

References - Citrinin

In this guide

[In this guide](#)

1. [Introduction and Background - Citrinin](#)
2. [Toxicity - Citrinin](#)
3. [Exposure - Citrinin](#)
4. [Risk characterisation - Citrinin](#)
5. [Conclusion and Questions- Citrinin](#)
6. [List of Abbreviations and Technical terms - Citrinin](#)
7. [References - Citrinin](#)

Abdelhamid, A.M., Dorra, T.M., (1990). Study on effects of feeding laying hens on separate mycotoxins (aflatoxins, patulin, or citrinin)-contaminated diets on the egg quality and tissue constituents. Archives of Animal Nutrition 40, 305–316. DOI: [10.3390/ani11061708](https://doi.org/10.3390/ani11061708)

Ali, N., Degen, G.H., (2020). Biological monitoring for ochratoxin A and citrinin and their metabolites in urine samples of infants and children in Bangladesh. Mycotoxin Res 36, 409–417. DOI: <https://doi.org/10.1007/s12550-020-00407-7>

Anninou, N., Chatzaki, E., Papachristou, F., Pitiakoudis, M., Simopoulos, C., (2014). Mycotoxins' activity at toxic and sub-toxic concentrations: differential cytotoxic and genotoxic effects of single and combined administration of sterigmatocystin, ochratoxin A and citrinin on the hepatocellular cancer cell line Hep3B. Int J Environ Res Public Health 11, 1855–1872. DOI: <https://doi.org/10.3390/ijerph110201855>

Arai, M., Hibino, T., (1983). Tumorigenicity of citrinin in male F344 rats. Cancer Letters 17, 281–287. DOI: [https://doi.org/10.1016/0304-3835\(83\)90165-9](https://doi.org/10.1016/0304-3835(83)90165-9)

Bates, B., Lennox, A., Prentice, A., Bates, C., Page, P., Nicholson, S., Swan, G. (2014). National Diet and Nutrition Survey Results from Years 1, 2, 3 and 4 (combined) of the Rolling Programme (2008/2009 – 2011/2012) [Main heading](#)

publishing.service.gov.uk)

Bates, B., Cox, L., Nicholson, S., Page, P., Prentice, A., Steer, T., Swan, G. (2016). National Diet and Nutrition Survey Results from Years 5 and 6 (combined) of the Rolling Programme (2012/2013 - 2013/2014) [National Diet and Nutrition Survey \(publishing.service.gov.uk\)](http://publishing.service.gov.uk)

Bates, B., Collins, D., Jones, K., Page, P., Roberts, C., Steer, T., Swan, G. (2020). National Diet and Nutrition Survey Results from years 9, 10 and 11 (combined) of the Rolling Programme (2016/2017 to 2018/2019) [National Diet and Nutrition Survey \(publishing.service.gov.uk\)](http://publishing.service.gov.uk)

Carlton, W.W., Sansing, G., Szczech, G.M., Tuite, J., (1974). Citrinin mycotoxicosis in beagle dogs. Food and Cosmetics Toxicology 12, 479-484. DOI: [https://doi.org/10.1016/0015-6264\(74\)90061-3](https://doi.org/10.1016/0015-6264(74)90061-3)

Carlton WW and Szczech GM, (1978). Citrinin. In: Mycotoxicoses in Laboratory Animals. Volume 2. Mycotoxic Fungi, Mycotoxins, Mycotoxicoses: An encyclopaedic Handbook. Eds Wyllie TD and Morehouse LG. Marcel Dekker, New York, 371 pp.

Chan, W.H., (2008). Effects of citrinin on maturation of mouse oocytes, fertilization, and fetal development in vitro and in vivo. Toxicology Letters 180, 28-32. DOI: <https://doi.org/10.1016/j.toxlet.2008.05.011>

Chan, W.H., (2007). Citrinin induces apoptosis via a mitochondria-dependent pathway and inhibition of survival signals in embryonic stem cells, and causes developmental injury in blastocysts. Biochem J 404, 317-326. DOI: <https://doi.org/10.1042/BJ20061875>

Chan, W.H., Shiao, N.H., (2007). Effect of citrinin on mouse embryonic development in vitro and in vivo. Reproductive Toxicology 24, 120-125. DOI: <https://doi.org/10.1016/j.reprotox.2007.04.070>

Csenki, Z., Garai, E., Faisal, Z., Csepregi, R., Garai, K., Sipos, D.K., Szabó, I., Kőszegi, T., Czéh, Á., Czömpöly, T., Kvell, K., Poór, M., (2021). The individual and combined effects of ochratoxin A with citrinin and their metabolites (ochratoxin B, ochratoxin C, and dihydrocitrinone) on 2D/3D cell cultures, and zebrafish embryo models. Food and Chemical Toxicology 158, 112674. DOI: <https://doi.org/10.1016/j.fct.2021.112674>

Degen, G.H., Ali, N., Gundert-Remy, U., (2018). Preliminary data on citrinin kinetics in humans and their use to estimate citrinin exposure based on biomarkers. *Toxicology Letters* 282, 43–48. DOI: <https://doi.org/10.1016/j.toxlet.2017.10.006>

EFSA (2012). Scientific Opinion on the risks for public and animal health related to the presence of citrinin in food and feed. *EFSA Journal*, 10(7): 2605. DOI: <https://doi.org/10.2903/j.efsa.2012.2605>

EFSA (2017). Generation of occurrence data on citrinin in food. *EFSA Journal*, 14(2): 1177E. DOI: <https://doi.org/10.2903/sp.efsa.2017.EN-1177>

Ezekiel, C.N., Abia, W.A., Braun, D., Šarkanj, B., Ayeni, K.I., Oyedele, O.A., Michael-Chikezie, E.C., Ezekiel, V.C., Mark, B.N., Ahuchaogu, C.P., Krska, R., Sulyok, M., Turner, P.C., Warth, B., (2022). Mycotoxin exposure biomonitoring in breastfed and non-exclusively breastfed Nigerian children. *Environ Int* 158, 106996. DOI: <https://doi.org/10.1016/j.envint.2021.106996>

Faisal, Z., Vörös, V., Lemli, B., Derdák, D., Kunsági-Máté, S., Bálint, M., Hetényi, C., Csepregi, R., Kőszegi, T., Bergmann, D., (2019). Interaction of the mycotoxin metabolite dihydrocitrinone with serum albumin. *Mycotoxin research* 35, 129–139. DOI: [10.1007/s12550-018-0336-z](https://doi.org/10.1007/s12550-018-0336-z)

Foods Standards Agency (2015). Total Diet Study of metals and other elements in food. The Food and Environment Research Agency. FS102081.

Föllmann, W., Behm, C., Degen, G.H., (2014). Toxicity of the mycotoxin citrinin and its metabolite dihydrocitrinone and of mixtures of citrinin and ochratoxin A in vitro. *Archives of Toxicology* 88, 1097–1107. DOI: [10.1007/s00204-014-1216-8](https://doi.org/10.1007/s00204-014-1216-8)

Hayashi, H., Itahashi, M., Taniai, E., Yafune, A., Sugita-Konishi, Y., Mitsumori, K., Shibutani, M., (2012). Induction of ovarian toxicity in a subchronic oral toxicity study of citrinin in female BALB/c mice. *The Journal of toxicological sciences* 37, 1177–1190. DOI: [10.2131/jts.37.1177](https://doi.org/10.2131/jts.37.1177)

Hood, R.D., Hayes, A.W., Scammell, J.G., (1976). Effects of prenatal administration of citrinin and viriditoxin to mice. *Food and Cosmetics Toxicology* 14, 175–178. DOI: [https://doi.org/10.1016/S0015-6264\(76\)80419-1](https://doi.org/10.1016/S0015-6264(76)80419-1)

Jagdale, P.R., Dev, I., Ayanur, A., Singh, D., Arshad, M., Ansari, K.M., (2020). Safety evaluation of Ochratoxin A and Citrinin after 28 days repeated dose oral exposure to Wistar rats. *Regul Toxicol Pharmacol* 115, 104700. DOI:

<https://doi.org/10.1016/j.yrtph.2020.104700>

Jeswal, P., (1996). Citrinin-induced chromosomal abnormalities in the bone marrow cells of *Mus musculus*. *Cytobios* 86, 29–33.

Kumar, M., Dwivedi, P., Sharma, A.K., Sankar, M., Patil, R.D., Singh, N.D., (2014). Apoptosis and lipid peroxidation in ochratoxin A- and citrinin-induced nephrotoxicity in rabbits. *Toxicol Ind Health* 30, 90–98. DOI: <https://doi.org/10.1177/0748233712452598>

Kuroda, K., Ishii, Y., Takasu, S., Kijima, A., Matsushita, K., Watanabe, M., Takahashi, H., Sugita-Konishi, Y., Sakai, H., Yanai, T., Nohmi, T., Ogawa, K., Umemura, T., (2013). Cell cycle progression, but not genotoxic activity, mainly contributes to citrinin-induced renal carcinogenesis. *Toxicology* 311, 216–224. DOI: <https://doi.org/10.1016/j.tox.2013.07.003>

Kyei, N.N.A., Cramer, B., Humpf, H.-U., Degen, G.H., Ali, N., Gabrysch, S., (2022). Assessment of multiple mycotoxin exposure and its association with food consumption: a human biomonitoring study in a pregnant cohort in rural Bangladesh. *Arch Toxicol* 96, 2123–2138. DOI: <https://doi.org/10.1007/s00204-022-03288-0>

Kyei, N.N.A., Waid, J.L., Ali, N., Cramer, B., Humpf, H.-U., Gabrysch, S., (2023). Maternal exposure to multiple mycotoxins and adverse pregnancy outcomes: a prospective cohort study in rural Bangladesh. *Arch Toxicol* 97, 1795–1812. DOI: <https://doi.org/10.1007/s00204-023-03491-7>

Lee, C. H., Pan, T. M., (2010). A 90-D toxicity study of *Monascus*-fermented products including high citrinin level. *Journal of food science* 75, T91–T97. DOI: [10.1111/j.1750-3841.2010.01626.x](https://doi.org/10.1111/j.1750-3841.2010.01626.x)

Li, X., Tian, L., Oiao, X., Ye, L., Wang, H., Wang, M., Sang, J., Tian, F., Ge, R.-S., Wang, Y., (2023). Citrinin inhibits the function of Leydig cells in male rats in prepuberty. *Ecotoxicology and Environmental Safety* 252, 114568. DOI: <https://doi.org/10.1016/j.ecoenv.2023.114568>

Meerpoel, C., Vidal, A., Tangni, E.K., Huybrechts, B., Couck, L., De Rycke, R., De Bels, L., De Saeger, S., Van den Broeck, W., Devreese, M., (2020a). A study of carry-over and histopathological effects after chronic dietary intake of citrinin in pigs, broiler chickens and laying hens. *Toxins* 12, 719. DOI: [10.3390/toxins12110719](https://doi.org/10.3390/toxins12110719)

Meerpoel, C., Vidal, A., Huybrechts, B., Tangni, E.K., Saeger, S.D., Croubels, S., Devreese, M., (2020b). Comprehensive toxicokinetic analysis reveals major interspecies differences in absorption, distribution and elimination of citrinin in pigs and broiler chickens. *Food and Chemical Toxicology* 141, 111365. DOI: <https://doi.org/10.1016/j.fct.2020.111365>

Narváez, A., Izzo, L., Rodríguez-Carrasco, Y., Ritieni, A., (2021). Citrinin Dietary Exposure Assessment Approach through Human Biomonitoring High-Resolution Mass Spectrometry-Based Data. *J Agric Food Chem* 69, 6330–6338. DOI: <https://doi.org/10.1021/acs.jafc.1c01776>

Pavlović, N.M., (2013). Balkan endemic nephropathy-current status and future perspectives. *Clin Kidney J* 6, 257–265. DOI: <https://doi.org/10.1093/ckj/sft049>

Petkova-Bocharova, T., Castegnaro, M., Michelon, J., Maru, V., (1991). Ochratoxin A and other mycotoxins in cereals from an area of Balkan endemic nephropathy and urinary tract tumours in Bulgaria. *IARC Sci Publ* 83–87.

Pfohl-Leszkowicz, A., Tozlovanu, M., Manderville, R., Peraica, M., Castegnaro, M., Stefanovic, V., (2007). New molecular and field evidences for the implication of mycotoxins but not aristolochic acid in human nephropathy and urinary tract tumor. *Mol Nutr Food Res* 51, 1131–1146. DOI: <https://doi.org/10.1002/mnfr.200700045>

Qingqing, H., Linbo, Y., Yunqian, G., Shuqiang, L., (2012). Toxic effects of citrinin on the male reproductive system in mice. *Exp Toxicol Pathol* 64, 465–469. DOI: <https://doi.org/10.1016/j.etp.2010.10.015>

Reddy, R. V., Maruya, K., Hayes, A. W., & Bernd, W. O. (1982a). Embryocidal teratogenic and fetotoxic effects of citrinin in rats. *Toxicology* 25, 151-160. DOI: [https://doi.org/10.1016/0300-483X\(82\)90026-9](https://doi.org/10.1016/0300-483X(82)90026-9)

Reddy, R.V., Wallace Hayes, A., Berndt, W.O., (1982b). Disposition and metabolism of [14C]citrinin in pregnant rats. *Toxicology* 25, 161–174. DOI: [https://doi.org/10.1016/0300-483X\(82\)90027-0](https://doi.org/10.1016/0300-483X(82)90027-0)

Roberts, C., Steer, T., Maplethorpe, N., Cox, L., Meadows, S., Page, P., Nicholson, S., Swan, G. (2018). National Diet and Nutrition Survey Results from Years 7 and 8 (combined) of the Rolling Programme (2014/2015 – 2015/2016) [National Diet and Nutrition Survey \(publishing.service.gov.uk\)](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/721112/national-diet-and-nutrition-survey-2014-2016-report-main-report.pdf)

SACN (2011), The influence of maternal, fetal and child nutrition on the development of chronic disease in later life. [SACN Early Life Nutrition Report.pdf](#)

SACN (2018), Feeding in the First Year of Life. Available: [SACN report on Feeding in the First Year of Life.pdf \(publishing.service.gov.uk\)](#)

Sharma, A., Singh, N., Dwivedi, P., Kumar, M., Telang, A., Patil, R., (2012). Studies on apoptotic changes in combined toxicity of citrinin and endosulfan in pregnant Wistar rats and their fetuses. *Toxicol Int* 19, 138. DOI: <https://doi.org/10.4103/0971-6580.97207>

Singh, N.D., Sharma, A.K., Dwivedi, P., Leishangthem, G.D., Rahman, S., Reddy, J., Kumar, M., (2016). Effect of feeding graded doses of citrinin on apoptosis and oxidative stress in male Wistar rats through the F1 generation. *Toxicology and industrial health* 32, 385–397. DOI: [10.1177/0748233713500836](https://doi.org/10.1177/0748233713500836)

Singh, N.D., Sharma, A.K., Dwivedi, P., Patil, R.D., Kumar, M., (2008). Experimentally induced citrinin and endosulfan toxicity in pregnant Wistar rats: histopathological alterations in liver and kidneys of fetuses. *Journal of Applied Toxicology* 28, 901–907. DOI: [10.1002/jat.1354](https://doi.org/10.1002/jat.1354)

Singh, N.D., Sharma, A.K., Dwivedi, P., Patil, R.D., Kumar, M., (2007a). Citrinin and endosulfan induced teratogenic effects in Wistar rats. *Journal of Applied Toxicology: An International Journal* 27, 143–151. DOI: [10.1002/jat.1185](https://doi.org/10.1002/jat.1185)

Singh, N.D., Sharma, A.K., Dwivedi, P., Patil, R.D., Kumar, M., (2007b). Citrinin and endosulfan induced maternal toxicity in pregnant Wistar rats: pathomorphological study. *Journal of Applied Toxicology: An International Journal* 27, 589–601. DOI: [10.1002/jat.1242](https://doi.org/10.1002/jat.1242)

Thacker, H. L., Carlton, W. W., & Sansing, G. A. (1977). Citrinin mycotoxicosis in the guinea-pig. *Food and Cosmetics Toxicology*, 15(6), 553-561. DOI: [https://doi.org/10.1016/0015-6264\(77\)90070-0](https://doi.org/10.1016/0015-6264(77)90070-0)

Tsai, J. F., Wu, T.S., Huang, Y.T., Lin, W.J., Yu, F.Y., Liu, B.H., (2023). Exposure to Mycotoxin Citrinin Promotes Carcinogenic Potential of Human Renal Cells. *J Agric Food Chem* 71, 19054–19065. DOI: <https://doi.org/10.1021/acs.jafc.3c05218>

Vesela, D., Veselý, D., Jelinek, R., (1983). Toxic effects of ochratoxin A and citrinin, alone and in combination, on chicken embryos. *Applied and environmental microbiology* 45, 91–93. DOI: [10.1128/aem.45.1.91-93.1983](https://doi.org/10.1128/aem.45.1.91-93.1983)

Vrabcheva, T., Usleber, E., Petkova-Bocharova, T., Nikolov, I., Chernozemsky, I., Dietrich, R., Märtlbauer, E., (2000). Citrinin in the diet of young and healthy persons living in balkan endemic nephropathy areas. *Mycotoxin Res* 16 Suppl 2, 150–153. DOI: <https://doi.org/10.1007/BF02940024>

Wei, W., Li, C., Wang, Y., Su, H., Zhu, J., Kritchevsky, D., (2003). Hypolipidemic and anti-atherogenic effects of long-term Cholestin (*Monascus purpureus*-fermented rice, red yeast rice) in cholesterol fed rabbits. *The Journal of Nutritional Biochemistry* 14, 314–318. DOI: [https://doi.org/10.1016/S0955-2863\(03\)00051-2](https://doi.org/10.1016/S0955-2863(03)00051-2)