Fungal burden in waste industry: an occupational risk to be solved

Waste management is a source of airborne microorganisms and their associated compounds (bioaerosols) in the waste facilities' air. Bioaerosol exposure can lead to several pathologies, hence additional monitoring should be performed to evaluate the effectiveness of implemented measures, and as a way to consider alternative strategies if the contamination problems remains. Therefore, this study intends to assess fungal contamination in one waste-sorting plant, more precisely in one presorting cabinet, before and after cleaning procedures, to analyze the effectiveness of this procedure.

The object of this study was a waste-sorting plant (WSP), located in the Lisbon region, working 5 days a week in a daily regimen of two 8 hour shifts. The WSP workers did not wear any respiratory protection devices. Air samples of 50L were collected through an impaction method, which is a process in which particles are removed from an air stream. Surfaces samples were also collected at the same time. In other hand, air samples of 250L were also collected for analysis of fungal DNA levels by qPCR. The sampling times were done before and after cleaning measures.

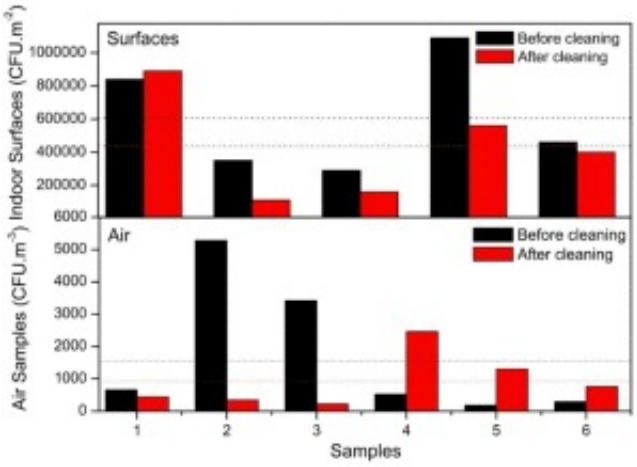

Fig. 1. Fungal load in air and surfaces before and after cleaning procedures.

Figure 1 shows the air and surfaces fungal load for all the sampling times done before and after cleaning measures. The air fungal load ranged from 180 CFU.m^{-3} to 5280 CFU.m^{-3} before cleaning and from 220 CFU.m^{-3} to 2460 CFU.m^{-3} after cleaning. Surfaces present higher load than the air in both periods with results that ranged from 290000 CFU.m^{-2} to 1090000 CFU.m^{-2} before cleaning and from 110000 CFU.m^{-2} to 890000 CFU.m^{-2} after cleaning (Fig. 1.).

When comparing CFU. m^{-3} on air and CFU.m^{-2} on surfaces before and after cleaning statistically

significant differences were not detected neither in the air (z=?0.674, p=0.500) nor on surfaces (z=?0.944, p= 0.345).

Before cleaning procedures, eight different species of fungi were identified in air samples and other eight in surfaces. In air, three fungal groups were more frequently isolated: Penicillium sp. (48.1%), species from A. fumigatus complex (32.0%) and species from A. niger complex (14.3%). In surfaces, species from A. niger complex (66.3%) and Eurotium herbarium (20.8%) were the most found. After cleaning procedures, seven different species of fungi were identified in air samples and six different were identified is surfaces. Among these, some were more frequently isolated: species from A. niger complex (51.4%) and Penicillium sp. (40.6%) and species from A. niger complex (63.4%) and Ulocladium sp. (29.0%), respectively. qPCR analysis successfully amplified DNA from the A. fumigatus complex in two sampling times (one before and one after cleaning). Interestingly, the presence of this fungal species was not identified by conventional methods.

The degree of separation of the domestic waste received by plants will govern the choice of equipment and work routines. Poorly separated waste may require either manual sorting at the plant or other work routines in which the workers have direct contact with the waste and that leads to a higher health risk to workers. An increase in microorganism's concentrations or differences in the species present indoors and outdoors may indicate an abnormal situation and specific health risks. In addition to the differences observed between indoor and outdoor samples regarding fungal load, prevalent species after cleaning procedures also differ from the ones most prevalent indoors. To reduce fungal burden in this setting, one of the possible measures is the application of cleaning products that contain fungicides. Considering fungal burden in this kind of setting and the scientific evidence that manual sorting of unseparated domestic waste may pose a high health risk to the workers, we strongly recommend the use of personal protective equipment (during also the cleaning procedures), and the teaching of safe working habits.

It is necessary to determine the fungal burden quantitatively and qualitatively to carry out risk assessment and to qualify the effect of protective measures already implemented. Although the results reveal less fungal load after cleaning procedures, effectiveness is in doubt since fungal species found after this procedure are known for their toxigenic potential. Conventional and molecular methods are complementary methodologies and should always be applied in the waste industry in order to ensure a real scenario characterization regarding fungal burden.

Publication

Fungal burden in waste industry: an occupational risk to be solved.
Viegas C, Faria T, dos Santos M, Carolino E, Gomes AQ, Sabino R, Viegas S.
Environ Monit Assess. 2015 Apr