

# ACRYLAMIDE MYSTERY SOLVED

## Heating asparagine with sugar yields chemical found in cooked foods

**T**HE DISCOVERY OF ACRYLAMIDE in potato chips, french fries, and other cooked foods has generated a flurry of questions about exactly how the suspected carcinogen—undetectable in uncooked foods—is produced. Working independently, scientists from England, Switzerland, Canada, and the U.S. have come to the same conclusion: The amino acid asparagine is to blame.

When heated, asparagine, as well as other amino acids, reacts with sugars via the Maillard reaction. This process produces intermediates that confer taste, aroma, and color in foods during cooking—giving bread its tasty golden-brown crust, for instance.

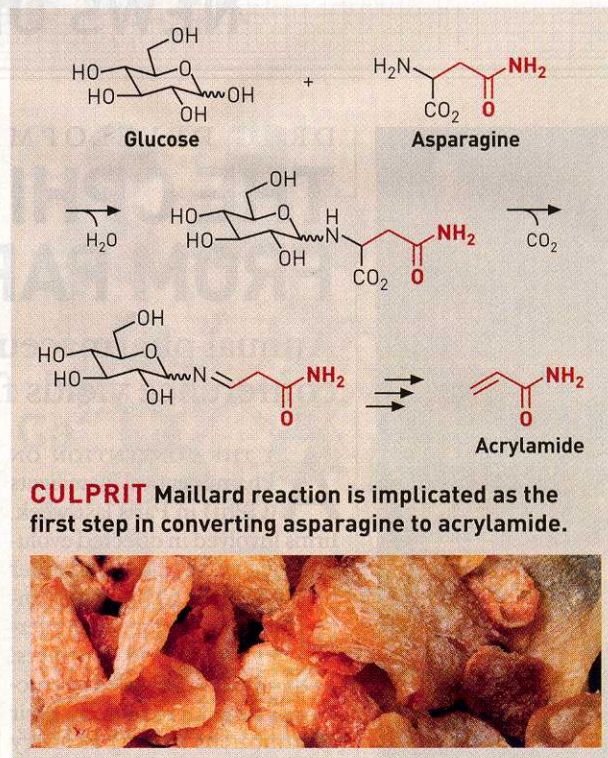
But the same reaction can produce precursors to acrylamide, a known neurotoxin that causes cancer in rats and possibly in humans, when foods are cooked at high temperatures. Noting that the chemical structure of asparagine looks suspiciously like that of acrylamide, two teams—one led by food chemistry professors Donald S. Mottram of the University of Reading and Bronek L. Wedzicha of the University of Leeds, both in England, and the other by Richard H. Stadler of Nestlé Research Center in Switzerland—have found that heating asparagine and glucose at 185 °C yields significant amounts of acrylamide [*Nature*, **419**, 448 and 449 (2002)]. Both Procter & Gamble and the Canadian government have announced that their scientists have used similar model systems to make the asparagine link.

Swedish scientists first spotted acrylamide in fried and baked—but not uncooked or boiled—foods earlier this year (C&EN, May 6, page 38). They found that potato chips and

french fries contain levels of acrylamide that are hundreds of times higher than what EPA and the World Health Organization consider safe for drinking water. Other cooked foods, such as crisp breads and crackers, contain lower but substantial levels of acrylamide. And the list continues to grow: P&G has found acrylamide in banana chips and in roasted asparagus.

Different cooking temperatures and times could give rise to the variability of acrylamide levels in foods. But the amount of free asparagine, as well as the availability of sugars in foods, could also be a factor: Potatoes and certain cereal grains contain high levels of free asparagine, Mottram says, and are rich in carbohydrates.

Both the Nestlé and P&G teams have mass spectrometry data showing that the reaction between asparagine and sugar yields an N-linked glycoside. Isotopic labeling shows that it's the asparagine portion of this intermediate that becomes acryl-



amide, but the exact mechanism remains unknown.

“By determining the steps that regulate the rate of the reaction and relating this to real foods, we should be able to suggest means of minimizing acrylamide formation,” Mottram says. Meanwhile, FDA and other world health agencies are scrambling to figure out just how much of a risk eating foods containing acrylamide poses to humans.—AMANDA YARNELL

## GOVERNMENT

### FDA Presents Its Acrylamide Action Plan

**T**he Food & Drug Administration has announced a draft action plan for dealing with acrylamide in food.

Acrylamide, a probable human carcinogen and neurotoxic agent, was recently discovered to form as a by-product of high-temperature cooking processes (greater than 121 °C), particularly in starchy foods.

The major goals of FDA's plan are to assess human dietary exposures to acrylamide, gather information about its toxicology, and develop techniques for reducing its formation in food. Also, FDA will foster partnerships to assess human risks.

FDA has already analyzed about 150 foods using a technique it developed and has found,

as have other studies, the highest levels in potato chips and french fries.

“The National Food Processors Association believes the priority areas identified by FDA for immediate attention are appropriate,” Henry Chin, vice president of NFPA's Center for Technical Assistance, says. However, “we do not believe we are faced with a public health emergency,” he adds.

In contrast, Michael F. Jacobson, executive director of the Center for Science in the Public Interest, calls the discovery of acrylamide in some foods “extremely worrisome,” because the amounts found in potato chips and french fries “would be expected to significantly increase the risk of cancer in humans.”—BETTE HILEMAN