to set upper target levels in the Code of Practice is therefore highly relevant. At the present time, however, the specification of universally applicable numerical values might be contra productive for practical reasons.

Firstly, the sugar levels differs between countries due to differences in cultivars, growth conditions, practices for storage, use of sprout inhibitors, etc. Also, levels are generally much higher after long time storage compared to new potatoes. Practically achievable target values of general applicability has to be based on the best practice for “worst case” conditions. We believe that there is an obvious risk that such specified target values will sometimes also be applied when lower limits would be achievable.

Secondly, target values should serve as a driving force for reducing acrylamide levels also in the long run. Fixed target values based on what is of today’s best practise might have a conservative rather than promoting effect for long term mitigation strategies, such as the development of low sugar potato cultivars.

**Sweden**, therefore **proposes** that the wording on target values –“target less than 0,3 % sugar on fresh weight basis for crisps and 0,4 % for French Fries” – should be deleted from CoP and be replaced by a call on authorities to establish target values at national level.

#### *2. Best frying conditions*

Deep frying is a dynamic and complex process. Resent research, incl HEATOX, has enabled more detailed advice on frying conditions that currently given in the draft Code of Practice.

The following is based on the HEATOX document *Guideline to authorities and consumer organisations on home cooking and consumption*.

**Sweden proposes** a new text for paragraph 19 as follows:

In order to achieve significant reduction in the acrylamide content of French fries, the initial oil temperature should not be above 170-175°C. Depending on the heating power of the fryer, the amount of potato immersed in the oil should be adjusted to give an actual frying temperature starting from about 140°C and ending at about 160°C. A bigger long-lasting temperature drop after addition of the potato will increase the fat uptake, and a higher end temperature will result in excessive acrylamide formation.

#### *3. Potatoes for restaurants and households*

The following text is based on the HEATOX document referred to under the previous paragraph:

**Sweden proposes** that a new paragraph 12 should be inserted under section Raw materials:

The selection of varieties, especially for consumer potatoes, is very country specific. Information on sugar levels in different varieties, and advice to consumers on suitable potato varieties, must be obtained and given on a national basis. Special labeling on consumer potatoes indicating suitability for frying could be considered in countries where home-cooked potato is known to be an important source of acrylamide intake. Also, recommendations to producers on sugar levels in prefabricated potato products for domestic frying could be considered.

#### 4. References

In addition, **Sweden** would like to **suggest** that a reference to the HEATOX project is included under References.

## SWITZERLAND

### General Remarks

#### Why focus on potato products?

- Roasted potatoes easily contain 1000-4000 µg/kg acrylamide, which means that a single serving may contain 1 mg acrylamide. This is more than the exposure from all other sources together over many days. Roasted potatoes are primarily a problem for certain households where they are frequently prepared. It is known how to reduce this level to 100-300 µg/kg. Potatoes low in reducing sugars are a prerequisite.
- French fries may still contain 500-1000 µg/kg acrylamide and there are consumers eating French fries almost every day. It is known how to reduce acrylamide formation below 50 µg/kg. Potatoes low in reducing sugars and relatively low oil temperature at the end of the frying process are the most important parameters.
- There are still potato crisps on the market which regularly contain above 1000 µg/kg acrylamide. Good manufacturing practice with conventional methods reduces the average concentrations below 400 µg/kg; with vacuum frying, concentrations can be reduced below 100 µg/kg. Potatoes low in reducing sugars are a prerequisite.

For the average consumer, potatoes are a source of acrylamide among others. But for the consumer with a high intake of acrylamide, roasted and fried potato products are the dominant sources. Since there are ways to strongly reduce acrylamide formation in these products, high priority should be given to them.

#### Why focus on reducing sugars?

- In potato products, acrylamide formation is proportional to the content of fructose and glucose (assuming same intensity of frying or roasting).
- Reducing sugars in potatoes vary widely (from about 0.01 to about 2 % fresh weight, i.e. 0.1-20 g/kg) and have a correspondingly large impact on acrylamide formation. Starting from a potato high in reducing sugars, it is impossible to obtain a crispy product low in acrylamide.
- For roasted and fried potato products, which are cooked in restaurants or at home, no sustainable reduction of the acrylamide content can be achieved through limiting the acrylamide content.

#### Proposed measures

There are many ways of reducing acrylamide formation in potato products. The following three measures have a major impact and are sustainable:

1. Potatoes low in reducing sugars for the industrial production of French fries and crisps. Contents of reducing sugars primarily depend on the cultivar and the storage conditions, and corresponding knowledge is well established in the industry.
2. Better fryers for French fries: acrylamide is formed towards the end of the frying process, when crusts are formed. As a consequence, the temperature at the end of frying is critical: it should be lower than the initial temperature (which can be rather high). Fryers with programmable temperatures are technically feasible, but will only be brought onto the market if they are requested by authorities.
3. Households and restaurants must be supplied with potatoes low in reducing sugars. Since it is not possible to ensure low sugar contents in all potatoes, potatoes low in sugars for roasting and frying should be supplied as a separate line.

### **0.3-0.4 % as target for reducing sugars is far too high**

With potatoes containing 0.4 % reducing sugars, as proposed by the present draft of the Code of Practice, French fries cooked to some minimal crispness contain at least 1000 µg/kg acrylamide; crisps made of potatoes containing 0.3 % reducing sugars are dark and contain several 1000 µg/kg acrylamide. No responsible European industrial producer of crisps or fries uses potatoes containing that much reducing sugar.

Usual concentrations are far lower. This is shown for the Swiss market in the Appendix. It is worth knowing that there are no Swiss potato cultivars: they are all imported from breeders from other European countries. Hence, there shouldn't be substantial differences in the cultivars available in Europe (and probably neither in the potatoes for industrial applications outside Europe).

### **More careful determination of the sugar targets**

Since the targeted content of reducing sugars is a key to mitigation of acrylamide, this value must be derived with care. It has to reflect what is achievable in practice if best choices are made and all stakeholders seriously collaborate.

A market survey may be useful, but it must focus on the most suitable samples. For instance, products to which reducing sugars have been added should be disregarding, just as those chosen to be of elevated sugar content to enhance browning of the final product. Also tubers stored at low temperature are of limited significance: it is known that there are possibilities to store them at higher temperature and to recondition those with an elevated content of reducing sugars.

The "target value" proposed in the Code of Practice must be distinguished from a legal limit: a challenging target will sometimes be exceeded, also because potatoes are a natural product which cannot be fully standardized.

As an indication, for Switzerland the targets could be 0.03 % (0.3 g/kg fresh weight) reducing sugars for the manufacture of crisps, 0.05 % for French fries and 0.07 % for potatoes for households recommended for frying and roasting. More than 80 % of the potatoes and prefabricates used for the manufacture of crisps and French fries by Swiss manufacturers currently comply with these values.

## **PROPOSALS REGARDING THE DRAFT CODE OF PRACTICE**

### **1. Target reducing sugars**

The target values proposed by the draft Code for reducing sugars in potatoes used for manufacturing crisps, French fries or other products prepared by roasting, frying or baking are far above the level of potatoes currently used by responsible industry. Referring to the cultivars (point 9ii), there are hardly any reaching such high concentrations (higher concentrations may, however, result from storage at low temperature).

The proposed target values could even encourage the use of potatoes with unacceptably high sugar contents and provide an excuse for using inappropriate tubers.

**Switzerland, therefore proposes that the target values (0.3 and 0.4 %) be deleted from the Code and be replaced by a call on authorities to establish target values at national level.** In many countries, the data on achievable contents appear to be insufficient. It would be difficult to agree on a more appropriate value also because the situation differs between countries: differences in the climatic conditions may have an effect, but also required duration of storage as well as the importance given to the mitigation of acrylamide and factors like preferences for products with significant browning. National authorities should investigate the realistic target values and communicate them to their producers. If the need arises, target values could be introduced into the Code of Practice during a future revision.

→ Remove target values from the box (bracket in first box)

→ Point 9ii: reduce to: "Cultivar<sup>58</sup> - select cultivars with low contents of reducing sugar" and add: "National authorities should investigate realistic target concentrations and communicate them to their industries".

## **2. Improved fryers for French-fries in restaurants and households**

Batch-Fryers controlling the oil temperature during the last part of the frying process may substantially reduce acrylamide formation. Since they do this in a sustainable manner, this is one of the most efficient ways to mitigate acrylamide. We therefore propose a **new text for Paragraph 19** as follows:

Acrylamide formation in French fries can be reduced by lowering the oil temperature. Since acrylamide is almost exclusively formed towards the end of the frying process, not the initial oil temperature is relevant (can be rather high), but that towards the end of frying. High quality French fries with low acrylamide contents were found with end temperatures of 145-160 °C.<sup>79</sup> Lower temperatures result in poor product quality and possibly increased uptake of fat. Depending on the relative proportions of raw potato to cooking oil, the temperature of the frying oil will drop after the raw French fries are added. Fryers should control the end temperature by allowing the oil temperature to drop, but preventing a decrease below the lower temperature limit (*K. Grob, (2007). Options for legal measures to reduce acrylamide contents in the most relevant foods. Food Add. Contam., 24 Suppl. 1, 71-81.*). Cook to a golden-yellow rather than a golden-brown colour.<sup>77,78</sup>

## **3. Potatoes low in reducing sugars for restaurants and households**

Since it was confirmed by many experts that a substantial part of the acrylamide is formed during cooking at homes or restaurants, it is essential to ensure a supply of potatoes suitable for frying and roasting. We therefore propose the addition of the following paragraph under the Section on Raw materials (paragraphs 9-11) as a **new paragraph 12**:

Since the highest exposure to acrylamide may result from fried or roasted potato products prepared in restaurants or private homes, potatoes low in reducing sugars should be made available to these markets.

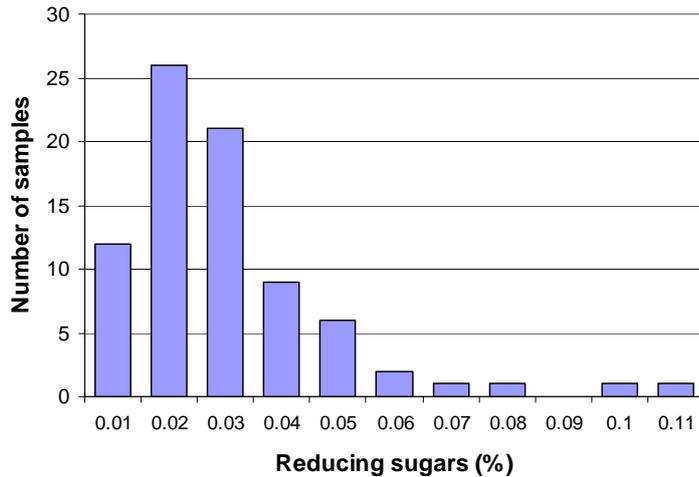
In Switzerland, a separate line of potatoes intended for frying or roasting was introduced in 2004 targeting a maximum of 0.1 % reducing sugar. In reality the mean content of reducing sugars in the tubers marketed in the winters from 2004-2007 was 0.16 % (*K. Grob, (2007). Options for legal measures to reduce acrylamide contents in the most relevant foods. Food Add. Contam., 24 Suppl. 1, 71-81.*).

## **APPENDIX: Data on reducing sugars from Switzerland**

### **French fries**

Prefabricates for French fries (mostly deep frozen) from the Swiss market (for restaurants and households; 2004 to 2008) were analyzed for reducing sugars (n=92). Products were eliminated (n=12) for which it was known that reducing sugars had been added or potatoes with a higher sugar content selected to result in a predetermined degree of browning ("country style", American licenses).

The median for the sum of glucose and fructose was 0.025 %, the 90<sup>th</sup> percentile 0.050 %, and the highest concentration 0.11 %. No value was near the target proposed by the current Draft Code of Practice (0.4 %). This is not surprising since the Swiss trade specifications for potatoes to be processed include a maximum browning in the frying test which is translated to about 0.07 % reducing sugar. The data show that this limit is rather well respected.

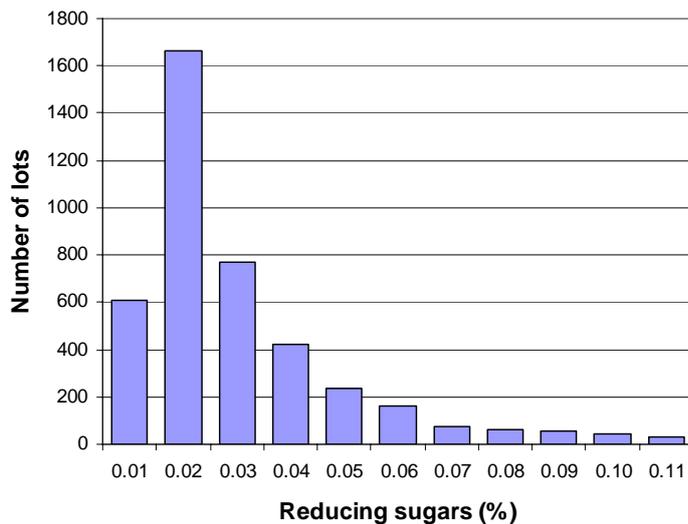


Reducing sugars (%) in prefabricates for restaurants and households sold in Switzerland

**Potato Crisps**

The major Swiss crisps manufacturer provided data on sugar contents in potatoes they received during the years 2005-2008 (4268 lots). The graphic below shows the data up to 0.11 %. 138 lots (3.2 %) exceeded this value. 87 % of the potatoes delivered contained less than 0.05 % reducing sugars. Merely 8 samples (0.18 % of all samples delivered) contained more than the 0.3 % reducing sugars proposed as a "target value" by the current Draft Code of Practice.

It is important to state that this producer almost always succeeds in using tubers with less than 0.04 % reducing sugars – even in late spring shortly before the next crop. The lots exceeding this limit (less than a fifth of all lots) are reconditioned at intermediate temperature to reduce the reducing sugars. The average sugar content of the potatoes actually used is clearly below 0.03 % - more than 10 times below the suggested “target”.



Reducing sugars in 4268 lots of potatoes received by the major crisp manufacturer in Switzerland.

## URUGUAY

According to the review performed by the subcommittee, Uruguay needs time to carry out product development tests and analyses to assess whether the code of practice is applicable.

## CIAA

CIAA, the umbrella organization of the European Food and Drink Industry, as a member of the electronic working group on the establishment of the proposed draft Code of Practice for Reduction of Acrylamide has actively contributed to the revision of the initial draft paper.

We believe the revised text is very reasonable and reflects very well tools to try to mitigate acrylamide, without being however an overall prescriptive manual.

At this stage we would like to inform the Codex secretariat that meetings with Swiss authorities to discuss sugar levels of potatoes for the production of French fries took place.

The outcome of this debate will be reflected within the next update of the CIAA Acrylamide Toolbox.

We would like to inform you that the CIAA Acrylamide Toolbox is becoming a global tool, and will in future also include important contribution from the U.S.

The consideration of global aspects has delayed the latest update of the Toolbox.

The 12<sup>th</sup> revision should be complete towards the end of 2008;

As this CIAA Toolbox is globally recognised by industry, CIAA strongly recommends the reintroduction of this reference; into the Draft Code of practice which had been removed at step 6 of the procedure.

We suggest to introduce a reference to Acrylamide Pamphlets

[http://ec.europa.eu/food/food/chemicalsafety/contaminants/acrylamide\\_en.htm](http://ec.europa.eu/food/food/chemicalsafety/contaminants/acrylamide_en.htm), which are available in 20 different languages and which were established jointly by the European Commission and EU Member States, and CIAA.

These pamphlets are a key source of information for the SMEs and should therefore also be included in the CoP.