

Communication 034/2026

16 June 2026

Hydrocyanic acid and cadmium in linseeds

It is best not to give raw, ground linseeds to young children

Linseeds are considered a superfood: they provide dietary fibre, omega-3 fatty acids, B vitamins and minerals. Less well known is the fact that they naturally contain so-called cyanogenic glycosides. When linseeds are chewed, crushed or ground, hydrocyanic acid (hydrogen cyanide) can be released. If large amounts are taken up, hydrocyanic acid can cause dizziness, headaches and nausea. Although severe poisoning is rare, it is possible if very high amounts are taken up. The risk is significantly reduced during baking or cooking, as hydrocyanic acid evaporates easily and the enzymes responsible for its release are inactivated by heat.

According to the German Federal Institute for Risk Assessment (BfR), no adverse health effects are expected in adults with an intake of up to 15 to 20 grams (approximately 2–3 level tablespoons) of ground raw linseed per day. However, larger amounts should not be consumed. Particular caution is advised for children: due to their lower body weight and detoxification mechanisms that are not yet fully developed, they are more sensitive to hydrocyanic acid. Young children should therefore avoid eating raw, ground linseeds. For children aged four and over, the BfR recommends no more than four grams (approximately one level teaspoon) per day.

In addition to hydrocyanic acid, linseeds may also contain significant amounts of the heavy metal cadmium. For this reason too, the BfR recommends limiting daily intake for adults to a maximum of 20 grams.

As natural plant compounds, linseeds contain cyanogenic glycosides, predominantly linustatin and neolinustatin. When linseeds are chewed, ground or crushed, hydrocyanic acid can be released from the glycosides due to the effect of enzymes (β -glucosidases), which are also present in the seeds, and subsequently taken up by the body. This is not the case when whole linseeds are consumed. The intake of hydrocyanic acid can pose a health risk in the event of excessive consumption, particularly of ground linseeds. Depending on the amount ingested, non-specific symptoms such as headaches, dizziness, nausea and vomiting

may occur. At high doses, acute symptoms of poisoning may occur, such as respiratory symptoms, cardiac arrhythmias, seizures, and even loss of consciousness and death.

The extent of toxic effects of hydrocyanic acid in humans therefore depends heavily on the ingested dose. Whilst small amounts can be rendered harmless through metabolism into thiocyanate, an overload of the body's own detoxification mechanisms due to excessively high concentrations can lead to severe symptoms of poisoning. Processing methods can help to reduce the hydrocyanic acid content and lower the amount ingested. Heat, for example during baking or cooking, minimizes the risk posed by hydrocyanic acid in linseeds: on the one hand, the substance evaporates even at low temperatures due to its low boiling point (around 26 °C); on the other hand, the heat inactivates the enzymes responsible for the release of hydrocyanic acid.

The European Food Safety Authority (EFSA) has derived an acute reference dose (ARfD) of 0.02 milligrams per kilogram of body weight (mg/kg bw) for the intake of hydrocyanic acid. The ARfD specifies the estimated maximum amount that can be consumed with food in the course of one day without a detectable health risk. To take account of the lower bioavailability of hydrocyanic acid from linseed compared, for example, to that from cassava or apricot kernels, a factor of 3 has been determined for ground linseed. The actual measured concentrations of hydrocyanic acid must therefore be divided by 3 before being compared with the ARfD of 0.02 mg/kg body weight.

An adult weighing 70 kg could therefore consume up to 28 grams (g) of linseed containing the maximum level of 150 mg/kg of hydrocyanic acid (taking into account the factor of 3: 50 mg/kg), which has been set for whole, ground, milled, cracked or chopped linseeds. The ARfD of 0.02 mg/kg body weight for hydrocyanic acid would not be exceeded with this amount.

Provided the recommended daily intake of ground linseed for adults – a maximum of 15–20 g per day (1 level tablespoon corresponds to approx. 6 g of ground linseed) – is observed, according to the BfR's assessment, no adverse health effects are to be expected from a toxicological perspective. Consuming larger amounts raw should be avoided. Furthermore, it is recommended that appropriately labelled products ("For cooking and baking only. Do not consume raw!") should only be consumed after the necessary processing in order to rule out harmful intake levels of hydrocyanic acid.

Due to their lower body weight, increased sensitivity to acute oxygen deficiency and less efficient detoxification mechanisms, children and young children may be more sensitive to the hydrocyanic acid contained in linseed. For a young child weighing 15 kg, the ARfD would already be fully exceeded from an intake of just 6 g of linseed.

Accordingly, it is recommended that young children should not be given raw, ground linseeds. For children aged 4 and over, a maximum amount of 4 g per day (approximately one level teaspoon) poses no health risk.

Besides releasing hydrocyanic acid, linseeds can also contain relatively high levels of cadmium. The EU also has maximum levels for cadmium in linseeds, as this heavy metal can accumulate in the plant. Against this background, the BfR recommends that adults consume no more than 20 g of linseed per day, thereby limiting their intake of cadmium from linseed.

Cadmium intake is associated with a wide range of adverse health effects. The kidneys are particularly sensitive to cadmium; cadmium accumulates there and, with chronic exposure, can impair kidney function. Furthermore, cadmium can lead to bone demineralisation.

The bioavailability and accumulation of cadmium, and consequently its toxicity, are influenced by various factors. For example, a deficiency in certain essential elements such as iron can promote the intake of cadmium in the body.

Further information on the BfR website on the topic of plant constituents:

BfR2GO science magazine, Main Topic: Plant ingredients:

<https://www.bfr.bund.de/en/publication/bfr2go-issue-22023-main-topic-plant-ingredients/>

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