Exposure to airborne (1→3)-β-D-glucans during metalworking processes

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During different machining operations, the metalworking fluids (MWF) can be biodeteriorated by fungi. Their propagules can be released into the air with MWF droplets. Whereas the occurrence of fungal spores in such working environment is relatively well controlled, the presence of (1→3)-β-D-glucans and occupational exposure to these immunotoxic components of fungal cell wall have so far been slightly recognized (Cyprowski *et al*, 2011). The aim of this study was to assess an exposure to airborne (1→3)-β-D-glucans released into the air during metalworking processes.

All aerosol measurements were carried out at work sites (L1-4) as well as in indoor and outdoor backgrounds (to control an influence of internal, i.e. within factory, and external, i.e. atmospheric, sources of microbial emission, respectively). The MWF aerosol measurements were performed near 4 metal-processing machines (1 grinder, 3 lathes), in which water-based MWF was used. For determination of (1→3)-β-D-glucans, the air samples were collected using 8-stage cascade impactor with 0.4/0.7/1.1/2.1/3.3/4.7/5.8/9 µm cut sizes. During 30-minute sampling at a flow rate of 28.3 l/min, the particles of each size range were separated onto 81-mm glass-fiber filters with a pore size of 1.0 µm. The glucan analysis was performed using Glucatell® test. Additionally, the concentrations of airborne culturable fungi were carried out using 6-stage Andersen impactor. Bioaerosol samples were collected on glass Petri dishes filled with malt extract agar. The sampling time was 5 minutes at a flow rate of 28.3 l/min. All isolated species were taxonomically identified.

The concentrations of glucans and fungi at studied sampling points are presented in Table 1. The highest glucan levels were found at work site L1 (grinder) – 6.64 ng/m^3, and the lowest at L2 (center lathe) – 3.02 ng/m^3. The concentrations of airborne culturable fungi were low, reaching maximally 367 CFU/m^3 at work site L1.

Table 1. Concentrations of airborne (1→3)-β-D-glucans and fungi at metalworking factory.

Work site (machine) or background	(1→3)-β-D-glucans [ng/m^3]	Fungi [CFU/m^3]
L1 (grinder)	6.64	367
L2 (center lathe)	3.02	154
L3 (center lathe)	4.88	84
L4 (NC lathe)	4.02	98
Indoor background	7.74	21
Outdoor background	16.1	77

The qualitative analysis of airborne mycoflora showed a dominance of *Acremonium*, *Penicillium*, and *Aspergillus* genera. There were no significant correlations between the concentrations of glucans and fungi.

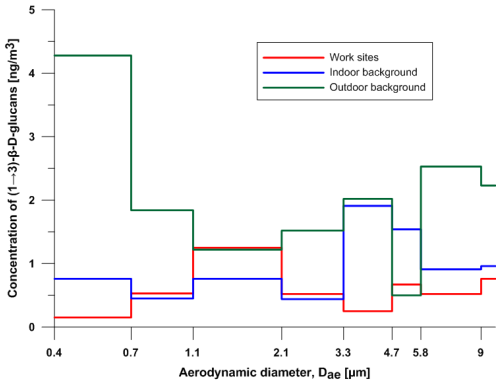

Figure 1. Size distribution of (1→3)-β-D-glucans in the air at metalworking factory.

The concentrations of (1→3)-β-D-glucans in MWF aerosol fractions showed large variability between the studied particulate size ranges as well as sampling sites (Kruskal-Wallis test: in both cases $p<0.05$) – see Figure 1. Based on the results it can be stated, that glucans are carried in the air mainly by MWF particles with aerodynamic diameter of 1.1-2.1 µm. The glucan concentrations are lower in this particle size range, if such MWF emission does not exist. In this case, the main glucan carriers are either small fragments (less than 0.7 µm in diameter), or single fungal spores or their aggregates (greater than 5.8 µm). Due to the half-life of airborne particles in 1.1-2.1 µm size range from a few to several hours, their mechanical elimination from the environment contaminated with MWF seems to be a simple and effective removal method. From the viewpoint of worker's exposure to airborne glucans, the use of personal protective masks with a suitable particle capture efficiency in this range should effectively reduce the risk of adverse health outcomes.

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Cyprowski, M., Sowiak, M. and Szadkowska-Stanczyk, I. (2011). *Aerobiologia* **27**, 345-351.