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MICROBIOLOGICAL CONTAMINATION WITH MOULDS IN WORK ENVIRONMENT IN LIBRARIES AND ARCHIVE STORAGE FACILITIES

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Abstract: Microbiological contamination with fungi, including moulds, can pose a significant health hazard to those working in archives or museums. The species involved include *Aspergillus*, *Penicillium*, *Geotrichum*, *Alternaria*, *Cladosporium*, *Mucor*, *Rhizopus*, *Trichoderma*, *Fusarium* which are associated mostly with allergic response of different types. The aim of the study was to analyse, both in quantitative and qualitative terms, workplace air samples collected in a library and archive storage facilities. Occupational exposure and the related health hazard from microbiological contamination with moulds were assessed in three archive storage buildings and one library. Air samples (total 60) were collected via impact method before work and at hourly intervals during work performance. Surface samples from the artifacts were collected by pressing a counting (RODAC) plate filled with malt extract agar against the surface of the artifacts. The air sample and surface sample analyses yielded 36 different mould species, classified into 19 genera, of which *Cladosporium* and *Penicillium* were the most prevalent. Twelve species were regarded as potentially pathogenic for humans: 8 had allergic and 11 toxic properties, the latter including *Aspergillus fumigatus*. Quantitative analysis revealed air microbiological contamination with moulds at the level ranging from 1.8×10^2–2.3×10^3 cfu/m^3. In surface samples from library and archive artifacts, 11 fungal species were distinguished; the number of species per artifact varying from 1–6 and colony count ranging from 4×10^1 to 8–10^1 cfu/100 cm^2. Higher contamination levels were found only for *Cladosporium cladosporioides* (1.48×10^3 cfu/100 cm^2) and *Paecillomyces varioti* (1.2×10^2 cfu/100 cm^2). At the workposts examined, although no clearly visible signs of mould contamination could be found, the study revealed abundant micromycetes, with the predominant species of *Cladosporium* and *Penicillium*. The detected species included also potentially pathogenic microorganisms which can cause allergic and toxic effects, such as *Aspergillus fumigatus*, that could be hazardous to workers' health. For some species, the concentration levels exceeded the values considered the proposed hygienic standards for total microscopical fungi in occupational settings. The findings of the study point to unsatisfactory hygienic conditions at the worksites examined, resulting in microbiological contamination with moulds, as well as the necessity for prompt remedial activities on the part of the employers.

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INTRODUCTION

Fungi and moulds are biological hazards that are ubiquitous both in the communal and occupational environments. Many fungal and mould species exhibit pathogenic properties; they can also have allergic, toxic or infectious effects on humans. Exposure to this microscopical fungi can produce a number of negative health outcomes, including

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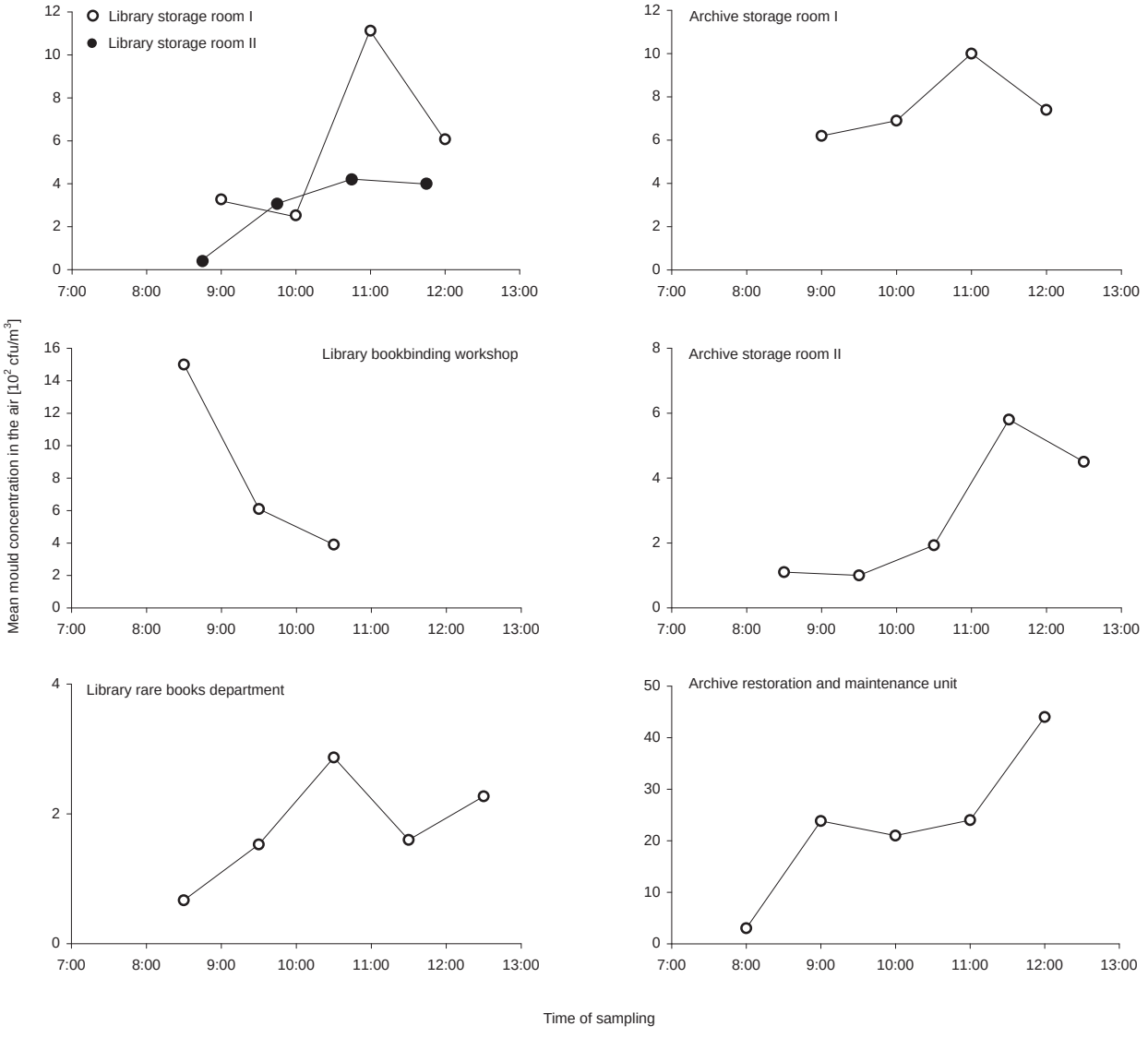


Figure 1. Dynamics of changes in air concentration of moulds during work performance at library and archive storage facilities.

allergies, mycoses, or toxicity [9, 10]. Moulds can pose a health hazard to library, archive and museum workers [13] to name but a few professions where this biological hazard can be encountered. The species accounting for mycological contamination of the library, archive and museum collections include *Aspergillus*, *Penicillium*, *Geotrichum*, *Alternaria*, *Cladosporium*, *Mucor*, *Rhizopus*, *Trichoderma*, *Fusarium*. These are also known as an etiologic factor of several conditions, e.g. allergic diseases [2, 3, 5].

At archive storage sites and libraries, the source of microbiological hazard can be the artifacts themselves, the house dust and bioaerosols as well as the construction units, and wooden bookcases and filing cabinets. Most of the artifacts stored at those sites are likely to be colonized with microscopical fungi due to the fact that in terms of chemical structure they are composed mostly of carbohydrates and proteins which are a good medium for microbial growth, especially of moulds [12, 20].

Generally, the library and archive workers are at no particular health risk if the collections are stored under appropriate hygienic and climatic conditions and the construction standards for this type of facilities are complied with. If the storage conditions change, e.g. the indoor temperature or humidity increases, the collections may become colonized with microscopical fungi presenting a health hazard to the workers. Also, when the already contaminated artifacts are removed for restoration and maintenance, the workers are exposed to microorganisms from the artifacts, house dust, and wall surface. Under conditions of increased humidity, the microorganisms, including moulds, form bioaerosol that is inhaled by the workers. Colonization with microorganisms and formation of bioaerosols can also proceed when the level of indoor humidity is normal but the volume of dust on the artifacts and inside the facility is high. The type of work that make library and archive workers particularly exposed to microscopical fungi through skin contact

and bioaerosol inhalation include: restoration and maintenance activities, transportation to and from the storage site, destroying damaged artifacts with a shredder, examination and remediation of contaminated artifacts, maintenance and repair of ventilation systems.

The aim of the project was to evaluate, both in quantitative and qualitative terms, the microbiological contamination at library and archive storage facilities, based on air sample analysis, and to determine the prevalence of selected symptoms of allergy as the potential health effects of occupational exposure to moulds. The present paper discusses the findings from the microbiological analysis of workplace air. The results of a survey on the prevalence and relative risk of allergic symptoms will be discussed under separate cover.

MATERIAL AND METHODS

Microbiological analysis concerned three archive storage sites and one library. As regards the archive, the field study was performed in three facilities: two storage rooms and a restoration and maintenance unit. At the library, the measurements were carried out in four facilities: two storage rooms, a rare books department and a bookbinding workshop.

Air sample analysis. Workplace air samples were collected using the impact method where a known volume of air passes into the device and the airborne fungal spores are impacted onto a counting (RODAC) plate filled with malt extract agar (MEA) and chloramphenicol as the medium. The method is in compliance with respective European standard PN-EN 13098 (2002) Workplace atmospheres: Guidelines for measurement of airborne micro-organisms and endotoxin. MAS 100 single-stage sampler (Merck) was used. For each single-stage sampling, the air volume was 50 l and 100 l. The samples (total 60) were collected in the worker's breathing zone before work and at hourly intervals during work performance. They were incubated at 30°C for 5 days. The resulting microbial growth was counted and fungal concentration in the air, expressed as the colony forming units per cubic meter of air (cfu/m^3) was determined.

Surface sample analysis. The surface samples of microscopical fungi were collected by pressing a counting plate (Count-Tact Sabouraud Dextrose Chloramphenicol Neutralizers Agar, BioMerieux, France) filled with MEA against the surface of the artifacts. In total, 11 samples were collected from the book and archive collections. The size of the counting (RODAC) plate was 25 cm^2. The samples were incubated as above and the results were expressed as cfu/100 cm^2.

Identification of predominant species. From the incubated microflora, fungal colonies were isolated and cultured on Czapek medium and incubated as above. These were later microscopically analysed and identified by morphological traits.

RESULTS

Quantitative analysis of air samples revealed moderate microbiological contamination varying from 1.8×10^2 cfu/m^3 in the rare books dept. of the library to 2.3×10^3 cfu/m^3 in an archive restoration unit. Mean values and concentration range determined for particular facilities are shown in Table 1.

Microbiological contamination was found to be a time-varying parameter. Figure 1 shows the dynamics of changes in mould concentration in workplace air during daily routine activities. The jobs performed at the facilities examined included transporting books from the storage room to the reading room (storage room, library), reading and restoring antique books and manuscripts (rare books dept., library) or archive files and documentation (restoration unit, archive), taking documentation from the storage room to make out extracts (storage room 2, archive), and book binding (maintenance workshop, library).

In all the facilities examined, except for the bookbinding workshop, mould concentration in the air was found to increase with time of work performance. It was gradually decreasing when the work shift was over. At the workshop, the static nature of the job and the related low air circulation may have accounted for the reverse dynamics of mould concentration during working hours. The highest concentration levels were recorded at the onset of work and then the values steadily decreased.

The field study yielded 36 species of moulds belonging to 19 genera. Twelve of them were pathogenic to humans: 8 produced allergic effect and 11 had toxic effect. In particular facilities, the number of detected species ranged from 12 at the bookbinding workshop to 20 at the archive restoration unit, and of the pathogenic species, from 6 in

Table 1. Total concentration of moulds at library and archive storage facilities.

	Range of concentrations (cfu/m^3)	Mean concentration (cfu/m^3)
Library		
storage room I	1.6×10^2–1.7×10^3	5.7×10^2
storage room II	2.0×10^1–7.8×10^2	2.9×10^2
rare books departament	6.0×10^1–8.0×10^2	1.8×10^2
bookbinding workshop	2.6×10^2–1.8×10^3	8.3×10^2
Archive		
restoration and maintenance unit	2.6×10^2–2.9×10^3	2.3×10^3
storage room I	6.0×10^1–1.2×10^3	6.3×10^2
storage room II	5.0×10^1–9.4×10^2	2.9×10^2

the archive storage room I to 11 in archive storage room II and library storage room. Predominant species belonged to the *Cladosporium* generus and included *Cladosporium cladosporioides*, *Cladosporium herbarium* and *Penicillium chrysogenum*. The *Aspergillus fumigatus* species was also detected in an air sample collected in archive storage room I and in a surface sample from archive storage room II (Tab. 2). In currently recommended hygienic standards for moulds, this species is indicated as inadmissible at facilities where humans dwell or work.

Table 3 summarizes mould species isolated from air samples at particular facilities, including their mean concentration values. Worthy of note are the high concentrations of *Alternaria alternata* (2.6×10^4 cfu/m^3) and *Cladosporium herbarium* (1.6×10^4 cfu/m^3) detected in the archive restoration room during the work shift. For the latter species, relatively high concentrations levels were also found at other facilities: 1.3×10^3–3.3×10^3 cfu/m^3 in both storage rooms and a bookbinding workshop in the library and 3.5×10^3 cfu/m^3 in the archive storage room I. High concentrations ($1.8 \times 10^3 - 3.9 \times 10^3$ cfu/m^3) were determined for *Cladosporium cladosporioides* in all archive facilities, *Acremonitum murorum* (1.5×10^3 cfu/m^3) and *Humicola fuscoatra* (2.3×10^3 cfu/m^3) in the archive restoration room, *Paecillomyces varioti* ($1.2 \times 10^3 - 1.3 \times 10^3$ cfu/m^3) in library storage rooms, *Penicillium chrysogenum* ($2.8 \times 10^3 - 3.7 \times 10^3$ cfu/m^3) in library storage room I and bookbinding workshop, and *Penicillium cyclopium* ($1.5 \times 10^3 - 3.1 \times 10^3$ cfu/m^3) in both library storage rooms and rare books dept.

Analysis of surface samples collected from library and archive artifacts (books, antique books and manuscripts, and records) yielded 11 mould species. In surface samples from the library collection, the micromycetes included only 2 mould species: *Aspergillus usus* and *Penicillium* spp. In the archive facilities, microscopical fungi were most abundant on the records dating back to 1847 that were stored in storage room I. As many as 6 mould species were identified in the samples from these artifacts. In the other archive facilities, the number of species detected in surface samples ranged from 1–3. The volume of micromycetes colonizing the surface of the examined books and records was not high; it ranged from 4×10^1–8×10^1 cfu/100 cm^2. A higher level of mould contamination could be found only for the species of *Cladosporium cladosporioides* (1.48×10^3 cfu/100 cm^2) detected in samples from the 1847 records at storage room I, and *Paecillomyces varioti* (1.2×10^2 cfu/100 cm^2) from 1920 records at storage room II (Tab. 4).

DISCUSSION

Reports on microbiological contamination of library and archive facilities as an occupational health problem have been rather scarce. Kolomodin-Hedman *et al.* [11] described a case of a museum worker who developed a number of symptoms (shivering, malaise, cough and nausea) while working at a facility where damp and mould-contaminated books were kept. Air sample analysis revealed contamination with fungal microflora (mostly *Aspergillus versicolor* and *Penicillium verrucosum*) at the level of 10^6 cfu/m^3 and 10^8 spor/m^3. A study on mycological contamination at an archive facility conducted by Krysińska-Traczyk [14] revealed a large number of mould species: *Peniciullium* genus, *Caldosporium herbarum*, *Geotrichum candidum*, *Cephalosporium glutineum*, *Mucor racemosus*, *Trichoderma viride*, and *Aspergillus niger* in

Table 2. Prevalence of moulds in workplace air at library and archive storage facilities.

Sampling site	Number of species		Predominant species
	Total	Potentially pathogenic to humans including A-allergenic, T-toxic	
Library			
Storage room I	15	9 (T – 6, A – 6)	*Penicillium chrysogenum* *Cladosporium herbarum*
Storage room II	14	11 (T – 8, A – 6)	*Penicillum chrysogenum* *Cladosporium herbarum*
Rare books department	17	10 (T – 6, A – 6)	*Penicillum chrysogenum* *Cladosporium herbarum*
Bookbinding workshop	12	8 (T – 6, A – 6)	*Penicillum chrysogenum* *Cladosporium cladosporioides*
Archive			
Restoration and maintenance unit	20	9 (T – 7, A – 6)	*Cladosporium herbarum* *Cladosporium cladosporioides*
Storage room I	17 (*Aspergillus fumigatus* – surface samples)	6 (T – 5, A – 6)	*Cladosporium cladosporioides*
Storage room II	16 (*Aspergillus fumigatus* – air samples)	11 (T – 8, A – 7)	*Cladosporium cladosporioides* *Penicillum chrysogenum*

Table 3. Mould species detected in the air samples collected at the library and archive storage facilities.

Species	Concentration [cfu/m^3]						
	Library				Archive		
	Storage room I	Storage room II	Rare books departament	Bookbinding workshop	Restoration and maintenance unit	Storage room I	Storage room II
Acremonium charticola	–	–	2.5×10^2	–	3.5×10^2	1.0×10^3	3.5×10^2
Acremonium murorum	5.0×10^2	–	2.0×10^2	2.0×10^2	1.5×10^3	7.2×10^2	–
Acremonium strictum	2.0×10^2	–	2.0×10^2	4.0×10^2	2.7×10^2	4.0×10^2	2.0×10^2
Alternaria alternata	3.3×10^2	3.0×10^2	2.0×10^2	4.5×10^2	2.617×10^4	7.3×10^2	4.0×10^2
Aspergillus fumigatus	–	–	–	–	–	–	5.0×10^2
Aspergillus niger	2.0×10^2	2.0×10^2	–	2.0×10^2	3.5×10^2	2.0×10^2	5.0×10^2
Aspergillus restrictus	–	–	–	–	–	–	3.5×10^2
Aspergillus ustus	2.0×10^2	2.4×10^2	2.0×10^2	5.0×10^2	7.5×10^2	–	–
Aspergillus sydowii	–	–	–	–	–	–	–
Aspergillus versicolor	2.0×10^2	2.0×10^2	5.0×10^2	3.5×10^2	4.4×10^2	5.0×10^2	5.7×10^2
Aureobasidium pullulans	–	–	–	–	4.4×10^2	–	–
Botrytis cinerea	2.8×10^2	2.0×10^2	3.0×10^2	–	–	–	–
Chaetomium globosum	–	2.0×10^2	–	–	–	–	–
Chaetomium spp.	–	–	2.5×10^2	–	7.5×10^2	–	–
Cladosporium cladosporiodes	6.0×10^2	2.5×10^2	3.1×10^2	1.06×10^3	3.94×10^3	3.76×10^3	1.81×10^3
Cladosporium herbarum	1.3×10^3	1.4×10^3	5.5×10^2	3.34×10^3	1.638×10^4	3.57×10^3	–
Epicoccum nigrum	6.0×10^2	–	2.0×10^2	–	–	–	–
Eurotium repens	–	–	–	–	5.0×10^2	–	–
Fusarium spp.	–	–	–	–	1.0×10^3	–	–
Humicola fuscoatra	–	–	–	5.0×10^2	2.31×10^3	4.3×10^2	–
Humicola spp.	–	–	–	–	–	–	–
Paecillomyces varioti	1.2×10^3	1.35×10^3	–	–	8.8×10^2	5.0×10^2	2.0×10^2
Pencillium chrysogenum	2.84×10^3	7.7×10^2	7.8×10^2	3.76×10^3	3.5×10^2	6.6×10^2	5.3×10^2
Penicillium citrinum	–	–	–	–	–	5.0×10^2	–
Penicillium corylophilum	–	–	–	8.5×10^2	9.0×10^2	9.4×10^2	–
Penicillium cyclopium	3.1×10^3	1.5×10^3	1.6×10^3	–	–	–	7.3×10^2
Penicillium funiculosum	–	–	–	–	–	–	8.9×10^2
Penicillium rugulosum	–	–	–	–	–	5.0×10^2	–
Penicillium spp.	3.0×10^2	1.25×10^3	2.0×10^2	2.0×10^2	5.7×10^2	–	3.5×10^2
Penicillium spinulosum	–	–	–	–	–	–	3.6×10^2
Rhizopus nigricans	–	2.0×10^2	–	–	–	–	3.5×10^2
Talaromyces helicus	–	–	–	–	–	2.0×10^2	–
Trichoderma viride	–	–	2.0×10^2	–	–	–	3.0×10^2
Trichotecium roseum	–	–	–	–	8.9×10^2	–	–
Ulocladium chartarum	–	–	2.0×10^2	–	–	–	–
Verticillium spp.	–	2.0×10^2	–	–	1.0×10^3	–	–

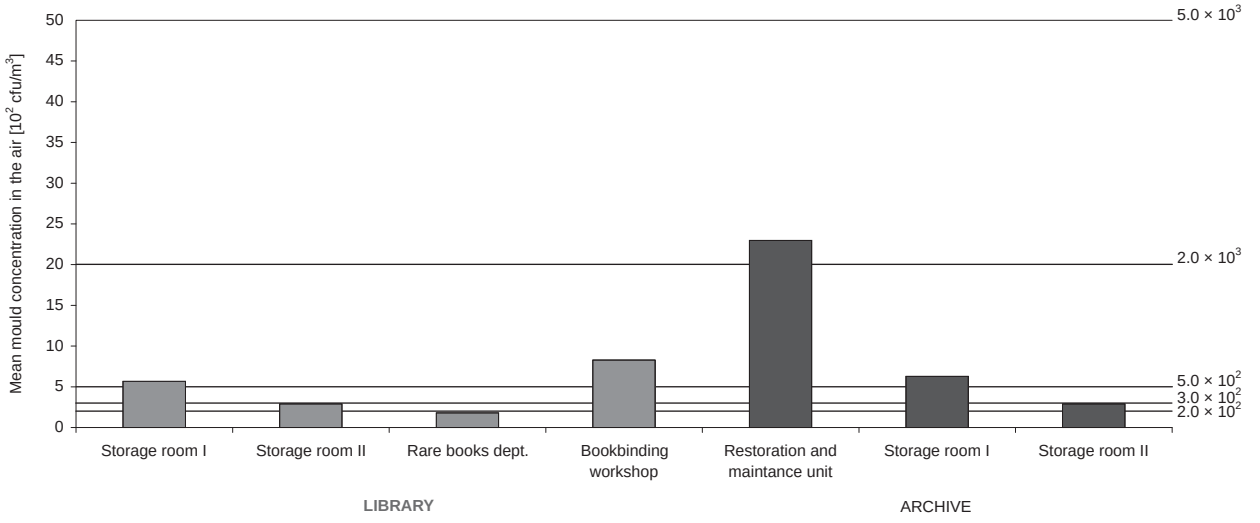
dust samples collected from the contaminated books. The concentration varied from 3.5×10^5 cfu/g for the *Penicillium* species to 5×10^2–1.0×10^5 cfu/g for the other species. It was found that a long duration of work under conditions of exposure to dust exhibiting allergic and toxic properties might have accounted for the symptoms of respiratory and skin allergies reported by archive workers. Krake *et al.* [13], in their study on mycological contamination of workplace air and the surface of artifacts in a museum, detected abundant mycological microflora belonging mostly

Table 4. Mould species detected in surface samples from the artifacts at library and archive storage facilities.

Sampling site		Material examined	Species	Colony count [cfu/100 cm^3]
Library	Storage room I	Book dated 1995	–	–
	Storage room II	Book dated 1955	–	–
	Rare books departament	Manuscript dated 7th cent.	*Aspergillus usus* *Penicillium* spp.	4.0×10^1 4.0×10^1
	Bookbinding workshop	–	–	–
Archive	Restoration and maintenance unit	The Bible dated 1949	*Paecillomyces varioti*	4.0×10^1
	Storage room I	Records dated 1826	*Cladosporium herbarum* *Penicillium chrysogenum*	8.0×10^1 4.0×10^1
		Records dated 1847	*Cladosporium cladosporiodes* *Cladosporium herbarum* *Penicillium corylophilum* *Aspergillus fumigatus* *Pencillium chrysogenum* *Acremonium murorum*	1.48×10^3 8.0×10^1 8.0×10^1 8.0×10^1 4.0×10^1 4.0×10^1
	Storage room II	Records dated 1920	*Paecillomyces varioti* *Aspergillus sydowii*	1.2×10^2 4.0×10^1
		Records dated 1978	*Rhizopus nigricans*	4.0×10^1
		Records dated 1998	*Cladosporium herbarum* *Penicillium* spp. *Paecillomyces varioti*	4.0×10^1 4.0×10^1 4.0×10^1

to the *Penicillium*, *Cladosporium*, *Aspergillus*, *Alternaria*, and *Tritirachium* species (36 species and genera in total). Air concentration of moulds ranged from ca. 1.8×10^2 to ca. 4.5×10^2 cfu/m^3, depending on the facility, and for the *Tritirachium* species it approximated 8.0×10^2 cfu/m^3. The workers taking part in the survey reported respiratory and sinus-related symptoms which could have been associated with workplace exposure to moulds. In a literature review, Zyska (1997) discussed study results on numerous filamentous fungi (84 genera represented by 234 species) isolated from various biological samples collected in library or archive storage environments in different countries during the period of 1919-1977 [21]. Among these genera and species, 19% (44 species) could be dangerous to the librarians due to mycotoxins exposure. Lugauskas and Krikstaponis (2004) [15] studied microscopic fungi present in libraries and analysed the factors affecting their development. A total of 174 fungal species belonging to 52 genera were isolated. The authors found that the mycological state of the books depended largely on the conditions of the buildings, their maintenance, location, and the type of the ventilation system. Such factors as the installation systems, overall maintenance of the premises, temperature, humidity, air movement and the number of visitors were assumed to be the major factors which determined the mycological pollution of the buildings and the level of contamination of the books. The authors pointed out that the allergenic properties of the fungi detected in libraries, as well as their ability to produce, accumulate and release volatile toxic secondary metabolites into the library surroundings, might pose a health risk to library workers. Similar studies were conducted by German researchers (Hödtl 1991, Neuheuser 1995, Schata 1995) [8, 17, 19] who noted that mesophytes comprised the majority of the fungi found growing on the books. The authors analysed the influence of various physical factors (temperature, humidity, substratum pH) upon the development of micromycetes on paper, parchment, leather, textile and other materials. Some of the archive workers who participated in a survey conducted by Schata (1995) reported various skin, eye and respiratory symptoms which could have been associated with occupational exposure to moulds. It was estimated that about 1/3 of archive workers might have developed allergy to moulds, which is about twice as high as in the general population. While evaluating the mycological state of libraries, some authors tend to apply the regional Kendall correlation coefficient. Pokrovskaja and Nyuksha (1995), in their comparative investigation on fungal contamination of book and document depositories, revealed 118 micromycete species belonging mostly to Penicillium, Aspergillus, Mucor, Fusarium, Trichoderma, Chaetomium, Stachybotrys, Sporotrichum, Stemphylium genera. The authors presumed that the main factor accounting for the presence of these particular species was the specificity of the substratum (books and documents) and environmental conditions (relative humidity and temperature) [18].

The present project focused on determining mould concentration in library and archive storage facilities before



2.0 × 10² – MAC value proposal for total fungal microflora (Etkin)
3.0 × 10² – MAC value proposal for total fungal species (Etkin)
5.0 × 10³ – MAC value proposal for total fungal microflora in non-industrial setting: increased/high contamination (CEC)
2.0 × 10³ – MAC value proposal for total fungal microflora in non-industrial setting: very high contamination (CEC)
2.0 × 10³ – TLV proposal for occupational exposure to fungal microflora (Malmros)

Figure 2. Air concentration of moulds at library and archive storage facilities vs. proposed hygienic standard values.

and during the work shift. Although no visible traits of mould contamination could be found, we detected abundant micromycete species (36 total) in the facilities examined. In workplace air samples, mean mould concentration was relatively high and ranged from 1.8×10^2–2.3×10^3 cfu/m^3. Analysis of surface samples collected from the artifacts revealed 11 species of moulds, generally at a low level of volume, except for the species detected in the samples from 2 record collections. Microbiological contamination with moulds of the *Cladosporium cladosporioides* and *Paecillomyces varioti* species was at the level of 1.48×10^3 cfu/100 cm^2 and 1.2×10^2 cfu/100 cm^2. In all the facilities examined, except the bookbinding workshop, a time-dependent increase in the air concentration could be noted. Mould concentration in workplace air increased with the increasing duration of work performance (removing books and files from the shelves and cabinets, examining and moving them to other locations) and then steadily decreased when the work shift was over.

It is impossible to definitely interpret the findings on fungal contamination in terms of the occupational health hazard. Contrary to the physical and chemical agents, the biological hazards lack commonly accepted criteria of exposure assessment as well as hygienic standards or reference values. Different proposals for standard values have been developed both by individual researchers and collegiate bodies (Fig. 2). These can be helpful in interpreting the results of measurements regarding biological hazards. A part of the proposed values are arbitrary, they define the biological hazard levels regarded either as acceptable or unacceptable with respect to the health risk for the exposed individuals [7].

According to the occupational health criteria proposed by Etkin [6], the admissible concentration for total moulds in workplace air is that of 2.0×10^2 cfu/m^3. However, if the dominant species is *Cladosporium* (which was noted for most of the samples examined in the present project), its air concentration is admissible up to the level of 3×10^2 cfu/m^3 [6]. Also the admissible level of air contamination with moulds is higher under these conditions and amounts to 500 cfu/m^3 [17]. The Commission of the European Communities proposed that values higher than 5.0×10^2 cfu/m^3 for air concentration of moulds in non-industrial setting should be regarded as an increased contamination level, while the values exceeding 2.0×10^3 cfu/m^3 as very high contamination [4].

In all the 7 facilities examined, except for the rare books dept., the mean concentrations of fungal microflora were higher than the above reference values: the admissible level of 2.0×10^2 cfu/m^3 was exceeded in 6 out of 7 facilities, while the values of 3.0×10^2 cfu/m^3 and 5.0×10^2 cfu/m^3 in 4 out of 7 units.

As reported by Malmros *et al.* [16], the Threshold Limit Values for occupational exposure to moulds range from 5.0×10^3–1.0×10^4 cfu/m^3. In our studies, mould concentrations detected in all the samples fell within this range. Figure 2 shows concentration levels recorded at particular facilities and compares them with some of the proposed hygienic standards and reference values for this microscopical fungi.

Literature reports are consistent with respect to the species that are inadmissible in human environment, these include *Stachybotrys alba*, *Stachybotrys chartarum*, *Aspergillus flavus* and *Aspergillus fumigatus* [1]. In our study, only the latter species was found in air samples collected in archive storage room II and in surface samples from archive storage room I.

CONCLUSIONS

At the workposts examined, although no clearly visible signs of mould contamination could be found, the study revealed abundant microscopical fungi, with the predominant species of *Cladosporium* and *Penicillium*. The detected species included also potentially pathogenic microorganisms producing allergic and toxic effects, such as *Aspergillus fumigatus*, that could be hazardous to workers health. For some species, the concentration levels exceeded the values considered the proposed hygienic standards for total microscopical fungi in occupational settings. The findings of the study point to unsatisfactory hygienic conditions at the worksites examined, resulting in microbiological contamination with moulds and posing potential risk to the workers' health, as well as the necessity for prompt remedial activities on the part of the employers.

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