German Federal Institute for Risk Assessment

FAQ

25. June 2024

Mould in foods – health risks and how to avoid them

In nature, mould is everywhere. It spreads via tiny spores and, in this way, makes its way onto foods. Under the right conditions, mould can propagate on and then in foods, such as bread, fruit, or jam. Mould can produce poisonous substances, known as mycotoxins, which can be harmful to health even in small amounts. Possible adverse health effects range from vomiting and diarrhoea to liver or kidney damage and cancer. Mycotoxins could be found in plant-based foods such as oil-rich seeds, nuts, grains, fruits, and vegetables, but also in animal food products such as dairy products. The German Federal Institute for Risk Assessment (BfR) has compiled frequent questions and answers regarding mould and mould toxins in foods.

What is mould and where does it occur?

Mould occurs everywhere in nature. Mould refers to fungi which form long threads known as hyphae and tiny spores only visible under a microscope. Mould uses these spores to spread through the air. If the conditions are right, mould forms a mycelium, a complex network of hyphae. Once the mould becomes visible, it often forms a powdery or fuzzy coating. Some foods offer ideal conditions for mould growth. In household contexts, these include bread, fruit, and jam. Sufficient moisture is a prerequisite for mould growth. Mould can grow on surfaces, but it can also penetrate deep into harvest products or foods and spread.

Why does mould grow in and on foods?

Mould spores spread through the air. If they land on a food and find suitable conditions – the right temperature, pH, and moisture level – they can settle there and begin to grow. In a warm and moist climate, carbohydrates, plant and animal fats, and organically as well as inorganically bonded nitrogen allow for optimal growth. Suitable conditions frequently arise when foods are improperly dried, incorrectly stored, or inappropriately processed.

How is mould recognised?

If mould spores land on foods and the conditions are favourable, they begin to germinate. They form filaments known as hyphae. These hyphae can spread inside the food and are thus not visible to the naked eye. Mould typically only becomes visible after some time and forms a whiteish-green, sometimes black or yellow coating. The coating generally has a powdery or fuzzy consistency.

How can mould on foods be prevented?

The following tips can help to prevent mould on foods.

- Buy foods as fresh as possible and consume them quickly; avoid bulk buying.
- Store foods clean, dry, and in a cool place.
- Store foods separately from each other.
- Clean bread boxes weekly and wipe down with vinegar and water.
- Remove breadcrumbs, as these facilitate mould growth.
- Clean the refrigerator after mould is found on foods.
- Throw away mouldy foods and do not leave them open.
- Store grains and flour in a cool and dry place and shake regularly.
- Try to buy undamaged fruits and vegetables.
- Do not store spices for years. Instead, buy them in small amounts and use quickly.
- Store mould-ripened cheeses (e.g. Roquefort, Camembert) in separate containers.

How should foods which are already visibly mouldy be handled?

Once foods have become mouldy, they should no longer be consumed nor left to stand open. Instead, they should be thrown out immediately. Moulds can form poisonous substances known as mycotoxins, which can be harmful to health. Foods particularly susceptible to mould include fruit conserves, fruit juice, jam, jelly, fruits, milk, and dairy products as well as bread. Once food has become mouldy, it should no longer be eaten. Exceptions to this rule include air-dried sausage (salami) and ham (e.g. whole Parma ham, not sliced ham). In these cases, the mouldy parts should be generously removed and not eaten. When it comes to nuts, the hazard often stems from mouldy individual nuts. Suspicious-looking nuts should therefore be discarded.

Are there any kinds of mould which are desirable on foods?

Yes. There is a group of moulds which is used in the production of certain types of cheese and salami, and which are harmless for human consumption. Examples of these types of cheese include Brie and Camembert. In order to prevent the mould from spreading to other foods in the refrigerator, these cheeses and salamis should be stored in separate packaging.

What are mould toxins (mycotoxins)?

Mould toxins, termed mycotoxins, are natural secondary metabolites produced by mould. For animals and humans, even small amounts of mycotoxins can be harmful to health. A disease caused by mycotoxins is called mycotoxicosis. More than 400 species of mould can

produce over 650 mycotoxins. However, only a relatively small number of mycotoxins naturally occur frequently and in concentrations high enough to be of importance for food and feed safety. Mould spores can also contain mycotoxins. They are almost all heat and acid stable and can therefore not be removed by cooking, frying, or marinating in acid.

Which health concerns can arise from mycotoxins?

Mycotoxins can lead to health impairments in humans. Their toxic effect depends on the specific toxin, the duration of exposure (acute or chronic), the amount of intake, and the health condition of the individual consumer. Possible symptoms of acute mycotoxin poisoning in animals and humans include liver and kidney damage, skin and mucous membrane damage, impairment of the immune system or the central nervous system, hormone-like effects, nausea, vomiting, and diarrhoea. Additionally, chronic exposure to some mycotoxins can lead to carcinogenic and mutagenic effects.

Via which foods do consumers come into contact with mycotoxins?

In the household, moulds forming mycotoxins are frequently found on bread, yoghurt, or cheese. The food should be thrown away as soon as the mould becomes visible (see question “How should foods which are already visibly mouldy be handled?). In this way, consumers can reduce the health risks caused by mycotoxins.

Mycotoxins can also occur in processed foods, for example when contaminated, unprocessed foods such as grains are further processed, e.g. oats to oat flakes. Consumers are generally not able to identify these contaminations. However, for many foods, EU regulations set maximum levels on the amount of mycotoxins permitted (see question: “How can consumers be protected from mould toxins?”).

How can consumers be protected from mould toxins?

EU regulations set maximum levels on the amount of mycotoxins permitted in certain foods, as it is unfortunately not possible to avoid them entirely. Therefore, there are maximum levels for certain mycotoxins in almonds, pistachios, and oilseeds as well as for grains and grain products. Whether additional regulations are necessary or if the existing ones are sufficient for health protection is constantly evaluated. Providing such advice is a risk management task and thus falls under the purview of the German Federal Ministry of Food and Agriculture (BMEL) in Germany. Insights gained from national research projects are also examined accordingly.

Mycotoxins can occur in a wide variety of foods. Recently, the Max Rubner-Institute (MRI) also found mycotoxins in plant-based drinks. What did the institute investigate?

In the study, the MRI closely examined various plant-based drinks. Such drinks are consumed i.a. as an alternative to cow’s milk. They are made from sources such as grains or nuts, for example. For the MRI study, oat, almond, and soy drinks were analysed. The investigation focussed on nutritional quality as well as the chemical and microbial safety of the products. Data on the occurrence of contaminants, including various mycotoxins, were also generated.

How does the BfR assess the health risks of mycotoxins in plant-based drinks that were part of the study by the Max Rubner-Institute (MRI)?

The BfR assessed the mycotoxin levels determined by the MRI in regard to potential health risks (on uncertainties in risk assessment, see the question "How meaningful are the results of the health risk assessment of mycotoxins in plant-based drinks?"); the BfR focussed on the particularly vulnerable group of children between the ages of 6 months and 6 years.

1 to2 out of 12 samples of **soy drinks** were found to have detectable amounts of mycotoxins. These levels were very low, leading to the conclusion that the additional exposure to mycotoxins through consumption of soy drinks by children can be preliminarily deemed negligible.

In **almond drinks**, the MRI found aflatoxins, a specific group of mycotoxins, in 23 out of 24 samples. Acute health impairments from the exposure to aflatoxins are very rare in humans. Chronic effects are the main concern here, such as carcinogenicity in the event of exposure to aflatoxins over a relatively long time (for more, see: FAQ: aflatoxins in food and feed (Only available in German)). The conclusion of the BfR's health risk assessment is that when almond drinks containing the aflatoxin levels measured in the study are regularly consumed by children, health impairments can occur with a medium likelihood. Thus, the limited data available to date indicate that the intake of aflatoxins through consumption of almond drinks can pose a health risk for vulnerable consumer groups.

In **oat drinks**, the mycotoxins deoxynivalenol (DON) as well as T-2 and HT-2 toxins (T2/HT2) from the group of *Fusarium* toxins were detected (in 33 and 29 out of 37 samples, respectively). Regarding the DON levels in oat drinks, the BfR concludes that health impairments are unlikely for both short-term and long-term consumption by children.

In the opinion of the BfR, short-term exposure to T2/HT2 solely via consumption of oat drinks is not likely to result in health impairments. The health-based guidance value is also not exceeded for long-term high consumption of oat drinks with medium levels. However, for both short- and long-term exposure, it should be noted that other oat products, such as oat flakes, can also contain these *Fusarium* toxins. The overall exposure and thus the likelihood of health impairments therefore increase with the consumption of multiple oat products, if these are also contaminated with T2/HT2.

How significant are the results of the health risk assessment of mycotoxins in plant-based drinks?

The data gathered by the MRI provide only an initial insight into the occurrence of mycotoxins in plant-based drinks. Due to the small number of samples and the lack of comparative data from other studies, the BfR is currently unable to assess the extent to which the MRI's data are representative of the German market and thus for the exposure of consumers in Germany.

Additionally, the current data available for the consumption of plant-based drinks regarding both children and adults is insufficient. This is true for both the consumption amounts and the category of consumed plant-based drinks. As only a limited number of data on the consumption of plant-based drinks by children exist, cow's milk intake in each age group was taken as a basis assuming that plant-based drinks are consumed as an alternative to cow's milk.

For a significant assessment of the health risks, the BfR is of the opinion that further data on the occurrence of mycotoxins in plant-based drinks should be generated. This is particularly the case regarding aflatoxins in almond drinks as well as T-2 and HT-2 toxins in oat drinks.

What does the detection of mycotoxins in several plant-based drinks mean for children's nutrition?

As of yet, too few data exist regarding the occurrence of mycotoxins in plant-based drinks to derive consumption recommendations for children and other consumers. The data collected to date show that mycotoxins can be detectable in plant-based drinks just as in the plant-based raw materials used in their production. Further studies are necessary in order to provide a more meaningful understanding of the occurrence of mycotoxins in plant-based drinks and thus better assess the health risks thereof. (Also see the question "How meaningful are the results of the health risk assessment?")

For healthy nutrition, it can be generally stated that a varied and diverse selection of foods not only ensures a balanced supply of nutrients, but also helps to keep the intake of undesired substances (which could not always entirely be avoided due to the natural origin of our foods) to a minimum.

Further information on mycotoxins

BfR Department Plant Toxins and Mycotoxins Unit:
https://www.bfr.bund.de/en/plant_toxins_and_mycotoxins_unit-292924.html

Assessment of health risks from ergot alkaloids in selected c cereal products:
https://www.bfr.bund.de/cm/349/assessment-of-health-risks-from-ergot-alkaloids-in-selected-cereal-products.pdf

About the BfR

The German Federal Institute for Risk Assessment (BfR) is a scientifically independent institution within the portfolio of the Federal Ministry of Food and Agriculture (BMEL) in Germany. The BfR advises the Federal Government and the States ('Laender') on questions of food, chemicals and product safety. The BfR conducts independent research on topics that are closely linked to its assessment tasks.

This text version is a translation of the original German text which is the only legally binding version.

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Responsible according to the German Press Law: Dr Suzan Fiack

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