

Mycotoxin (toxin from fungus)	Fungus	Agricultural raw materials and food products	ADI of AWI (ug/kg body weight)	Effects	Legislative regulations	Comments
Aflatoxin (five species: B1, B2, G1, G2; M1 occurs in milk and comes from B1) and M2 (M1 and M2 are conversion products of Aflatoxin B1, B2 into lactating mammals)	<i>Aspergillus flavus</i> <i>Aspergillus parasiticus</i>	Cereals, buckwheat, maize and maize products, cottonseed, peanuts, other types of nuts (pistachio-nuts, walnuts), spices, dried figs, milk (products), sesame seed soy and soy products.		Acute toxicity; degradation of liver and kidneys. Chronic: carcinogenic (cancer forming) especially in the liver.	Maximum levels according to Regulation (EC) 2023/915	Aflatoxin B 1 is the most common and toxic carcinogen. In milk (products) is the most common aflatoxin M 1 formed after B 1 is broken down. Around 1-3% B 1 is processed in milk to M 1. M 1 is not as poisonous and carcinogenic as B 1. Next to M 1 are other break-down products of B 1 present in milk. Fungus mostly grows during transport and storage in the tropics, mostly characterised by high temperatures (optimum 25 °C: range 8-37) and or high humidity (>83%). In developed countries (VS) are aflatoxins mainly caused during difficult growth seasons (growth stress).
Ochratoxin A and B	<i>Aspergillus</i> <i>Penicillium</i> species	Barley, rye, wheat, rice, maize, peanuts, Brazilian nuts, peppers, Cotton seed, and Cheese.	ADI of toxin A: 0,112 (JECFA, 1990) limit: 10 ug/kg food product. LD 50 (rat, oral) of toxin A: 20 mg/kg		Maximum levels according to Regulation (EC) 2023/915	Toxin A is more toxic than B. In the Netherlands, such low amounts found that the risk is perceived as very low and therefore is there no norm. Growth fungus is possible in a temperate climate. Toxin A is inactivated at > 221 °C
Sterigmatocystine	<i>Aspergillus versicolor</i> ; <i>Aspergillus ruber</i> ; <i>Aspergillus flavus</i> ; <i>Penicillium luteum</i> ; <i>Aspergillus nidulans</i> , <i>Bipolaris</i> .	Grain, buckwheat, wheat, rice, peanut, soy, cheese, cheese crust, green coffee beans and melting cheese.	No ADI	Acute: Damage to liver, teratogenic. Chronic: mutagenic and carcinogenic.	Maximum levels according to Regulation (EC) 2023/915	In the Netherlands research was conducted on the presence of toxins in grain, buckwheat, and soy products. Toxins were not found and therefore the control is considered unnecessary.
Patulin	<i>Apergillus clavatus</i> ; <i>Penicillium roqueforti</i> ; <i>Penicillium expansum</i> ; <i>Penicillium patulum</i>	Apples, apple juice, molded fruits, grains, cheese and sausage	AWI: 7 (JECFA, 1989)	Acute toxicity: (damaging of lungs, brains, liver and kidneys); carcinogenic effects are not found (IARC, 1985).	Maximum levels according to Regulation (EC) 2023/915	During the fermentation of apple juice to cider, vitamin C destruction takes place. The Patulin content can be an indication for the handling of GMP guidelines (to establish that rotten apples are not used).
Ergot alkaloids	<i>Claviceps purpurea</i> ; <i>Claviceps paspali</i>	Rye (mainly), wheat, barley, oats.	ADI: 0,001 mg/kg (Human). Medicinal: 0,125 mg/kg	Hallucinations, gangrene. Carcinogenicity is not proved yet.	Maximum levels according to Regulation (EC) 2023/915	Europe : last human case was in 1951. In the middle ages was it a common disease (St. Anthoniusvuur). Toxins are encapsulated by stiff purple granules. Toxin forming takes already place at the agricultural level.
Deoxynivalenol (DON)	<i>Fusarium spp.</i> , <i>Fusarium graminearum</i>	Wheat, barley, maize, oats, rye, rice, grain flakes and bran.	ADI Adults: 3 ADI, children: 1,5 (NRC, Canada 1985)	Acute toxic: several effects (such as vomiting and degradation of immunity). Possible tetragene. Carcinogenicity is not proven.	Maximum levels according to Regulation (EC) 2023/915	The interactions and toxicity are relatively unknown; more research is preferred. <i>Fusarium spp.</i> is found on grains in temperate climates and its toxins are produced at the agricultural level.
Nivalenol (NIV)	<i>Fusarium tricinctum</i>	Wheat, barley, maize, oats, rye, rice, cereal flakes and bran.		Possible carcinogenic for esophagus and liver.	Maximum levels according to Regulation (EC) 2023/915	Mostly found next to DON and toxins are produced mainly on the agricultural level.
Fumonisin B1, B2 and B3	<i>Fusarium moniliforme</i>	Maize and maize products			Maximum levels according to Regulation (EC) 2023/915	
T2-toxin	<i>Fusarium spp.</i>	Millet, wheat, oats, barley, rye, buckwheat, peanuts, maize and sorghum.		Acute toxicity: alimentary toxic aleukia (ATA) → 80% dies. Possible also mutagenic and teratogenic.	Maximum levels according to Regulation (EC) 2023/915	The growth of the fungus is stimulated by low temperatures, especially around the freezing point. Hibernating grains on the field is not recommended. The inactivation of toxins happens at temperatures higher than 200 °C.
Zearalenone (ZEN)	<i>Fusarium spp.</i> , among others: <i>Fusarium graminearum</i> <i>Fusarium roseum</i> , <i>Fusarium culmorum</i> , <i>Fusarium moniliforme</i>	Maize, sorghum, wheat, barley.		Negative estrogenic effects on fertility. Probably mutagenic, teratogenic and carcinogenic.	Maximum levels according to Regulation (EC) 2023/915	Forming of toxins is stimulated by temperatures for a long time around the freezing point and temperature changes from low to moderate. Fungal growth happens mainly on the field but it is also possible during storage. Inactivation of the toxins happens at temperatures higher than 165 °C.
Rubratoxine A and B	<i>Penicillium rubrum</i>	Ground, peanuts, legumes, maize, and sunflower seeds.		Acute toxicity	Maximum levels according to Regulation (EC) 2023/915	Diseases are often found in animals that consumed contaminated animal feed. Inactivation of toxin A happens at temperatures higher than 214 °C and toxin B at temperatures higher than 170 °C.
Yellow-rice-toxins (o.a. citrinin, citreoviridin)	<i>Penicillium spp.</i> sometimes <i>Aspergillus spp.</i> <i>Penicillium citrinum</i> and <i>Penicillium veridicatum</i> .	Rice, wheat, barley and peanuts.		Citrinin: LD 50 b for rats, oral = 50 mg/kg.	Maximum levels according to Regulation (EC) 2023/915	Citrinin gets inactivated around temperatures higher than 172 °C; citreoviridin at temperatures higher than 110 °C. <i>P.Citrinum</i> produces (except citrinin) also a yellowish pigment that becomes fluorescent under UV light.
Fycotoxins		Algae, and fish products (as a consequence of the food supply) especially shellfish naturally in plants.		Toxic and or unfavourable for the bioavailability of nutrients.	Maximum levels according to Regulation (EC) 2023/915	Heat resistant during normal preparation treatments, occurring toxins; solanum-alkaloids in potatoes, glucosinolates in cabbage species and agaritine in mushrooms.