codex alimentarius commission

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

WORLD HEALTH ORGANIZATION

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Agenda Item 14 (g)

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JOINT FAO/WHO FOOD STANDARDS PROGRAMME

CODEX COMMITTEE ON FOOD ADDITIVES AND CONTAMINANTS

Thirty-eighth Session

The Hague, the Netherlands, 24 – 28 April 2006

DISCUSSION PAPER ON ACRYLAMIDE

COMMENTS

The following comments have been received from: European Community, Japan, WHO and ICGMA

EUROPEAN COMMUNITY:

The European Community and its Member States (ECMS) thank the working group under the lead of the United Kingdom and United States, for the very extensive and comprehensive discussion paper on acrylamide in food.

The 64th JECFA meeting evaluated acrylamide for neurotoxicity, reproductive and developmental effects, genotoxicity, as well carcinogenicity, and considered that the pivotal effects of acrylamide were its genotoxicity and carcinogenicity. JECFA derived margins of exposure (MOEs) of 300 for the general population and 75 for consumers of high amounts of foods containing high acrylamide levels. JECFA considered these MOEs to be low for a compound that is genotoxic and carcinogenic and that they may indicate a human health concern. Therefore, appropriate efforts to reduce acrylamide concentrations in foodstuffs should continue.

The ECMS therefore fully support the starting from now onwards the elaboration of a "Code of Practice for the reduction of acrylamide in food" for reducing contamination of foods with acrylamide and proposes that CCFAC decides at its 38th Session to forward the project document on a proposal for new work on a Code of practice for the reduction of acrylamide in food to the Codex Alimentarius Commission for acceptance.

Recognising that the knowledge on the effectiveness and feasibility of different mitigation measures is still evolving, the ECMS agree with the proposed timeline in the project providing for sufficient time for the elaboration of the Code at Step 3/4 before the planned advancement to Step 5 in 2009.

JAPAN:

Japan would like to thank the United Kingdom, the United States and other Working Group members for preparing the Discussion Paper on Acrylamide. We are pleased to submit the following comments.

Para. 79

Japan is of the opinion that CCFAC should start discussion to develop a draft Code of Practice for the reduction of acrylamide in food in consideration of JECFA recommendation, albeit JECFA has to wait for the results of several studies of carcinogenicity and long-term neurotoxicity to revaluate acrylamide.

ANNEX 1: OUTLINE DRAFT CODE OF PRACTICE FOR THE REDUCTION OF ACRYLAMIDE IN FOOD

We propose to add the following sentences in the sections "PREVENTATIVE MEASURES" and "REFERENCES".

PREVENTATIVE MEASURES

Potatoes

Food Processing and Heating

Removing some residual heat of French fries (chips) after frying may help limit the formation of acrylamide (*reference number*).

REFERENCES

(*reference number*). Ishihara, K., Matsunaga, A., Miyoshi, T., Nakamura, K, Sakuma, K., & Koga, H. Examination of Conditions Inhibiting the Formation of Acrylamide in the Model System of Fried Potato. *Biosci. Biotechnol. Biochem.* In press (2006)

WHO:

The World Health Organization welcomes this important work undertaken by the CCFAC working group under the leadership of the UK and would like to provide the following comments.

Paragraphs 8-30

The sections on toxicology and epidemiology, analytical methods and dietary exposure are superseded by the information contained in the 2005 JECFA evaluation, as published in the summary report and the full report of the 64th meeting, and should not be considered in detail. Only more recent information available after the 2005 JECFA and particularly relevant for these topics should be included.

Paragraphs 75-78

The conclusions in paragraphs 75 to 78 do not, in our opinion, sufficiently reflect the seriousness of the potential health concern. Moreover, paragraph 78 refers to the conclusions and recommendations of the FAO/WHO consultation held in 2002. These are also superseded by the 2004 JECFA evaluation and any reference to conclusions and recommendations by FAO/WHO should come from the latest meeting.

Paragraph 79

WHO agrees that it is important to develop a Code of Practice. However, we suggest to expand in more detail the current recommendation as follows:

- rapid elaboration of a Code of Practice based on current knowledge of formation and mitigation procedures;
- in parallel, continuation of further investigations regarding formation and mitigation measures; and
- revision of the Code of Practice once new information on further mitigation is available.

WHO recommends to also note in the paper that other sources of acrylamide exposure, mainly from drinking water and air, are minor as compared to exposure from foods.

WHO appreciates the efforts undertaken by governments and industry in reducing acrylamide levels in food, and encourages that these efforts are continued. Moreover, we would like to encourage governments and industry to share their information and also submit relevant information to the FAO/WHO Acrylamide INFONET (*http://www.acrylamide-food.org/)*

ICGMA:

The International Council of Grocery Manufacturers Associations (ICGMA)1 is pleased to provide the following comments on the Discussion Paper on Acrylamide (CX/FAC 06/38/35, pp. 1-17), and on the Outline Draft Code of Practice for the Reduction of Acrylamide in Food (CX/FAC 06/38/35, Annex 1, pp. 18-24).

We wish to compliment the Working Group on its efforts to prepare these documents. The research on acrylamide in foods – formation, mitigation, impact on human health – changes on an almost daily basis, and the Working Group has captured the state of the science quite well in the Discussion Paper. The authors should also be recognized for their efforts to balance the constraints of interventions with the promising, yet still limited, information on these interventions.

ICGMA has included more detailed comments on the Discussion Paper on Acrylamide and the Outline Draft Code of Practice in the following pages. In addition we want to make the following general comments:

We strongly encourage including in the Discussion Paper the discussion, and the references, of the subject of Constraints in Developing Preventative Measures as in the Draft Code, in particular the sections on Chemical and Microbiological Food Safety, Nutritional Impact and Consumer Acceptance. Inclusion of this discussion should be not dominate the discussion paper and give a message that nothing can be done. But ICGMA believes that the Discussion Paper will become an important background document referred to in the future and therefore needs to present the complete picture.

The Draft Code in our estimation should include only concrete, actionable recommendations that have been shown to be possible on a commercial scale (e.g., agronomic characteristics, processing, reformulation). Recommendations based on limited laboratory-scale studies are indicative, but should not be relied on to any significant degree. The Draft Code does need to include factors such as food safety, nutrition and consumer acceptance that need to be considered before interventions that can have a significant impact on the food supply are taken.

ICGMA appreciates the opportunity to comment on these two documents.

ICGMA Comments on Discussion Paper on Acrylamide (CX/FAC 06/38/35, pp. 1-17)

- ***Paragraph 1:*** The text refers to the formation of acrylamide (AA) at "high" temperature. The reaction occurs at 120°C and above, which does not seem especially high. More importantly use of the term "high" implies that all we need to do is turn down the heat to reduce AA, and this is incorrect. The rate of any Maillard type of reaction is due to many factors inclusive of but not limited to precursor availability, time, temperature, water activity and pH. Balancing these conditions with the goal of delivering an end product that is both safe for consumption and organoleptically acceptable makes reduction/mitigation very complicated. Therefore we recommend more specific wording such as "the formation of acrylamide (AA) at a temperature of 120°C or above."
- ***Paragraph 3:*** "Carbohydrate-rich foods" is an understandable simplification, but not entirely accurate, e.g., rice. Also, the reaction requires reducing sugar and asparagine and heat.
- ***Paragraph 7:*** See comments for paragraph 3 regarding rice
- ***Paragraph 8:*** The last sentence mentions the possible association between human occupational exposure and pancreatic cancer. There are several methodological confounders in the two referenced studies, such as the failure to control for smoking, which is known to be associated with pancreatic cancer. Additionally, the fact that the referenced studies are not up to current standards and contain flaws should be mentioned and the statement "toned down."

[1] ICGMA, a recognized NGO before the Codex Alimentarius Commission, represents the interests of national and regional associations who collaborate with all sectors of the consumer packaged goods industry. ICGMA promotes the harmonization of scientific standards and policies concerned with health, safety, packaging, and labeling of foods, beverages, and other consumer packaged goods. ICGMA also works to facilitate international trade in these sectors by elimination or preventing artificial barriers to trade.

- ***Paragraph 9:*** The last sentence mentions demonstration of three DNA adducts follwoing glycidamide exposure. In fact many DNA adducts have been found after either glycidamide or acrylamide exposure by several investigators. Only two references are provided, and no reference is made to the most recent research in this area by Dan Doerge's laboratory at NCTR.

- ***Paragraph 28:*** We believe it would be important to reference here and at an appropriate, perhaps introductory, paragraph in the Code of Practice, the results of FDA's Updated Exposure Assessment for Acrylamide http://www.cfsan.fda.gov/~dms/acrydino.html , and in particular the What-If Scenario's demonstrating the relatively small decease in the total exposure to acrylamide if acrylamide could be completely removed from the foods that are major contributors to the diet. We make this recommendation not to avoid activity to mitigate acrylamide in the diet, rather to reinforce the idea that mitigation is neither technically nor dietarily trivial.

- ***Paragraph 33.*** For completeness, and to reinforce the complexity of the issue, we recommend referencing newer information on mechanisms in purified gluten, i.e., pyrolytic formation. [Claus *et al*. Mol Nutr Food Res (2006) 50:87-93]

- ***Paragraph 35:*** It would be more accurate to state that studies "show acrylamide is present in home-prepared foods." Levels can be minimized, but also may be increased by consumer practices.

- ***Paragraph 36:*** This section needs updating. There is at least one report that shows acrylamide in roasted almonds also declines over time [Amrein *et al.* J Ag Food Chem (2005) 53:7819-7825]. Also, one report has shown that acrylamide does not decline over time in biscuits [Hoenecke and Gaterman JAOAC Int (2005) 88:268], underlining the complexity of the issue and the need to assess specific foods before we understand what can be done.

  More generally, at present, it is unclear what factors drive this decline in acrylamide levels. Acrylamide levels have been shown to decline but never to zero. This observation is less a means to mitigate acrylamide levels and more a reflection of our incomplete knowledge of acrylamide and food chemistry.

- ***Paragraph 40:*** "Reducing sugar varies by a factor of 32" but paragraph 7 in the Draft Code indicates a variation up to two orders of magnitude. This needs to be clarified to ensure consistency

  The statement "while asparagine varies within a narrow range" is not referenced. Further, work by Doyle (FRI, 2002) suggests a 20-fold variation in free asparagine in potatoes. For potato cultivars that are already low in sugar, reducing asparagine is the most viable agronomic option. This reference needs to be considered for inclusion.

  Suggest dropping, or preferably more completely describing, statements about specific holding temperatures. Holding at temperatures above 10 °C may result in tissue breakdown (loss of potato stock) and formation of sprouts (requiring use of additional sprout retardant).

- ***Paragraph 41:*** Since the background paper is meant to reflect the current science, it would be very appropriate and more thorough to include here the different references on the variation of asparagine in cereals referenced in the Draft Code, and basically include here the text of para 23 in the Draft Code.

- ***Paragraph 43:*** It's probably more accurate to say that acrylamide formation increases with pH. Use of ingredients such as citrate for pH reduction may significantly affect consumer acceptance of foods. All precursors need to be present for acrylamide formation to occur, following which pH will come into play. For the statement that acrylamide formation increases with pH to be included there needs to be a reference available to support it. Include reference if available.

- ***Paragraph 45:*** Asparaginase has been used successfully in laboratory experiments to obtain significant reductions of acrylamide levels in potato flakes and French fries. The authors of the Discussion Paper do note that regulatory approvals would be necessary before wide-spread use of asparaginase in the food supply, and even then its use would be limited to specific product applications. Also, rosemary is mentioned twice, which appears unnecessary.

The reference to Tareke, number 96, is problematic. First, it is incomplete and therefore there is no way to confirm the statements it is being used to support. Second, it refers to the effect of antioxidants on acrylamide in meat, which no one has suggested is a significant let alone minor contributor to exposure to acrylamide in food. Therefore the claimed increase of acrylamide in meat has minimal relevance for this Background paper, and even less for a Draft Code which is intended to provide direction. Third, the statement about adding vegetable oil to potatoes is vague; is the addition simply a coating to dry potatoes when roasted, or addition of oil to potatoes already in frying oil which, one would think, would increase the oil volume and dilute the antioxidants in the oil? Fourth, the terms "appeared to enhance," "appears to increase" and "thought due to antioxidants" are less than compelling, which may be why the Tareke reference is not cited in the Draft Code, rather, two different references are used there to support the statement "however it is difficult to draw firm conclusions as reports regarding their effects are conflicting."

Therefore, we would recommend addressing the subject of antioxidants by adding a new paragraph here:

> 44 bis: The use of antioxidants may reduce acrylamide formation in some situations. BHT, sesamol, and vitamin E, appeared to enhance acrylamide formation in meat96. However it is difficult to draw firm conclusions19, 20 as reports regarding their effects in other foods are conflicting.

- ***Paragraph 48:*** It is worthwhile to reemphasize an important conclusion of the CIAA toolbox, that not all mitigation or reduction approaches will be applicable to all food categories or processing conditions.
- ***Paragraph 50:*** An acceptable alternative which should be considered going forward is a new commercial cultivar. However, since technologies such as genetic modification (GMO) are not widely available, and several years may be required to develop an acceptable commercial cultivar, this option will not present immediate results. It should also be noted that regulatory approval will be required.
- ***Paragraph 51:*** Similar to our comments paragraph 39, suggest dropping, or preferably more completely describing, statements about specific holding temperatures. Holding at temperatures above 10 °C may result in tissue breakdown (loss of potato stock) and formation of sprouts (requiring use of additional sprout retardant).
- ***Paragraph 52:*** We are concerned with the statements here and elsewhere in the Background Paper and the Draft Code that these various treatments "may also affect taste and texture." Although increasing the soaking or blanching times may lower acrylamide precursors and potentially effect the level of acrylamide in the finished product, in the experience of US industry increasing blanch time to 20 minutes or more will result in significant changes in flavor and/or reduction in the consumer acceptability of cut fries and chips. Therefore we recommend that it be pointed out here and in other references that the methods or design of sensory evaluation are typically not included in the references. In addition, rigorous and objective assessment of the impact of various treatments on product sensory characteristics is necessary before guidance or direction can be provided in a Draft Code.

  We suggest insertion of the following text at the end of the paragraph "It is important that such treatments need to be assessed for their effect on product sensory characteristics using appropriate and recognized methodology."
- ***Paragraph 53:*** In addition to the inconsistency across products, this strategy is currently not actionable. Use of amino acids as a processing aid in potato products, or other foods, is not currently approved by FDA, or, to our knowledge, by authorities in other jurisdictions. This option is likely to require new regulatory approvals in certain countries.
- ***Paragraph 54:*** First, the reference cited is a patent application describing laboratory studies. Use of calcium ions may also result in noticeably tougher texture without efficacy of actual acrylamide reduction. This treatment should not be recommended, and is not likely to be applied, in the absence of rigorous and objective sensory assessment of its effects.

Second, results may vary with the product application and with processing variables. Factors to be taken into account include the solubility of the salt, effect on other processing variables, and just as importantly, sensory impact on the end product. Addition of calcium ion can result in textural changes. This is not unlike potential changes caused by other treatments, e.g., lower frying temperatures, acid addition, etc.)

- ***Paragraph 55:*** It should be noted that thicker slices may require longer cooking time, which could offset acrylamide reduction due to lower surface area (e.g., average level of acrylamide in thick kettle fried potato chips is much higher than in thinly sliced chips).

- ***Paragraph 56:*** Again, the authors of the Discussion Paper acknowledge that commercial application is some way off. This strategy is currently not feasible. Use of asparaginase in potato products is not currently approved by FDA, or, to our knowledge, by authorities in other jurisdictions. Also, commercial quantities of asparaginase are not available.

  Suggest insertion of a new sentence at the end of the paragraph: 'The application of asparaginase would however require regulatory approval."

  The potato crisps referred to are fabricated crisps made from potato flakes. The enzyme is effective in this type application - dough versus intact slices – in the laboratory. The paper indicated the French fries were blanched, and therefore were not formed from potato flakes. This was an experimental result and it might be anticipated that commercial results may not meet the same level of reduction.

- ***Paragraph 57:*** Replacement with other ingredients may be limited (e.g. new data suggests gluten may also be a precursor to acrylamide formation). The possible impact on changes to formulated potato snacks – flavor, color, texture - on consumer preference have not been addressed.

  Suggest changes to text as highlighted:

  > Formulated potato snacks are based on doughs made predominantly from potato flakes. It <u>appears to be</u> feasible to lower the acrylamide content of such products by partial replacement of the potato ingredients, with other ingredients such as wheat, maize and rice, which have a lower reducing sugar/asparagine content75. <u>The possible impact of the changes on flavour, colour and texture will however still need to be evaluated.</u>

- ***Paragraph 58:*** ICGMA agrees it is appropriate to provide practical advice for consumers. However, it is up to the consumer whether choose to follow it. Advice for this particular application is very much end user dependant since most potato fries are par-fried and then preparation is completed by the end user. It is believed that consumers will cook to the desired doneness.

- ***Paragraph 59:*** As for paragraph 57 in the Discussion paper, we would comment that while the correlation of browning with acrylamide is reasonably established, it is not known what consumers will do with modified cooking instructions. Will they follow them or ignore them completely? It is likely that consumers will cook to the desired doneness regardless if that is a high temperature for a short time or a lower temperature for a longer time. Lower temperatures with longer cooking times has limited advantage in reducing acrylamide formation when the finished product is cooked to a desired color or texture. ICGMA agrees it is appropriate to provide practical advice for consumers, but in order to assess its effectiveness some follow up will be needed to determine whether consumers are following it.

- ***Paragraph 62:*** We think it is worthwhile to emphasize the paradox of unrefined vs. refined flours. This underscores the complexity of the issue of mitigation, and the need to address benefits as well as risks. It would be useful to duplicate the third and fourth sentences in paragraph 42 in the Draft Code that addresses nutritional issues.

- ***Paragraph 63:*** Reference 87 is a note from a workshop but provides no data or references. References 79 and 89 cover a single product, gingerbread, and not a range of sweetened bakery products.

  Suggest rewording as:

> Using alternatives to ammonium bicarbonate as a leavening agent in gingerbread79, 89 has been shown to reduce the level of acrylamide. Such changes may therefore be promising for other sweetened bakery products, although possible changes in taste need to be considered and may require modifications in other ingredients.

Reference 89 is an example of industry's concern about the comments in the Background Paper and the Draft Code on taste, texture and other sensory characteristics of the foods. This reference describes a laboratory/pilot plant study that "…gave a product very similar in terms of color, taste, volume, dry matter, and acrylamide to the product prepared by the industry." The reference describes methods for measurement of color, dry matter and pH, but provides no information on the measurement of taste, texture or other similar sensory characteristics important to consumers. We recommend therefore that when comments are made about sensory characteristics that they be supported with appropriate references and methodology.

- ***Paragraph 67:*** One expects a Background Paper to contain scientific detail; while the reference is the same, there is much more detail on this subject in paragraph 23 in the Draft Code than here. We would recommend copying that text here.

ICGMA Comments on Outline Draft Code of Practice for the Reduction of Acrylamide in Food (CX/FAC 06/38/35, Annex 1, pp. 18-24)

- *Paragraph 7:* We agree that exploiting variations in reducing sugars between cultivars is an opportunity area to investigate. We disagree that reducing sugar is the most important factor in driving the kinetics of this reaction. Both substrates – reducing sugar and asparagines – are required to drive the reaction. Lowering either substrate will have an impact. However, asparagine levels are less variable and therefore may be less amenable to control strategies and managing the level of reducing sugars is most likely the most the more feasible option in the short term.

  In addition, factors such as reconditioning temperature, growing region, cultivar, storage time, finished product use of the potatoes all contribute to the amount of reducing sugar in potatoes. All of these factors should be included in this paragraph.

  Finally, an acceptable alternative which should be considered going forward is a new commercial cultivar. However, since technologies such as genetic modification (GMO) are not widely available, and several years may be required to develop an acceptable commercial cultivar, this option will not present immediate results. And it should be noted that regulatory approval will be required.

  Suggest insertion of text into draft Code of Practice as highlighted:

  > Reducing sugars are the most important factor that can be practically used to influence acrylamide formation in potatoes; i.e., they exert greater effect than the asparagine concentration. There is a strong correlation between reducing sugar content and cooking-mediated formation of acrylamide6. Concentrations of reducing sugars in potatoes can vary by up to two orders of magnitude7, depending upon cultivar and storage history. Exploitation of the variation in the reducing sugar content represents a major opportunity for reducing acrylamide formation during cooking. A number of other factors can be used to influence the level of reducing sugar e.g. reconditioning temperature, growing region, cultivar, storage time, finished product use.

- *Paragraph 8:* We would recommend rewording as ' . . should be avoided if at all possible for high temperature cooking processes.' An acceptable alternative which should be considered going forward is a new commercial cultivar. However, since technologies such as genetic modification (GMO) are not widely available, and several years may be required to develop an acceptable commercial cultivar, this option will not present immediate results.

- *Paragraph 9:* As for paragraphs 39 and 49 in the Background Paper, we suggest either dropping statements of specific holding temperatures or adding more detail on the procedures. Holding at temperatures above 10°C may result in tissue breakdown (loss of potato stock) and formation of sprouts (requiring use of additional sprout retardant).

- *Paragraph 10:* Typical industry practice is to use cultivars which yield a desirable product after being stored in a controlled environment and prepared according to defined processing methods. Screening incoming loads for sugar and then adjusting the process accordingly may not be feasible at this time.

- *Paragraph 11:* Replacement with other ingredients may be limited (e.g. new data suggests gluten may also be a precursor to acrylamide formation). The question regarding if the changes to formulated potato snacks will impact consumer preference have not been addressed.

- *Paragraph 12:* It should be noted that thicker slices may require longer cooking time, which could offset acrylamide reduction due to lower surface area (e.g., average level of acrylamide in thick kettle fried potato chips is much higher than in thinly sliced chips).

- *Paragraph 13:* We are concerned with the statement here, and elsewhere in the Background Paper and the Draft Code, that these various treatments "may also affect taste and texture." Although increasing the soaking or blanching times may lower acrylamide precursors and potentially effect the level of acrylamide in the finished product, in the experience of US industry increasing blanch time to 20 minutes or more will result in significant changes in flavor and/or reduction in the consumer acceptability of cut fries and chips. Therefore we recommend that it be pointed out here and in other references that the methods or design of sensory evaluation are typically not included in the references. In addition, rigorous and objective assessment of the impact of various treatments on product sensory characteristics is necessary before guidance or direction can be provided in a Draft Code.

  We recommend adding a last clarifying sentence:

  > Alternatively, washing, blanching or par-boiling treatments may be employed to leach the asparagine/reducing sugar reactants from the surface of the potato before the cooking step, as has been demonstrated for potato slices13, 14. The sensory characteristics of the resulting product need to be checked to see if this is a viable option.

- *Paragraph 14:* In addition to the inconsistency across products, this strategy is currently not actionable, and therefore does not represent an appropriate practice. We do not believe that the use of amino acids as a processing aid in potato products, or other foods, is currently approved by authorities in any jurisdiction.

  We recommend adding a last clarifying sentence:

  > Treatment of French fries with amino acids15, 17, 18 or sodium acid pyrophosphate9 (added during the last stages of blanching) can be effective, to varying degrees, in reducing acrylamide formation, although such treatment is still experimental. This option however will require the necessary regulatory approval.

- *Paragraph 15:* Since this is a Draft Code of Practice, and if the effects are conflicting, what is the appropriate practice? Refer to our comments on paragraph 44 in the Background Paper. Suggest deleting as evidence is scant and conflicting.

- *Paragraph 16:* This strategy is currently not feasible. Use of asparaginase in potato products is not currently approved by FDA, or, to our knowledge, by authorities in other jurisdictions. Also, commercial quantities of asparaginase are not available.

  The potato crisps referred to are fabricated crisps made from potato flakes. The enzyme is effective in this type application – dough versus intact slices – in the laboratory. The paper indicated the French fries were blanched, and therefore were not formed from potato flakes. This was an experimental result and it might be anticipated that commercial results may not meet the same level of reduction.

  Suggest insertion of text as highlighted:

  > In some situations the asparagine content may be reduced by treatment with the asparaginase enzyme. This technique has shown good potential, both for dough-based potato crisps (potato chips) and for chips/French Fries. However, it may be best suited to food products manufactured from liquidized or slurried materials. This would be an option if regulatory approval can be obtained.

- *Paragraph 17:* First, the references cited are patent applications describing laboratory studies. In practice, the use of calcium ions may also result in noticeably tougher texture without efficacy of actual acrylamide reduction. This treatment should not be recommended, and is not likely to be applied, in the absence of rigorous and objective sensory assessment of its effects. In the light of the fact that this is currently only a laboratory study it is suggested that paragraph 17 is deleted.

  Second, results may vary with the product application and with processing variables. Factors to be taken into account include the solubility of the salt, effect on other processing variables, and just as importantly, sensory impact on the end product. Addition of calcium ion can result in textural changes. This is not unlike potential changes caused by other treatments, e.g. lower frying temperatures, acid addition, etc.

- *Paragraph 19:* ICGMA agrees it is appropriate to provide practical advice for consumers. However, it is up to the consumer whether choose to follow it. Recommending lower temps with longer cooking times may have limited advantage in reducing acrylamide formation when the finished product is cooked to a desired color or texture. It is believed that consumers will cook to the desired doneness regardless if that is a high temperature for a short time or a lower temperature for a longer time. Research may be needed to support this statement. Control is end user dependant.

- *Paragraph 20:* As for paragraph 59 in the Discussion paper, we would comment that while the correlation of browning with acrylamide is reasonably established, it is not known what consumers will do with modified cooking instructions. Will they follow them or ignore them completely? It is likely that consumers will cook to the desired doneness regardless if that is a high temperature for a short time or a lower temperature for a longer time. Lower temperatures with longer cooking times has limited advantage in reducing acrylamide formation when the finished product is cooked to a desired color or texture. ICGMA agrees it is appropriate to provide practical advice for consumers, but in order to assess its effectiveness some follow up will be needed to determine whether consumers are following it.

- *Paragraph 23:* Reference 35, as is clear from its title, is based on model systems, and therefore it is premature to present the treatment as a recommended practice. Clearly the observed effect deserves more research to determine its applicability in a commercial setting.

- *Paragraph 34:* The CIAA Acrylamide Status Report December 2004 includes the information summarized here. Two specific references are cited therein for the stability work in coffee powder:

  Delatour, T., et al. J Agric Food Chem. 2004 Jul 28; 52(15):4625-31.

  Andrzejewski D, et al. J Agric Food Chem. 2004 Apr 7; 52(7):1996-2002.

- *Paragraph 39:* Another aspect of chemical safety that needs to be considered here and definitely in the Background Paper is the number of beneficial chemicals that are produced during food processing, and that any recommendation for a treatment, practice or policy must also consider the impact on them. For example, “Suppressing the Maillard reaction in general leads not only to AA mitigation but also to losses of substances considered to be beneficial.” Summa *et al*. J. Agric. Food Chem. (2006) 54:853-859

  Also, data presented to the EC in 2005 showed reduction in antioxidant activity in coffee in parallel with reduction in acrylamide.

- *Paragraph 41:* In addition to these examples, we recommend including the paradox of higher acrylamide levels in products prepared from unrefined as compared with those from refined flours, i.e., increased consumption of whole grains as proposed in the most recent US Dietary Guidelines could lead to increased consumption of acrylamide. This underscores the complexity of the issue of mitigation, and the need to address benefits as well as risks.