

Acrylamide in Fried, Baked or Roasted Foods May Increase Risk of Cancer in Susceptible Individuals

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Acrylamide is a chemical found in both, industrial and household chemicals. Recently Swedish scientists discovered high levels of acrylamide in fried, baked, or roasted carbohydrate rich foods. It is believed that acrylamide is formed during the Millard reaction between sugar molecules and the amino acid, asparagine. At present there exists no safety regulatory value for acrylamide in foods. The prevalence and possible health effects of acrylamide in various foods create an enormous, growing public concern to scientists, and the general public, worldwide. Acrylamide is toxic at high levels in animals. Insufficient data exist regarding the toxicity of acrylamide in humans. Despite the lack of data, the precautionary principle should be adopted and the presence of acrylamide in foods should be carefully regulated and monitored. The risk of developing adverse health effects depends on the level of exposure to acrylamide. Since acrylamide is consumed frequently by the general population at very high levels, this may serve to increase the risk of cancer in humans. The prevalence and incidence of cancer as a leading cause of death is noted in many countries, worldwide. Whether the intake of acrylamide in food leads to the development of cancer is a hypothesis that needs to be urgently tested. International standards and limits for acrylamide in various foods should be developed and implemented without delay in protecting the public's health.

Key words: Acrylamide, food, cancer, public health safety

INTRODUCTION

Acrylamide is a chemical found in most household and industrial formulations such as plastics, resins, pesticides, household cleaning compounds, and a whole range of research chemicals and SDS gels. Its presence in tobacco smoke and other air borne pollutants can serve to distribute acrylamide far from its source and cause adverse health effects at a distance (INFOSAN, 2005).

The toxic effects of acrylamide on the human nervous system are well documented. Experimental studies have shown that acrylamide is genotoxic and can fragment DNA and RNA, leading to improper transcription and translation of the genetic code. These changes increase the likelihood of genetic mutations and increased genetic susceptibility to cancer (INFOSAN, 2005).

THE PROBLEM

The in-process formation of acrylamide came to the forefront when Swedish scientists and researchers in 2002, discovered that high levels of acrylamide are formed when potatoes and cereal products are fried, baked, toasted or roasted at high temperatures. It is believed that at these high temperatures (> 120°C) a Millard type reaction occurs between sugar molecules and the amino acid, asparagine.

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The prevalence and possible health effects of acrylamide in various foods create an enormous concern to the scientists, researchers, consumers and the general public, worldwide.

This led to increased sensitization and collaboration among scientists and prompted the Joint Expert Committee (FAO and WHO) on Food Additives (JECFA) to evaluate existing data on the possible health effects of acrylamide in foods.

JECFA estimated the risk posed to humans by using the risk assessment approach known as the Margin of Exposure (MOE). MOE is calculated by dividing the toxicity estimate from animal experiments by the estimated intake from food. The lower the MOE the greater the public health concern. The most sensitive carcinogenicity estimate from animal studies was 0.3 mg/kg body weight per day. Human intake values of 0.001 and 0.004 mg acrylamide/kg body weight represented intakes by the general population and high consumers, respectively. The MOE for the general population is calculated as 300, while the MOE for high consumers is 75. Despite, calculation of MOE the precise level of risk for human health is unknown. JECFA suggested that the average acrylamide intake for the general population may be 1µg/kg body weight per day, while high consumers may be 4 µg/kg body weight per day.

While there exist no generally accepted health based guidance value for acrylamide in foods, the WHO guidelines for drinking water quality is 0.5 µg/L; EU guideline is 0.1 µg/L; US regulations is based on treatment techniques, rather than a water quality standard for acrylamide (www.FoodProcessing.com).

California's Safe Drinking Water and Toxic Enforcement Act of 1986 or Proposition 65 states that "no person in the course of doing business shall knowingly and intentionally expose any individual to a chemical known to the state to cause cancer or reproductive toxicity without first giving clear and reasonable warning to such individual..."

In 1990, acrylamide was known to the state of California to cause cancer pursuant to Proposition 65. A no-significant-risk level was set at 0.2 µg per person per day without the knowledge that acrylamide forms when foods are cooked. Acrylamide is present in many foods at a few hundred parts per billion (ppb) far exceeding the 0.2 µg per person per day as previously stipulated (www.FoodProcessing.com).

The US Office of Environmental Health Hazard Assessment (OEHHA) is now contemplating that a variety of cooked foods may require carcinogen warnings when sold in California.

The International Agency for Research on Cancer in 1994 classified acrylamide as probably carcinogenic to humans, because of sufficient experimental evidence on laboratory animals, but insufficient or inconclusive evidence on humans. The nervous system is the principal site identified for toxicity in humans (JECFA, 2005).

Meanwhile, surveys on the foods containing acrylamide are ongoing, consumers are still being exposed to high levels of acrylamide in foods on a daily basis (www.food.gov.uk; www.foodsafety.gov). This makes the health risks associated with acrylamide a growing public health concern that needs to be promptly addressed by food manufacturers, regulatory agents, Governments and other stakeholders, worldwide.

Some of the major foods identified by JECFA as containing acrylamide:

- Potato crisps (6-46%).
- Coffee (13-39%).
- French Fries (16-30%).
- Bread and toasts (10-30%).
- Pastries and sweet biscuits (10-20%).
- Other food items (< 10%).

Factors affecting increased acrylamide formation:

- Temperature (> 120°C).
- High carbohydrate, low protein content.
- Free asparagine.
- Reducing sugars.
- pH.
- Water content.
- Ammonium bicarbonate.
- High concentration of competing amino acids.

Possible health effects of acrylamide:

- Carcinogenic.
- Genotoxic.
- Neurotoxic.

- Reproductive toxicity.
- Developmental toxicity.

Recommendations for reducing the level of acrylamide in foods:

- Reduce the levels of fried, roasted, toasted or baked foods rich in carbohydrates, low in proteins.
- Eat a varied diet including lots of fruits and vegetables.
- Eat fried and fatty foods moderately.
- Establish interactive communication among scientists, researchers and industry so that the latest information on methodology and on ways of reducing or eliminating acrylamide can be rapidly communicated.
- Establish a data repository for the international exchange of information.
- Establish regulatory requirements at a national and international acceptable level for acrylamide in various foods.
- Disseminate information to the public on food safety regarding the public health safety of acrylamide in foods and ways of reducing or eliminating acrylamide from the diet.
- Encourage, and develop research on new varieties of vegetables that do not form acrylamide during manufacture. Develop new research into plant breeding and variety selection.
- Develop research into the enzymatic transformation of acrylamide into asparagine or the selective removal of asparagine via asparaginase, prior to heating.
- Knowledge of formation of acrylamide in foods may serve to identify intermediates such as 3-aminopropionamide that could be sequestered leading to the elimination or decreased formation of acrylamide.
- Encourage changes to recipes and processes that lead to the formation of acrylamide for example addition of glycine and citric acid to carbohydrate rich foods prior to baking, frying, roasting or toasting.
- Controlling growth and storage factors affecting sugar concentration in potatoes.
- Pre-treatment of potatoes by soaking in calcium chloride or blanching.
- Prolonged yeast fermentation time in bread making.

CONCLUSION

Acrylamide is toxic at high levels in animals. Insufficient data exist regarding the toxicity of acrylamide in humans. Despite the lack of data, the precautionary principle should be adopted and implemented, that is, if there is a possibility or probability that acrylamide can cause adverse health effects then its use and hence its presence in foods should be carefully regulated and monitored. The risk of developing adverse health effects depends on the level of exposure to acrylamide. Since acrylamide is consumed frequently by the general population at very high levels, this may serve to

increase the risk of cancer in humans. The prevalence and incidence of cancer as a leading cause of death is noted in many countries, worldwide (www.who.int). Whether the intake of acrylamide in food leads to the development of cancer is a hypothesis that needs to be tested. International standards and limits for acrylamide in various foods should be developed and implemented without delay in protecting the public's health.

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