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Airborne and dust borne microorganisms in selected Polish libraries and archives

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ABSTRACT

The aims of this work were to quantitatively and qualitatively study culturable fungi and bacteria in the air and settled dust in the storerooms of five Polish libraries and archives as well as to estimate the effect of water intrusion on the microbial air quality indoors. In all studied storerooms, the total bioaerosol concentrations at the workplaces ranged from 100 to 1000 cfu/m^3. The most prevalent part of the storerooms' bioaerosol consisted of bacteria, mainly *Staphylococcus* spp. and *Micrococcus* spp., followed by filamentous fungi. In four of the studied premises, fungal aerosol concentrations were below 100 cfu/m^3. The only exception was observed in the fifth storeroom, which has been periodically flooded with rainwater and where significantly higher concentrations of fungal aerosol were measured. Among the identified fungal species, those of the genus *Penicillium* were the most numerous. Moreover, *Trichothecium laxicephalum* and *Alternaria tenuis* were present in all of the examined storerooms.

The other objective of this study was to evaluate the effect of renovation and mechanical cleaning of the flooded storeroom collection on the level of microbial contamination. The obtained results show that both of the applied procedures reduced the concentration of fungal and bacterial aerosols by almost 80% and 50%, respectively. A significant reduction in the number of airborne microbial species was also noted. Hence, if the source of moisture is removed and mechanical cleaning is subsequently applied, the hygienic quality of a storeroom collection can be significantly improved.

1. Introduction

For several centuries, libraries and archives have been collecting, storing and rendering available thousands of books and documents. The condition of such preserved collections is under the constant influence of different environmental factors. The most crucial among them are: microclimate in storerooms (i.e. temperature and humidity of the air), type and amount of light (i.e. type of light waves on the electromagnetic spectrum and radiation intensity) received by collections, type and amount of chemicals indoors, as well as the hygienic condition of collections and the air quality in storage rooms, in both cases determined by microorganisms' abundance [1–3].

Of all the harmful microbiological agents, fungi and bacteria have the greatest influence on the hygienic condition of library and archive storerooms and, thereby, on the state of preservation of the gathered collections. While the majority of fungal sources are located outdoors (soil, plants, water bodies), the major indoor bacterial reservoirs are considered to be humans and animals. Hence, the dominant microorganisms in the atmospheric air are fungi, while bacteria prevail in the air of closed spaces [4–8]. If the infiltration of outdoor air is not an issue, the number of fungal particles in the air of libraries or archives can increase as a result of spore dispersal from several internal sources, such as contaminated collections, wallpaper, paint or even flowerpot soil.

Books or other archival materials are a rich reservoir of many nutritional substances. Among them are cellulose, which is the main constituent of paper, and proteins, which are present in, for example, leather book bindings and adhesives used in the manufacture of paper and books. Each of the above-mentioned nutritional substances stimulates the growth of a specific group of microorganisms. Fungi exhibit strong cellulolytic (mainly species of the genera *Trichoderma, Penicillium, Botrytis, Chaetomium, Stemphylium* and *Alternaria*), proteolytic (e.g. species of the genera *Mucor, Aureobasidium, Chaetomium, Trichoderma, Verticillium* and *Epicoccum*) and lipolytic properties (as above plus *Paecilomyces*) [9–23]. Bacteria rarely exist on paper and their number increases significantly only when library or archive collections are damp, flooded or when the drying process of this type of material is too slow. Such conditions are favorable for the development of

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