



## Acrylamide

### What is acrylamide?

Acrylamide is a chemical widely used during the manufacturing of paper, dye, and other industrial products. It can also be formed when certain foods are cooked at high temperatures. Frying, baking, or roasting certain foods, such as potatoes or grains, can create acrylamide. French fries and potato chips, for example, may have measurable acrylamide levels. Acrylamide is also found in cigarette smoke.

### How do people get exposed to acrylamide?

Food and cigarette smoke are the major sources of acrylamide exposure.

### How does acrylamide get into foods?

When certain foods are cooked at high temperatures, sugars, such as glucose and fructose, can react with the free amino acid, asparagine, to form acrylamide. Acrylamide forms as part of a chemical reaction, known as the Maillard reaction, which contributes to the aroma, taste, and color of cooked foods. Acrylamide is one of the hundreds of chemicals that can form during the Maillard reaction.

### Why did the NTP study acrylamide?

The nomination to study acrylamide came from the U.S. Food and Drug Administration (FDA). FDA wanted high quality data from animal studies, to help support risk assessments to understand



any potential risks to humans. Acrylamide has been previously shown to cause several types of cancer in animals, but more information was needed to better understand how acrylamide causes tumors and at what doses the tumors occurred in animals.

NTP also conducted studies on glycidamide, the major metabolite of acrylamide. When acrylamide is consumed through food, the body converts it to glycidamide. Since this conversion may differ among rodent species, comparing the effects of acrylamide and glycidamide in rats and mice provides meaningful support for human health risk assessments.

The NTP studies on acrylamide and glycidamide were conducted at the FDA National Center for Toxicological Research (NCTR), as part of an interagency collaboration between NIEHS and FDA/NCTR.

### What did the NTP studies find?

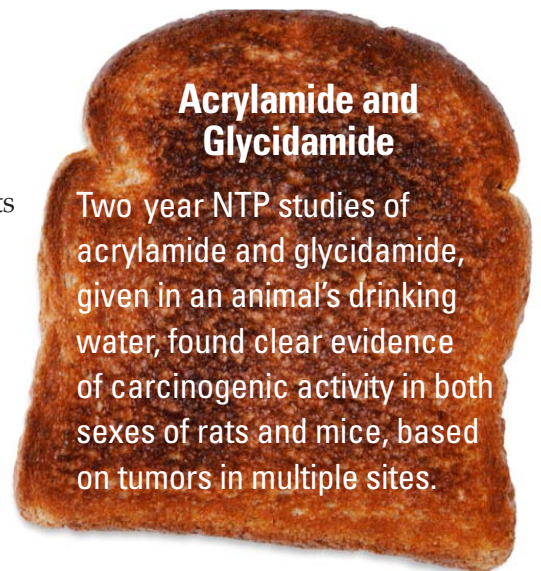
The two-year NTP studies of acrylamide, given in an animal's drinking water, found clear evidence of carcinogenic activity in male and female rats and mice, based on tumors in multiple sites.

For example, tumors were found in the mammary and thyroid glands in female rats, and the reproductive organs in male rats. Tumors of the lung were among those observed in mice.

Additionally, NTP conducted parallel studies on glycidamide, which was also found to be a multisite carcinogen in both male and female rats and mice. The types of tumors induced by glycidamide were the same as those seen in acrylamide. Findings of clear evidence of carcinogenic activity in both sexes of rats and mice, and at multiple sites, is relatively uncommon and indicative of a strong carcinogenic response.

### Acrylamide and Glycidamide

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### What do the NTP studies mean for humans?

Acrylamide is already classified as reasonably anticipated to be a human carcinogen (see [12th Report on Carcinogens](#)). Estimating the potential risks to humans, associated with dietary exposure to acrylamide, involves difficult analyses and judgments that are well beyond the intent of the NTP technical report. NTP studies will help FDA make better scientific assessments of the risk posed to the human population at low levels of exposure, and to identify risk management options that may be warranted for reducing food-related acrylamide exposure.

### Are acrylamide levels regulated?

FDA is currently developing guidance for industry on reduction of acrylamide levels in food products.

FDA also regulates the amount of acrylamide in a variety of materials that come in contact with food.

The U.S. Environmental Protection Agency (EPA) regulates acrylamide levels in drinking water.

### How can I reduce my family's exposure to acrylamide?

Adopt a healthy, balanced eating plan that includes fruits and vegetables, lean meats, fish, high-fiber grains, and beans.

The FDA offers advice for consumers who want to reduce acrylamide in foods. See <http://www.fda.gov/Food/FoodborneIllnessContaminants/ChemicalContaminants/ucm151000.htm> for more information.

Other tips:

- Fry foods at 170 degrees Celsius (338 degrees Fahrenheit) or lower.
- Cook potato strips, such as french fries, to a golden yellow rather than a golden brown color.
- Toast bread to the lightest color acceptable.
- Soak raw potato slices in water for 15-30 minutes before frying or roasting. Drain and blot dry before cooking.
- Do not store raw potatoes in the refrigerator.



### Where can I find out more about acrylamide?

#### **NTP acrylamide and glycidamide data and reports**

<http://go.usa.gov/WZfH>  
<http://go.usa.gov/WDgC>

#### **U.S. Food and Drug Administration**

<http://www.fda.gov/food/ucm053569.htm>

#### **Agency for Toxic Substances and Disease Registry**

<http://go.usa.gov/WJqH>

#### **National Cancer Institute**

<http://go.usa.gov/WJaB>

#### **National Institute for Occupational Safety and Health**

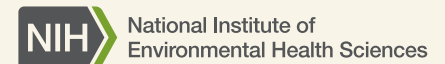
<http://www.cdc.gov/niosh/topics/acrylamide>

#### **NTP Monograph on Acrylamide**

<http://go.usa.gov/WJxT>

#### **U.S. Environmental Protection Agency**

<http://go.usa.gov/WJxA>



For more information on the National Institute of Environmental Health Sciences, go to <http://www.niehs.nih.gov>.



For more information on the National Toxicology Program, go to <http://ntp.niehs.nih.gov>.