

Questions and Answers about Acrylamide

Updated FAQ of 24 August 2011

In connection with the health assessment of acrylamide, the institute is receiving inquiries about the intake and effects of acrylamide and estimation of the risk potentially posed to consumers through the consumption of foods containing acrylamide as a heat-induced contaminant. The BfR has listed and answered the most frequently asked questions in the following paragraphs. For any questions not listed below, particularly those concerning the acrylamide content of specific foods and the possibilities for reducing the formation of acrylamide in private households by means of appropriate food preparation methods, we refer to the aid homepage (<http://www.waswiressen.de>) and aid information brochure "Acrylamide - 10 Questions, 10 Answers".

What is acrylamide?

Acrylamide is used industrially for the manufacture of plastics and dyes. The substance was synthesized for the first time in 1949 and has been used since the 1950s mainly in the manufacture of polyacrylamide. Non-cross-linked acrylamide polymers are usually water soluble and are used as stabilizers or flocculants in many applications, such as drinking and waste water treatment and as a packaging material and bonding agent for paper and cardboard. Cross-linked polyacrylamides are not soluble and they swell up in water. They are used in particular as a material for biochemical analyses.

In foods, acrylamide is also formed as a by-product of the browning reaction (Maillard reaction) when baking, roasting, grilling, frying and deep-frying. Larger quantities of acrylamide are formed when foods rich in carbohydrates, as well as the amino acid asparagine, are subjected to intense heating. Acrylamide starts to be formed at temperatures of over 120 °C and rises rapidly at 170-180 °C.

How is acrylamide ingested?

Acrylamide can enter the body through food, the skin or breathing. It is distributed and metabolized in the body. Acrylamide and metabolites can pass the placenta barrier and is distributed into breast milk.

What are the health-damaging effects of acrylamide?

Experiences of the health-damaging effects of acrylamide have been made in the field of industrial safety. The substance can irritate eyes, and skin and can sensitize the skin to other substances. In quantities which the consumer is never exposed to under normal circumstances, acrylamide can also cause nerve damage.

Other effects which could be of greater significance to the consumer have only been detected in animal experiments up to now. It is known that acrylamide can be mutagenic and carcinogenic. Acrylamide is converted in the liver into glycidamide, a substance classified as mutagenic and carcinogenic.

The results of a new long-term study with rats and mice published in 2011 show that acrylamide in dosages of approx. 300 to 10,000 micrograms per kilogramme body weight per day can induce tumors in numerous organs. This matches up with the results of older laboratory animal studies. The epidemiological studies conducted in recent years on the association between the intake of acrylamide from foods and carcinogenesis are not able to confirm a carcinogenic effect of acrylamide in humans with certainty. In these studies, considerably

smaller quantities of the substance were ingested with food in relation to the doses administered in the animal experiments.

To what extent are humans exposed to acrylamide?

The major source of acrylamide for the general population is smoking. It is estimated that smokers have a daily intake of 0.5 to 2 micrograms of acrylamide per kilogram body weight.

The consumption of food is the second most important source of acrylamide. The BfR is currently assuming a mean daily intake of approx. 0.3 micrograms of acrylamide per kilogram body weight. Exposure estimates of this kind are connected with a certain level of uncertainty because all foodstuffs cannot be taken into consideration. A high intake of foodstuffs with a relatively low concentration of the substance could also lead to a high acrylamide intake.

Are children and young people particularly at risk through acrylamide in foods?

In relation to their body weight, children eat more than adults. This means that their acrylamide intake can be significantly higher than that of adults, but this also depends strongly on the individual eating habits of each child. In the worst case, when large quantities of foods containing a high level of acrylamide are consumed, the daily intake of acrylamide can amount to a few micrograms per kilogram body weight.

What findings have been made regarding the harmful effects of acrylamide during pregnancy, e.g. damage to the child, risk of miscarriage?

According to scientific estimations, the quantities of acrylamide ingested by humans through foods do not impair the development of newborn babies, nor do they increase the risk of miscarriage. Nevertheless, pregnant women and nursing mothers should take care of consuming a low-acrylamide diet.

Which foods contain a lot of acrylamide?

The highest content of acrylamide is found in potato products, such as crisps, potato fritters and French fries, as well as cereal products, such as crispbread, crackers and biscuits. As acrylamide also forms during roasting, coffee is also a relevant source of acrylamide.

Is there any exposure of acrylamide from other sources than food and smoking?

Up to now it must be assumed that contamination from other sources is negligible. Very low levels of acrylamide are contained in drinking water, for example.

Because regulations which clearly limit the levels of residual acrylamide in cosmetics have been established on a European level, the risk of acrylamide to consumers exposed via cosmetic products is regarded today as insignificant.

Is there a “tolerable limit” for the intake of acrylamide?

Based on the present knowledge it can be established, that there is no “upper limit” below which a risk for the consumer can be excluded. To determine a limiting value of this kind, a certain safety margin in the extrapolation from animals to humans is usually taken into account. As a rule, tolerable limits of this kind are not determined for substances like acrylamide which have the potential to damage genetic material and can cause cancer, because it must be assumed that theoretically, smaller doses can also pose a health hazard. The higher the acrylamide intake, the higher the risk.

For all of these reasons, at present the ALARA principle (As Low As Reasonably Achievable) applies to acrylamide intake, which basically means that levels should be kept as low as possible.

Within the scope of the acrylamide minimization concept, a so-called signal value of maximum 1000 micrograms per kilogram was determined for food products by the Federal Office of Consumer Protection and Food Safety (BVL). If this value is exceeded, the monitoring authorities of each federal state enter into a minimization dialogue with the affected manufacturers. An attempt is then made to reduce the acrylamide concentration by changing the recipe or manufacturing method.

What can consumers do to reduce their acrylamide intake?

As acrylamide belongs to the group of undesired substances which occur when preparing foods at high temperatures, it is not only the manufacturers of foods rich in carbohydrates who can contribute towards a reduction in acrylamide but also the consumers who fry, grill, bake, deep-fry or roast foods of this kind (e.g. potatoes) at home.

The acrylamide level in the foods in question depends to a great extent on the degree of browning achieved through heating: the darker the product, the more acrylamide it contains. The rule of thumb is therefore "Don't burn it, lightly brown it". Considerably lower quantities of acrylamide are produced at temperatures below 180 degrees Celsius than at higher temperatures.