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Constant human health mycobiotic irritants in the urban environment of the Old Town of Vilnius

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One of the main goals of this work is to determine mycobiotic irritants and mycobiota, dominant on old construction materials, which were formerly widely used under reconstruction and renovation environment of the Old Town of Vilnius during 2012–2014. It was determined that the composition of mycobiota at different construction objects significantly differs. *Aspergillus* spp., *Penicillium* spp. and *Fusarium* spp. have been reported as the main genera present in building wastes. Scanning electron microscopy was used to characterize the morphology of the fungi. The chemical characterization of samples was performed by the Fourier Transform InfraRed, X-ray fluorescense spectroscopy methods and the X-ray diffraction analysis. Reconstruction and renovation of old urban construction materials produce plenty of chemical and biological pollution, which can have a real hazard for human health and environment.

Keywords: building materials, microbiology, pollution, urban health

INTRODUCTION

Building restoration and renovation works are constantly carried out in the Old Town of Vilnius. These processes produce plenty of chemical and biological pollution, including various mycobiota species and air pollutants, which can damage and destroy valuable ancient, new and restored buildings [1–3]. Additionally, many people participate in these activities and quite possibly develop human and biota pathogens wich can have a negative impact on human health [4].

A part of building materials is susceptible to humidity and when damp becomes easily damaged by microorganisms [5–9]. Generally, indoor pollutants mycobiota are a mixture of those that have entered from outdoors and those from indoor uses [10]. Mycobiota under urban environmental conditions have the potential to produce mycotoxins. Poor indoor air quality causes fatigue, nausea, headache, dizziness, irritability, lack of concentration and memory loss, irritated eyes, nose and throat mucus, skin reddening, as well as breathlessness and cough attacks [11, 12]. The findings of exposure interactions and exposure–response relationships of mycobiota and endotoxin with an increased risk of building-related symptoms contribute to an understanding of the role of microbial agents in building-related asthma and respiratory and systemic symptoms [13, 14]. The main requirements for fungal growth in buildings are the source of infection, temperature, nutrients, oxygen and water [15–18]. Too high or too low humidity can course a variety of health threats and illnesses [19, 20].

Organic and inorganic transformations occurred as a result of metabolism and degradation of organic substrates, uptake, accumulation, production of hybrid materials and biominerals [8, 9, 20–26]. Among the metabolites with chelating properties some of the most common are carboxylic acids and, in particular, oxalic acid [27, 28].

The destruction of the same material under different environment conditions may proceed quite differently [8, 9, 29]. It is necessary to limit the quality of environment where hazardous materials could be accumulated. In order

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to preserve people-friendly mycobiotical conditions, a constant mycobiotic control is essential.

In this work we have focused on the results of chemical analysis, to determine mycobiota capacities to function in substrates of construction materials, that can become aggressive sources of urban environment to human health in the outdoor and indoor environment of the Old Town of Vilnius by restoration and renovation works during 2012–2014.

EXPERIMENTAL

Samples of construction materials were collected in different sites of the Old Town of Vilnius during 2012–2014. The studied samples of collected materials were divided into five groups, generally 20 samples (Table 2).

Airborne mycobiota were collected with a slit-to-agar single stage impactor Krotov 818 (OJSC "Krasnogvardejec" 3,

Table 1. **A brief description of sampling objects**

Group	No.	Sampling objects
I	1	Dwelling-house, domestic premises, dust and other small organic and inorganic pollutants
	2	Indoor of an old building used as a knitting shop, using natural and synthetic threads, dust and spinning remains
	3	Indoor of an old apartment building, a cellar, dust and different organic and inorganic pollutants
	4	Inside of an old brick house, the first floor, dust of durable activities of a hair dressing salon, hair remains and other pollutants
	5	Indoor of an old building, the first floor, a carpet shop: selling, cutting, cleaning, repairing
II	6	Outdoor environment, a metallic fence made in the 19th century, many times repainted, scrubbed, coated with an organic layer, scraps from the surface
	7	Outdoor environment, a rusty, decaying metallic box to store a gritting salt and sand mixture, scraps from the surface
	8	Outdoor environment, scraps from the metallic surface of rusty tubes and municipal sewerage lines from different city streets
III	9	Indoor of an old dwelling-house contacting with outdoor environment, vent hole walls covered with a black scurf and a dark dust layer, splinters of brick building fouling with a black thin coating of dust
	10	Outdoor environment, scraps from crannied walls of a school building which was built 25 years ago, several times repaired, repainted, spotted
	11	Outdoor environment, remaining synthetic cloth used for packing instruments, decomposing into small pieces
IV	12	Outdoor environment, a wooden fence, few times painted with oil paints, unevenly putrefied and scrambling into pieces of different size, which were mixed with dust and inorganic materials
	13	Outdoor environment, an old architectural ensemble, several times renovated, repaired, repainted with different materials, a brick building situated along a high traffic road, a wall eroded with a grey-dull coating
	14	Outdoor environment, a protective wall of an old architectural ensemble, several times renovated with different materials, repaired, repainted, intensively crumbling, much dust and other pollutants
	15	Outdoor environment, an old brick monument, several times renovated, lies about on sandy soil, gradually crumbling with a dark and gray cover in some places
	16	Outdoor environment, a protective wall surrounding an old architectural example, built in the 18–19th centuries from red bricks, several times rebuilt and renovated with different bricks and materials, walls crumbling, streaked with dirt, dust, in some places wall bricks crumble, coated with organic materials
V	17	Indoor of a house, a laboratory where investigations of electrochemistry processes were carried out, brick scrapings are mixed with dust and metals and various organic compounds systems, scraps from walls
	18	Indoor of a chemical laboratory, a pantry to store, weigh and distribute chemicals. Brick wall scrapings mixed with dust and other pollutants
	19	Outdoor environment, pieces of a crumbling asphaltic road mixed with gravel, dust, and organic substanses, average to intensive traffic
	20	Outdoor environment, pieces of an asphaltic road coating mixed with road dust, soil and organic remains

Russia). It was used for the total airborne fungal spore sampling cut-off 0.5 μm; the volume of the sampled air was 0.05 m^3 per sample. Simultaneously with the collection, the gravitation settle plate method was used for a qualitative analysis of the mycobiota. The number of mycobiota propagules was expertised as colony forming units (CFU) propagules per g mass (CFU/g). Microorganisms from every object's separating, crumbled bricks and adhesive materials were sown directly on Petri dishes filled with nutrient standard media. Two nutrient media were used for the isolation of mycobiota: standard malt agar (DIFCO) with 0.5 g/l chloramphenicol and Sabouraud dextrose agar 65.5 g/l with 0.5 g/l chloramphenicol [30].

The contamination of building materials with propagules of mycobiota was investigated – pieces of building materials were placed in Petri dishes containing a sterile agar medium of malt extract supplied with chloramphenicol. The samples were cultivated in a thermostat at a temperature of 26 ± 2 °C [20].

Dust and other contaminants from the surfaces were taken with sterile cotton swabs and prints were made onto media: metal, wall and ceiling scrapings were placed directly onto the same agar media. This was done with the aim of isolation and identification of the highest possible amount of mycobiota species.

The mycobiota in Petri dishes were evaluated by using a scanning electron microscope (SEM) EVO 50 EP (Carl Zeiss SMTAG, Germany) to characterize the morphology of the mycobiota.

Infrared spectra were recorded on an ALPHA Fourier Transform InfraRed (FTIR) spectrometer (Bruker, Inc., Germany) equipped with a room temperature detector DLAGTS and a platinum-ATR accessory. The spectral resolution was set at 4 cm^{-1}. The spectra were acquired from 16 scans.

The chemical composition of the samples was determined using an X-ray fluorescense spectrometer with a wave dispersion (XRF-WD) Axios Max (PANalytical, Netherlands) with the 4 kW Rh anode. The quantification of elements was performed using the Omnion (PANanalytical) software for the standardless method.

X-ray diffraction (XRD) patterns were recorded using an X-ray diffractometer Smarttab (Rigaku) equipped with a 9 kW rotating C anode X-ray tube. The step-scan mode was used in the 2-theta range from 10 to 80° with a step length of 0.02° and a cutting time of 5 s per step. A qualitative analysis was performed with PDXL 2.

RESULTS AND DISCUSSION

The results of our studies of fungal diversity are shown in Table 2.

Table 2. **Record of mycobiota specia in testing objects**

Group		I					II			III			IV					V			
	No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Quantity of mycobiota mass, CFU/g	$1{\cdot}10^3$	$1{\cdot}10^2$	$1{\cdot}10^4$	$1{\cdot}10^5$	$1{\cdot}10^3$	$1{\cdot}10^1$	$1{\cdot}10^3$	$1{\cdot}10^5$	$1{\cdot}10^5$	$1{\cdot}10^2$	$1{\cdot}10^3$	$1{\cdot}10^1$	$1{\cdot}10^2$	$1{\cdot}10^2$	$1{\cdot}10^3$	$1{\cdot}10^2$	$1{\cdot}10^4$	$1{\cdot}10^2$	$1{\cdot}10^2$	$1{\cdot}10^2$
	Number of mycobiota	14	5	9	9	8	8	13	10	12	7	9	8	12	14	11	7	9	8	7	11
Mycobiota	*Acremonium murorum*								+												
	A. rutilum	+																			
	Actinomycetes spp.							+										+			
	Alternaria alternata	+		+		+															
	A. tenuissima	+		+														+			
	Aspergillus candidus											+									
	A. clavatus				+		+		+					+	+	+	+				
	A. carbonarius								+												
	A. fischeri						+														
	A. flavus										+	+							+		
	A. fumigatus									+								+			
	A. niger			+		+		+		+								+	+		
	A. penicillioides							+													
	A. puniceus						+	+						+							
	A. terreus						+							+	+	+					+
	A. ustus													+	+	+					
	A. versicolor						+	+			+	+		+							
	Aspergillus spp.									+				+	+	+	+			+	
	Aureobasidium pullulans														+						
	A. nidulans																				+

Table 2 **(continued)**

Group		I					II			III			IV					V			
	No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Quantity of mycobiota mass, CFU/g	$1{\cdot}10^3$	$1{\cdot}10^2$	$1{\cdot}10^4$	$1{\cdot}10^5$	$1{\cdot}10^3$	$1{\cdot}10^1$	$1{\cdot}10^3$	$1{\cdot}10^5$	$1{\cdot}10^5$	$1{\cdot}10^2$	$1{\cdot}10^3$	$1{\cdot}10^1$	$1{\cdot}10^2$	$1{\cdot}10^2$	$1{\cdot}10^3$	$1{\cdot}10^2$	$1{\cdot}10^4$	$1{\cdot}10^2$	$1{\cdot}10^2$	$1{\cdot}10^2$
	Number of mycobiota	14	5	9	9	8	8	13	10	12	7	9	8	12	14	11	7	9	8	7	11
Mycobiota	*A. ochraceus*																				+
	Botrytis cinerca								+												
	Candida albicons							+							+			+			
	Cylindrocarpon didymum		+																		
	Chaetomium globosum								+				+								
	Chaetomium spp.																			+	+
	Chrysosporium merdarium								+												
	Cladosporium cladosporioides	+				+		+	+						+						
	C. herbarum	+										+									
	Exophiala jeanselmi								+												
	Eurotium chevalieri							+						+							
	E. repens		+																		
	E. rubrum							+							+						
	Fusarium gibbosum											+									
	F. moniliforme					+															
	F. oxysporum										+		+								
	F. poae												+	+		+	+				+
	F. semitectum	+					+									+					
	F. solani	+					+								+		+				+
	Fusarium spp.																				+
	Gilmaniella humicola																	+			
	Hypocrea spp.												+								
	Humicola grisea																			+	
	Mortierella alpina												+			+	+				
	Mucor hiemalis											+	+		+						
	Mucor spp.				+					+					+						
	Oidiodendron spp.														+						
	Paecilomyces puntonii																		+		
	Paecilomyces spp.	+																			
	Penicillium albocoremium	+																			
	P. brevi-compactum															+					+
	P. chrysogenum	+		+						+				+							
	P. clavigerum																		+		
	P. commune								+	+											
	P. daleae		+																		
	P. expansum				+					+								+			
	P. decumbens			+																	
	P. diversum			+																	
	P. flavigerum	+																			
	P. funiculosum					+															
	P. lanosum		+							+											
	P. oxalicum																		+		
	P. piscarium	+																			
	P. spinulosum																	+			

Table 2 **(continued)**

	Group	I					II			III			IV					V			
	No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Quantity of mycobiota mass, CFU/g	$1{\cdot}10^3$	$1{\cdot}10^2$	$1{\cdot}10^4$	$1{\cdot}10^5$	$1{\cdot}10^3$	$1{\cdot}10^1$	$1{\cdot}10^3$	$1{\cdot}10^5$	$1{\cdot}10^5$	$1{\cdot}10^2$	$1{\cdot}10^3$	$1{\cdot}10^1$	$1{\cdot}10^2$	$1{\cdot}10^2$	$1{\cdot}10^3$	$1{\cdot}10^2$	$1{\cdot}10^4$	$1{\cdot}10^2$	$1{\cdot}10^2$	$1{\cdot}10^2$
	Number of mycobiota	14	5	9	9	8	8	13	10	12	7	9	8	12	14	11	7	9	8	7	11
Mycobiota	*P. verrucosum*	+									+			+	+				+		
	P. viridicatum									+											
	Penicillium spp.										+					+	+			+	
	Phoma exiqua								+												
	Rhizomucor pusillus				+					+			+							+	+
	Rhizopus stolonifer			+																	
	Rhodotorula rubra				+				+												
	Scytalidium lignicola									+											
	Sclerotinia sclerotiorum								+							+					
	Scolecobasidium humicola				+																
	Sporothrix schenckii				+																
	Talaromyces spp.																			+	+
	Trichoderma harzianum			+															+		
	T. viride					+															
	Torulomyces lagena										+										
	Ulocladium chartarum	+			+	+															
	Mycelia sterilia	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

The activity of mycobiota depends on their biological variety in the composition of the substrates which are formed by contamination with microorganisms and coupled with the surrounding medium [30, 31]. A SEM image of some mycobiota is presented in Fig. 1.

Recently abundant data have been presented on a hazardous mycotoxin impact upon human health, problems concerning their synthesis, chemical composition and mechanisms of activity [15, 32–35]. A strong intensity and overlapped bands in the region 1030–1060 cm^{-1} are observed in the FTIR spectra (Fig. 2) of the dust and they are characteristic of skeletal C–C stretching vibrations. The stretching vibrations of the C–H bond recorded in the region 2852–2920 cm^{-1} together with the above-mentioned skeletal vibrations indicate that the whole mixture of dust is composed of saturated and unsaturated hydrocarbons of a linear and branched chain, likewise the ester of fatty acids. For all these compounds the absorption bands in the regions 1412–1472 cm^{-1} and 715–780 cm^{-1} characteristic of methyl (CH_3) and methylene (CH_2) groups were recorded. Absorption bands typical of the amide group of polypeptides in the region 1637–1644 cm^{-1} are observed in the infrared spectra of all samples, except for sample No. 3 (Fig. 2). The streching vibrations of N–H and O–H are observed in the far region of spectrum (3305–3279 cm^{-1}). Judging by the intensities of the absorption bands, the quantity of the compounds with N–H and O–H groups is greater in specimen No. 5 (Fig. 2). In all samples the bands are observed at 880 cm^{-1}, similarly for the first four where the bands were observed at 464 cm^{-1}. These bands together with the absorption bands in the regions 1030–1060 cm^{-1} and 1412–1472 cm^{-1} are specific of absorption of inorganic carbonates and silicates. The bands at 2330 and 2360 cm^{-1} in sample No. 4 are ascribed to C≡C, C≡N streching vibrations likewise P–H and Si–H.

In the specimens of group II (Table 1) inorganic compounds dominated. Intensive absorprtion bands in the region 415–453 cm^{-1}, the shoulder at 564 cm^{-1} are specific of oxygenous compounds of metals (M–O streching vibrations, Fig. 2, No. 6–8). A broad band at 1022 cm^{-1} and absorprtion at 2300 cm^{-1} are characteristic of Si–O and Si–H vibrations, whereas the band at 880 cm^{-1} is typical of inorganic carbonates. Somewhat more organic compounds may be found in sample No. 6 (Fig. 2) because the bands in the region 2852–2920 cm^{-1} are ascribed to the C–H streching vibrations in aliphatic hydrocarbons, whereas the bands in the region 1300–1650 cm^{-1} are ascribed to the vibrations of the amide group. The second two specimens No. 7 and No. 8 of this group contain an insignificant amount of organic compounds.

Inorganic compounds dominated in group III, samples No. 9 and No. 10 are like in the dust of group II. In the FTIR spectra of these samples the absorption bands characteristic

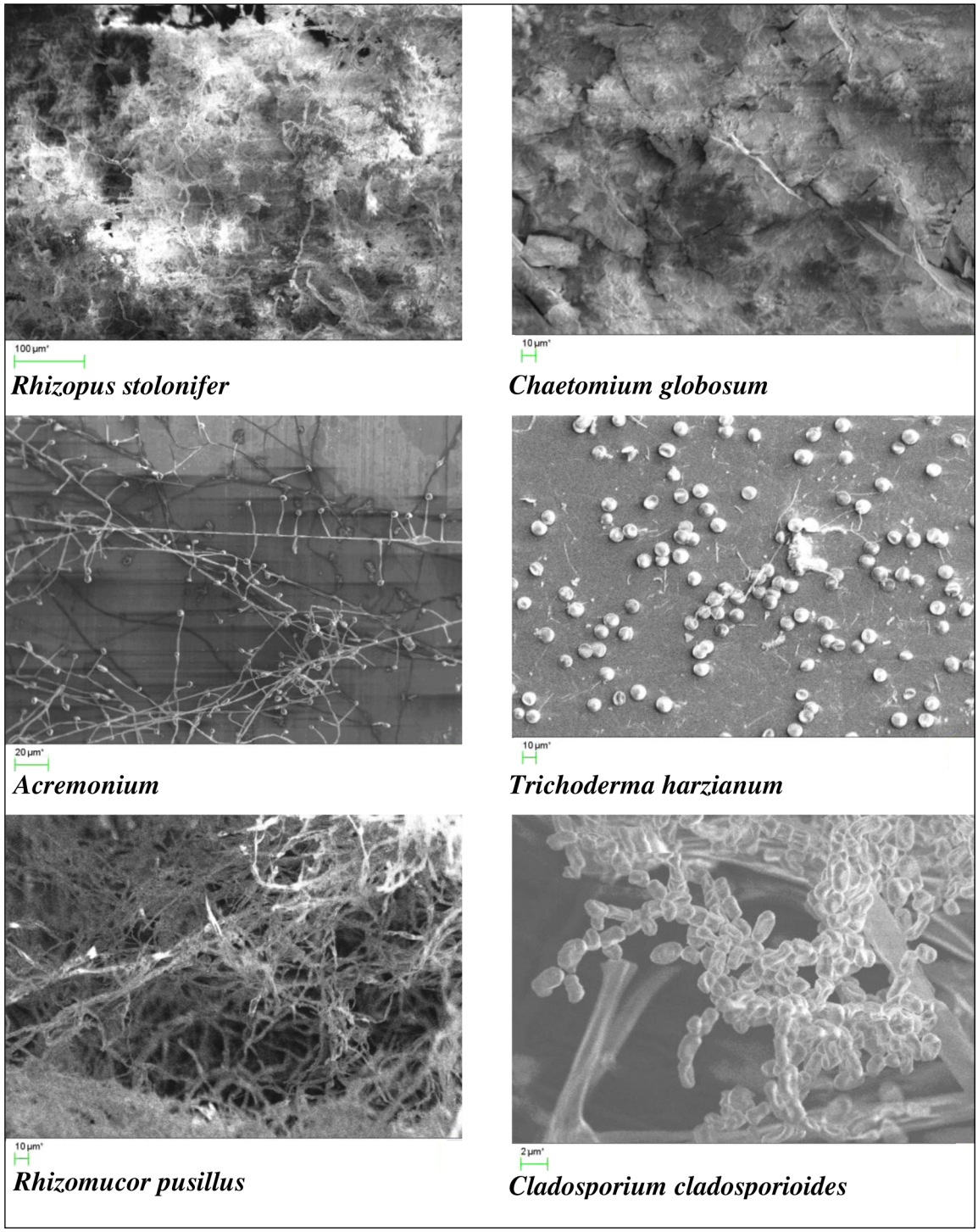

Fig. 1. A SEM image of some mycobiota

of carbonates and silicates are observed. Only in the spectra of specimen No. 11 the absorption bands in the regions 2840–2953 cm^{-1} and 1380–1640 cm^{-1} and at 3354 cm^{-1} are registered. These bands are ascribed to the C–H and N–H stretching vibrations, similarly to the deformation vibrations of primary amines and stretching vibrations of the amide (CO–NH) group.

In the spectra of group IV, No. 12, an absorption band at 2896 cm^{-1} is attributed to the C–H stretching vibrations (Fig. 2). A broad band at 3309 cm^{-1} indicates that in this spectrum region N–H and O–H streching vibrations overlapped (commonly it is O–H of water). The bands at 1262 cm^{-1} and at 1509 cm^{-1} are ascribed to the vibrations of the aromatic ring, some moderate intensity absorption bands around 1262 cm^{-1} are typical of vibrations of the phenolic group and/or bending vibrations of O–H and deformations vibrations of C–O. The natural polymer lignan is the most likely component of this specimen. Judging by a broad absorption band in the near spectra region,

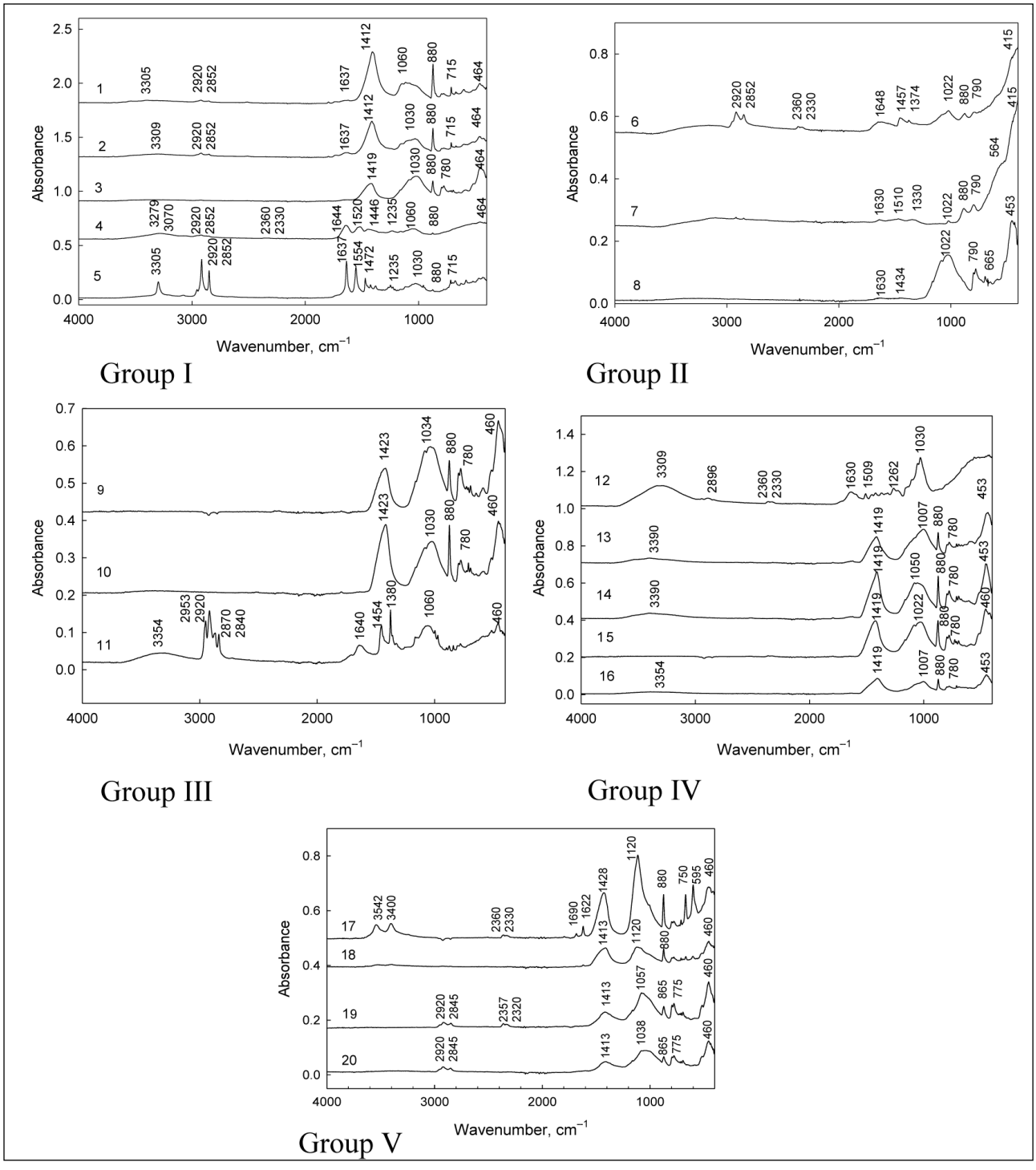

Fig. 2. FTIR spectra obtained from samples taken from different objects. Numbers from 1 to 20 at curves described in Table 1

impurities of inorganic compounds (oxygenous compounds of metals) were detected in sample No. 12.

In other specimens of dust inorganic compounds, namely carbonates and various structure silicates, dominated. According to the above mentioned bands of spectra, inorganic carbonates and silicates, likewise oxygenous compounds of metals, are identified in all samples of group V (Fig. 2, No. 17–20). The absorption bands in the region 2845–2920 cm^{-1} indicate that aliphatic hydrocarbons were present in the last two specimens. Sample No. 17 (Fig. 2) noticeably differs from the other samples. The bands of spectra at 3400 cm^{-1} and at 3542 cm^{-1} are characteristic of N–H stretching vibrations of primary amines whereas the bands at 1622 cm^{-1} and 1690 cm^{-1} are typical of the C=O stretching vibrations of ketones and aldehydes. A broad band at 1120 cm^{-1} indicates that in this region of spectra the absorption bands of inorganic carbonates and sulphates overlap.

Table 3. **Elemental composition of samples, wt-%**

		Elements																									
Gr.	No.	O	Na	Mg	Al	Si	P	S	Cl	K	Ca	Ti	Cr	Mn	Co	Fe	Ni	Cu	Zn	Br	Rb	Sr	Y	Cd	Ba	Zr	Pb	V
	1	17.801	0.088	0.367	0.333	2.959	0.069	1.197	0.152	0.236	27.684	0.066	0.027	0.046		1.551	0.014	0.014	0.316			0.217			0.025		0.137	
	2	17.132	0.172	0.164	0.518	4.372	0.103	1.117	0.594	0.548	20.664	0.206	0.038	0.062		1.778	0.012	0.043	1.387		0.003	0.108		0.008	0.157		0.268	
I	3	26.474	0.209	0.52	1.854	15.202	0.1	0.326	0.069	1.256	12.469	0.263	0.01	0.046		2.255	0.006	0.078	0.11	0.004	0.006	0.038			0.039	0.022	0.019	
	4	9.5	0.168	0.092	0.233	1.053	0.066	4.29	0.669	0.329	2.261	0.112		0.019	0.03	0.442		0.016	0.088			0.015			0.008	0.01		
	5	11.802	0.312	0.273	0.862	4.526	0.166	0.837	0.807	1.124	5.25	0.272	0.046	0.052		1.926	0.015	0.028	0.187		0.009	0.025			0.009	0.03	0.031	
	6		0.019	0.007	0.042	1.098	0.002	0.005	0.214	0.070	0.093	0.012		0.252		60.35	0.049	0.036	0.042								0.022	
II	7	30.248	0.049		0.08	0.539	0.006	0.032	0.217	0.037	0.106		0.029	0.345		68.142	0.067	0.08				0.012			0.012			
	8	11.097	0.131	0.262	1.79	6.87	0.091	0.047	0.006	0.707	0.525	0.176	0.004	0.018		1.789	0.009	0.014	0.032		0.005	0.007	0.003			0.024	0.011	
	9	45.363	0.425	0.887	2.693	29.766	0.045	0.178	0.027	1.46	16.891	0.148	0.011	0.051		1.739		0.223	0.018		0.01	0.037	0.003		0.007	0.008	0.009	
III	10	26.803	0.133	0.43	1.331	15.929	0.032	0.113	0.012	0.908	15.656	0.134	0.006	0.027		0.83	0.006	0.004	0.02		0.005	0.038			0.021	0.036	0.002	
	11	7.741	0.241	0.209	0.247	1.943	0.295	0.574	0.67	2.292	6.094	0.693		0.043	0.218	0.66	0.015		0.228			0.017				0.089	0.01	
	12	8.999	0.056	0.104	0.825	1.743	0.077	0.171	0.042	0.258	0.947	0.041		0.032		0.522	0.008	0.008	0.574			0.012			0.091		0.015	
	13	41.758	1.378	1.604	3.037	22.554	0.047	0.866	1.376	3.188	21.116	0.302		0.068		2.554		0.011	0.044		0.013	0.034			0.052			
IV	14	42.283	0.042	0.69	0.77	23.382	0.061	1.137	0.039	0.311	29.505	0.402		0.032		1.262			0.013			0.053			0.018			
	15	42.732	0.146	3.36	1.805	23.732	0.04	0.121	0.037	1.117	21.668	2.567		0.065		2.075			0.016		0.006	0.035			0.453	0.024		
	16	44.743	0.264	3.305	5.205	26.456	0.058	0.035	0.03	2.864	13.003	0.404		0.069		3.436			0.007		0.019	0.024			0.042	0.031		
	17	42.011	0.144	0.48	0.754	8.773		10.928	0.081	0.578	35.037	0.286		0.028		0.515			0.231			0.118			0.027		0.008	
	18	38.47	0.211	0.756	1.27	19.798	0.028	0.871	0.424	1.032	22.396	0.039	0.015	0.026		0.61		0.015	13.756			0.039			0.098		0.144	
V	19	40.839	0.278	4.86	2.11	20.012	0.04	0.292	0.074	1.403	28.023	0.135		0.066		1.805	0.012				0.008	0.033			0.013			
	20	44.972	0.745	1.001	5.155	27.066	0.098	0.279	0.03	1.827	13.885	0.371		0.104		4.261	0.008					0.07			0.09			0.038

Heavy metals along with dust or by other means may enter the human existence zones and affect some organs, to disturb their functions and cause illnesses. The elements detected by the XRF-WD method are shown in Table 3. The quantities of cancer-causing heavy metals, such as lead, zinc, cadmium, nickel, cobalt, chromium, vanadium and other heavy metals, in some sides are terrible high (HN 60:2015).

The data obtained by the XRD method (Fig. 3) suggest that silicon dioxide and calcium carbonate crystalline materials dominate in the major part of the samples (groups I–V). Moreover, it has been determined that in building wastes during biological cyclization microcline, anorthite, ferrosilite are formed, all of them can accumulate heavy metals and may enter the human existence zones and affect some organs.

Under the conditions of our studies *Aspergillus* species of mycobiota were isolated from almost all samples of sampling materials (Table 2). *Aspergillus* is among the most abundant and widely distributed ones in organisms. Some *Aspergillus* species have been widely employed as a source of enzymes and acids. Some of *Aspergillus* species are hazardous to humans and go to pathogens and numbers of species are allergenic. Most human diseases caused by mycobiota are associated with immunosuppression. As the number of immunosuppressed people in the population has risen, so has the importance of infection by *Aspergillus fumigatus, A. flavus, A. terreus, A. niger,*

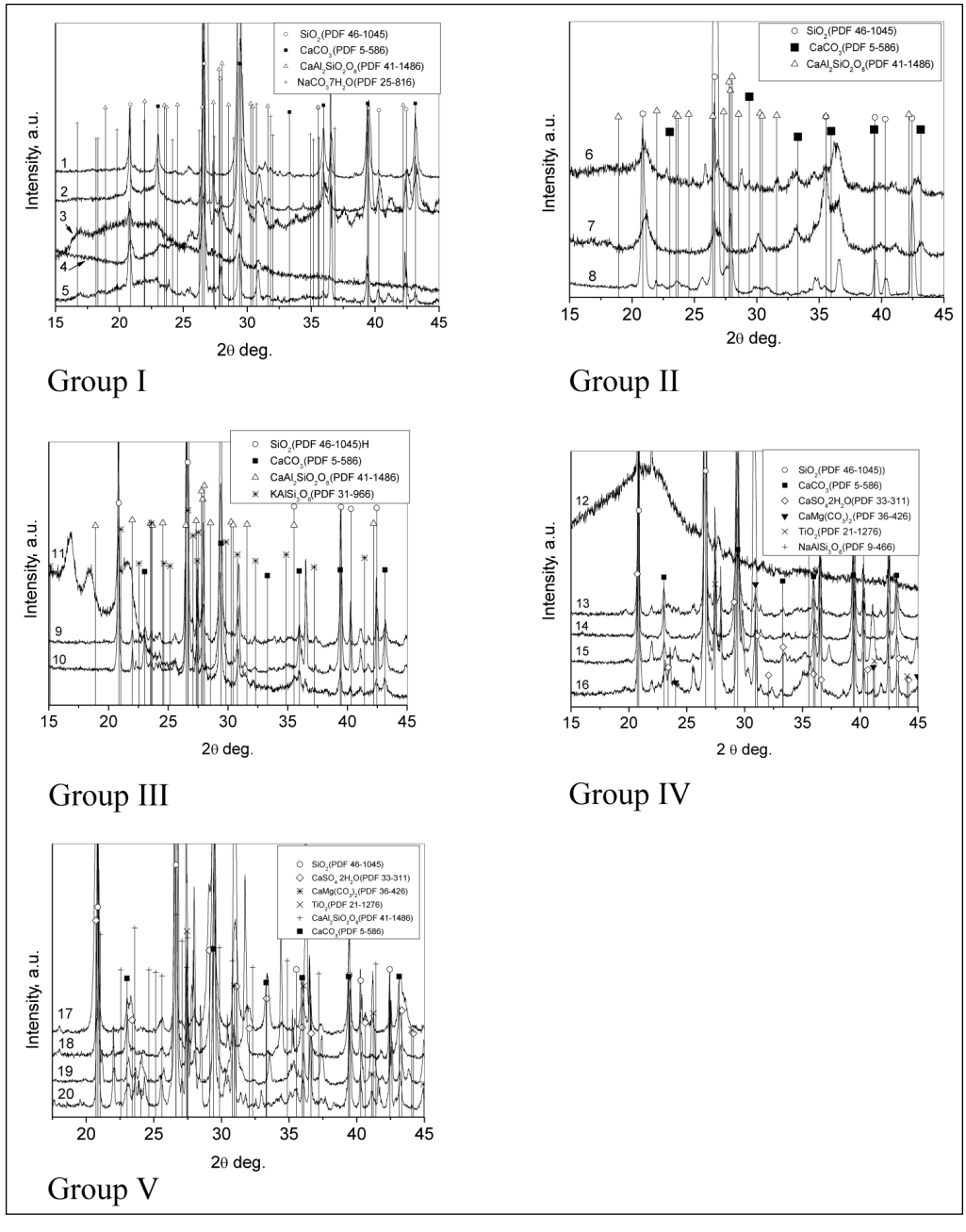

Fig. 3. XRD spectra obtained from samples taken from different objects. Numbers from 1 to 20 at curves described in Table 1

A. nidulans, A. oshraceus. [36, 37]. *A. flavus* fungi produce a lot of various compounds and are active parasites. Under high humidity occurrence of *A. flavus* may be related to occurrence of aflatoxins. *A. fumigatus* fungi are capable of assimilating various substances and produce different allergens. It is known that *A. terreus* produces patuline and some other toxic substances. In building pollutants fungi of *A. candidus* species, which usually produce allergens, were of frequent occurrence. Developing on different food products they produce toxins and find themselves in human organisms causing lungs, ears, nose injuries and allergies and strongly affecting the nervous system.

The *Aspergillus* species may be the primary cause of spoilage, or they may play a major role in a partnership with other genera, notably *Penicillium, Cladosporium, Phoma.*

Frisvad and Samson [34] and Koval et al. [30, 38] consider that mycobiota of *Penicillium* genera are potential pathogens to humans and other biota. *Penicillium commune* produces isobutanol, isopentanol, styrene, ethyl acetate, 3-octanol, 3-heptanone, cyclopiazonic acid. *P. expansum* produces patuline etc. *P. chrysogenum* are extremely hazardous mycobiota which actively produce metabolites. They are known to be pathogens causing endocarditis, eyes and ears illnesses.

Ulocladium chartarum, C. cladosporioides were also evaluated as allergenic species [39]. Cases when *A. alternata* developed in human skin, a subcutaneous layer, have been reported, the fungi may damage bones, ears, eyes and ureters. *Fusarium oxysporum* mycobiota actively excrete into the environment metabolites of various composition [40]. *F. solani* can damage bones, skin, eyes and other organs in humans. *F. semitectum* synthesize miscellaneous metabolites: moniliformin, fusaproliferin, proliferin 4,5,10,11-tetrahydroxybisboline. *F. moniliforme* species for growth and mycotoxin production need a higher water content.

Sporothrix schenckii fungi are often diagnosed in bones, lymphatic system, internal organs, oral mucosa. The illness is hard to diagnose, because the symptoms are akin to those caused by angina, stomatitis, pharyngitis.

Yeast-like fungus *Candida albicans* functions in organic substrates and living organisms. It intensively produces endotoxins – gliucoproteides and enzymes. It has been determined that unbond lipids of this yeast are toxic to humans. Proteolitic enzymes and hemolizines synthesized by this yeast are also ascribed to toxic metabolites [41, 42].

Current scientific abstracts do not present such complex chemical and mycological monitoring in reconstruction and renovation environments [20, 29, 31, 43, 44].

CONCLUSIONS

The data obtained by using the XRF-WD, XRD, FTIR methods leads us to think that mycobiota, their mycotoxins and other dust particles (such as biomaterials, heavy metals) propagated in human existence and activity zones during renovations and reconstruction work heavily increase health risks for humans and other biota. *Aspergillus* spp., *Penicillium* spp. and *Fusarium* spp. have been reported as the main genera present in building wastes.

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SVEIKATAI PAVOJINGŲ MIKOBIOTŲ SUKELIAMŲ DIRGIKLIŲ ĮVERTINIMAS RENOVUOJAMO VILNIAUS SENAMIESČIO APLINKOJE

S a n t r a u k a

Pagrindinis darbo tikslas – nustatyti mikobiotų sukeliamus sveikatai pavojingus cheminius ir biologinius dirgiklius ir mikobiotus, kurie dominuoja atstatomame ir renovuojamame Vilniaus senamiestyje (2012–2014). Morfologiniai ir struktūriniai tyrimai atlikti naudojantis skenuojančiu elektroniniu mikroskopu taikant Furjė transformacijos infraraudonųjų spindulių, rentgeno fluorescencinės spektroskopijos su bangų dispersija ir rentgeno difraktometrijos metodus. Labiausiai paplitę mikobiotai tirtoje aplinkoje buvo *Aspergillus* spp., *Penicillium* spp. ir *Fusarium* spp. Nustatytas užterštumas sveikatai pavojingais sunkiaisiais metalais ir biomineralais.