

Contaminants

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79. Very few studies, described below, have investigated the potential contaminants in Echinacea preparations, including heavy metals, moulds and mycotoxins.

80. From 1999-2004, 13,504 adults participated in National Health and Nutrition Examination Survey (NHANES) interviews, examinations and had their blood lead levels assessed (Buettner et al., 2009). The authors fitted a regression model for women of child-bearing age (16-45 years), which showed that those who used herbal supplements had adjusted blood lead levels 20% (95% CI 5%-34%, $p = 0.008$) higher than women who did not. However, when broken down by the specific herbal supplement, the difference was not significant for Echinacea supplements (8%, 95% CI -15% - 35%, $p = 0.55$).

81. Filipiak-Szok et al., (2015) conducted a study measuring concentrations of heavy metals, including lead (Pb), cadmium (Cd), arsenic (As), aluminium (Al), nickel (Ni), barium (Ba), and antimony (Sb), in raw plant material of selected medicinally used herbs and dietary supplements available on the Polish market. These results were compared against the limits set by WHO (0.3 mg/kg for cadmium, 10 mg/kg for lead and 5.0 mg/kg for arsenic) and by the EU Commission Regulation (EC) No. 1881/2006 (1.0 mg/kg for cadmium and 3.0 mg/kg for lead). The levels found in the dried Echinacea purpurea samples were considerably lower with 0.02 mg/kg cadmium, 0.6 mg/kg lead and 0.16 mg/kg arsenic.

82. Another study analysed popular food supplements, including seven Echinacea containing brands, for the presence of heavy metals and microbial contamination (Raman et al., 2004). The supplements analysed were in the forms of tablets, capsules or soft gels. The authors determined the daily dose of each heavy metal that would be ingested if the supplement was taken as recommended by the manufacturer. Depending on the Echinacea brand, the daily doses of heavy metals would be: lead 0.034-2.901 $\mu\text{g}/\text{day}$, cadmium 0.004 - 0.967 $\mu\text{g}/\text{day}$, arsenic 0.027 - 0.908 $\mu\text{g}/\text{day}$, chromium 0.125-8.838 $\mu\text{g}/\text{day}$, and thallium 0.002 - 0.383 $\mu\text{g}/\text{day}$. Mercury was not detected in the samples. The authors compared these values to tolerable intake levels at the time of publication and concluded that the supplements do not pose a risk to consumers.

83. *Alternaria alternata*, *Aspergillus* spp., *Fusarium* spp., *Phoma* spp. and yeasts have been detected in Echinacea herbal supplements at 100-1,000 CFU/g with 71% of the Echinacea samples ($n=7$) harbouring fungi (Tournas, 2009). Twenty one samples were analysed as part of a study investigating the presence of moulds and their secondary metabolites in Echinacea dietary supplements available on the Polish market (Pilarska et al., 2022). It was found that 12 samples were contaminated with *Aspergillus* spp., whilst *Eurotium* and *Penicillium* spp. were detected in 8 of the samples. Mycotoxin contamination was found in 18 of the samples with zearalenone (18/21), deoxynivalenol (5/21) and T-2 (3/21)

occurring at the highest frequencies.