Journal of Young Scientist, Volume IV, 2016
ISSN 2344 - 1283; ISSN CD-ROM 2344 - 1291; ISSN Online 2344 - 1305; ISSN-L 2344 – 1283

EVALUATION OF AIR AND SURFACES QUALITY THROUGH MICROBIOLOGICAL METHODS CASE STUDY – A2 STUDENT HOUSE

Corina DUMITRACHE, Mihai FRINCU, Stefania ILA, Ana-Maria GODEANU

Scientific Coordinators: Prof. PhD. Carmen CIMPEANU, Lect. PhD. Constanta MIHAI

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăşti Blvd, District 1, 011464, Bucharest, Romania, Phone: +4021.318.25.64, Fax: +4021.318.25.67, Email: frincumihai18@yahoo.com

Corresponding author email: frincumihai18@yahoo.com

Abstract

The purpose of this study was to investigate the hygiene from one Student House Of Agronomical University Camp by evaluation of airborne microflora from 12 rooms (total air cubing: 480 m^3). The degree of microbiological contamination of indoor air was checked by monitoring of 60 surface samples and 36 air samples. Qualitative analysis of indoor air and surfaces that might contain microorganisms was made by identifying colonies on Petri plate with solid culture specific to bacteria and molds. The results regarding microbes from indoor air presented fairly large variations from one room to another (from less than 100 CFU/m^3 to slightly above 2000 CFU/m^3), but in no one inverstigated space have been exceeding the admitted limit (2500 CFU/m^3).

***Key words**:* air *microflora, air contamination, pathogen germ, bvacteria, fungi.*

INTRODUCTION

Air microbiology is concerned with the study of microorganisms living in suspension in the air. Even if the organisms in the air are less than those living in the soil or in the water, there are enough microorganisms which can affect the quality of the air (Amato, 2012).

The frequency and nature of microorganisms vary by location tracking, for example in sparsely populated areas dominant the microorganisms will be originated from the nature. The structure and density of the air changes the microbial flora in areas with human intervention in areas with urban agglomerations. Thus, besides the germs in water, germs develop adaptability to human and animal parasitism, increasing their density in the air according to population density of that area. Air contamination si closly related to contamination of surfaces and objects which are often contaminated with air flora. From those surfaces, many microorganisms come in the air, along with the dust.

Usually it is not common to determine all the germs in the air, but only certain groups that can give significant information about the microbial contamination.

Assessing the health status of air in enclosed spaces is persormed based on microbiological indicators concentration as staphylococci and α - streptococci and β – hemolytic, total number of microorganism and fungus per cubic meter of air.

The environment of the educational institutions favours the apparition and development of microorganisms which need an organic source of nutrition and an environment with high humidity for surviving and spreading.

Exposure to bacteria can have negative effects on health status, even if some bacteria are useful for the good functioning of the body and we normally can find them in healthy people. *Staphylococcus aureus* can be isolated on the skin and from the nose mucus. It is responsible for different purulent infections: furuncle, osteomielitis, panaritium etc. *Staphylococcus epidermidis* is not normally pathogen, but it can cause infections in patients with immunity deficiency.

Exposure to streptococci also has an important impact on health status. For example, fecal streptococci are pathogenetically conditioned, being able to determine different diseases, as

hepatitis. Oral streptococci can determine inflammation of the respiratory and pulmonary tracts and once they enter in the circulatory system they can cause endocarditis. Pyogenic streptococci are the cause for various acute and chronical diseases.

MATERIALS AND METHODS

The microbiological analysis of the air can give a hygienic and epidemiological estimation of the air. Based on this analysis we can establish the necessary measures for the prophylaxis of aerogen infections which represent a large part from the infectious pathology.

The sampling in this study concerning quantitative and qualitative determination of microorganism from the air, was performed by gravitational sedimentation method (Koch method - which retains the germs on the surface of Petri plates containing solid culture media). The sampling under study was made by cushion method: a specific area of 100 cm^2 is marked to be examined and it is swept with a wet cushion moistened with liquid dilution at a right angle to each other. Buffer rods are aseptically cut into a test tube containing a sterile liquid dilution and subsequently homogenized manually (Figure 1). The initial suspension and if necessary, the following decimal dilutions, are used to determine the number of microorganisms under investigation.

Figure 1. Study sampling - Student House Of Agronomical University Camp

There have been selected 12 rooms with a total air cubing of 480 m^3, from one Student House Of Agronomical University Camp. In each room there have been made 2 samplings: in the morning (between 6 and 7) and in the evening (between 7 and 8), in two different days with 1-2 weeks time span. The 2 solid culture media used in the experiment:

- agar growth medium;
- YPG growth medium.

All the analyzes have taken place in the laboratory of Biochemistry Environment from Faculty of Land Reclamation and Environmental Engineering.

The plates for mesophilic aerobic bacteria with nutrient agar were incubated at 37º C, for 24, 72 and 96 hours, and the plates for filamentous fungi were incubated at 28º C, in the dark, for 3-5 days (Figure 2).The exposure time was 15 minutes. After incubation the colonies present on plates were counted, starting from the premise that each colony has been developed from a single microorganism with an colony counter. Using the table and formula from instructions guide of the device were determinated the number of bacteria and fungi expressed in CFU/m^3.

Figure 2. Thermostat with incubated samples

For expression per unit volume of air was used Omeliansky calculation formula, which is based on the observation that in 5 minutes is deposited on an area of 100 cm^2 germs from 10 liters of air:

$$\text{Germs number/m}^3=\frac{nx1000}{Sx\frac{T}{5}}\text{, with:}$$

S - surface of the box,
T - exposure time in minutes,
n - number of colonies grown on the surface of the culture medium.

NTG - total number of germs per cubic meter of air identified and isolated from five different points in the same room for the expression of an average air samples.

In order to identify microorganisms by microscopic analysis smears were performed with a simple Gram stain and double to highlight the spores.

Identification of microorganisms grown on smears was performed in drop of oil, with the objective of 100x of the Siemens microscope with camera located in the laboratory of Environmental Biochemistry.

RESULTS AND DISCUSSIONS

The obtained results showed a large variety of molds and bacteria in the environment from the student: in 80% of investigated rooms have identified the presence of Penicillium species, in 60% of investigated rooms have identified the presence of molds Aspergillius species and Mucor, in 40% of the room have identified the presence of Rhizopus species, in 30% of the rooms studied were identified Fusarium species, Streptococci, Enterobacter and 25% of the rooms have identified the presence of Aeromonas and Bacillus species (Figure 3).

Figure 3. Macroscopically identified microflora

The microbiological analysis of air microflora showed the existence of molds in all the samplings, in large quantity in room nr. 11 and and the total number of germs does not exceed the limit of 2500 CFU/m^3 .
The microbiological analysis of surfaces shows the existence of molds in all the samplings.
From the total number of 12 rooms that had been investigated, in 6 rooms the air microflora samplings presented real concern regarding the limits of bacteria and fungi, as well as pathogen germ, *Staphylococcus aureus*.

MACROSCOPIC INVESTIGATION (Figure 4):
- gray/whitish mold quick growth up to 37º C invading the whole Petri plate;
- colonies with woolly appearance, diaphane with aerial mycelium;
- white-gray colori/dark gray – sporulate.

Figure 4. Macroscopic investigation

MICROSCOPIC INVESTIGATION (Figure 5):
- sporocysts easily visible to the stereomicroscope;
- septate filaments or rarely septate, wide and irregular;
- sporangiophores.

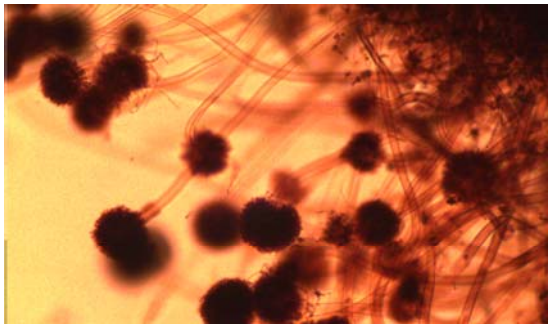

Figure 5. Microscopic investigation

The total number of germs (NTG) showed big variations among rooms, with values from 275,59 to 2180,66 CFU/m^3 of which: bacteria 44,7-572,22 CFU/m^3 actinomycete (Gram positive bacteria of the total number of isolated bacteria colonies), filamentous fungi 78,74 1608,44 CFU/m^3 and around 90-100% molds (Table 1). The quantitative evaluation of air microflora in room nr. 11 showed a total number of germs of 2180,66 CFU/m^3, that is the highest value in this environment of this study. In both measurement campaigns we discovered a significant level of microbian pollution in this room (Figure 6).

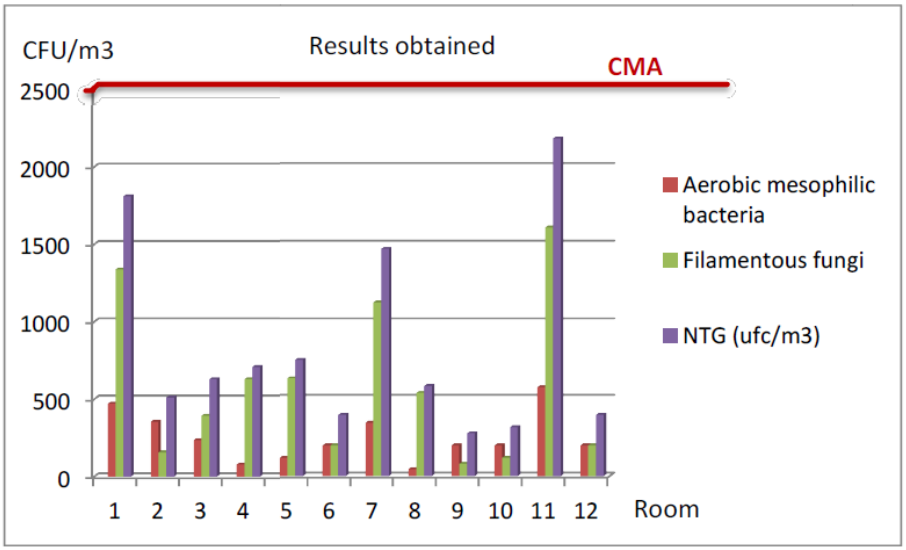

Figure 6. Graphic representation of the results obtained

Table 1. Results obtained in the rooms investigated

Room	Aerobic mesophilic bacteria	Filamentous fungi	NTG (CFU/m^3)
1	472,44	1338,58	1811,02
2	354,33	157,48	511,81
3	236,22	393,7	629,92
4	78,74	629,92	708,66
5	118,11	629,92	748,03
6	196,85	196,85	393,70
7	344,11	1125,92	1470,03
8	44,7	535,45	580,15
9	196,85	78,74	275,59
10	196,85	118,44	314,96
11	572,22	1608,44	2180,66
12	196,85	196,85	393,70

NTG results: for yeasts and molds – from 10^{-1} dilution = 508 colonies, from 10^{-2} dilution = 63 colonies and from 10^{-3}dilution = 5 colonies (Figure 7).

Figure 7. NTG results

Results from dilutions determined for yeasts and molds are highlighted in the chart below:

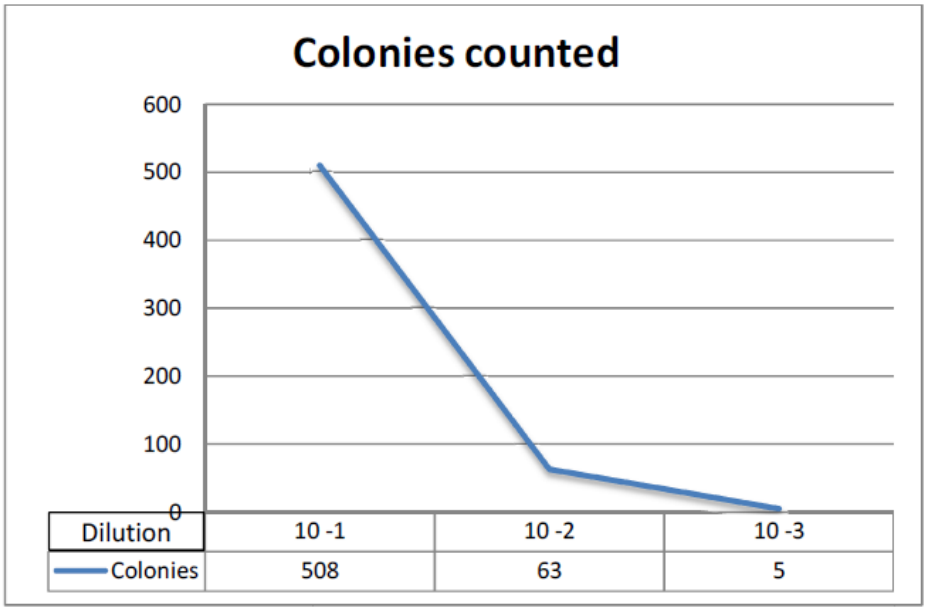

Figure 8. Results dilutions determined for yeasts and molds

CONCLUSIONS

As a result of this study, it was observed a lower degree of microbiological pollution on the down floors, compared to the upper floors. This study will be used as a starting point for further studies, as for example about the air quality in some boys rooms, kitchens etc.
Analysing studies on the working environment in the institutions of education highlighted the existence of several molds in all the studied rooms. Analyses marked out the existence of bacteria in half of the rooms under investigation. A high level of microorganisms has been discovered in room 11, and their existence signifies an insalubrious environment, because of contamination of human origin.

As a conclusion, students and auxiliary personnel is exposed to harmful conditions (biological agents) which can affect in time their health status (contact dermatitis, dermatite de contact, allergic rhinitis,pneumopathies etc.):

- Rhizopus species is an opportunistic agent, producing fungal infections in humans which in some cases can be fatal. Rhizopus infections can give serious complications for diabetics.
- Aspergillus species produces pulmonary aspergillosis or a series of allergic reactions.
- Enterobacter infections can include lower respiratory tract infections, skin and soft-tissue infections, urinary tract infections, intra-abdominal infections, septic arthritis, osteomyelitis, Central Nervous Sistem infections and ophthalmic infections.
- Infections caused by Penicillium includes: pulmonary infections, had cerebral diseases, paravertebral infections, prosthetic valve endocarditis endophthalmitis, upper urinary tract infection and intracranial infection.

To ensure a good indoor air quality is necessary to ensure a level as low microbiological contaminants through proper ventilation, reducing indoor humidity and avoid agglomeration.
Preventive measures and combating of nosocomial infections aimed at ensuring optimal hygiene conditions on accommodation, thermal environment, drinking water, food, disinfection, cleaning).

REFERENCES

Chinn RY, Diamond RD. (1982). "Generation of chemotactic factors by Rhizopus oryzae in the presence and absence of serum: relationship to hyphal damage mediated by human neutrophils and effects of hyperglycemia and ketoacidosis". Infection and Immunity38 (3): 1123–29).

Goel, Ayush. "Pulmonary aspergillosis". Mediconotebook. Retrieved 29 May 2015.

Guinea J, Torres-Narbona M, Gijón P, Muñoz P, Pozo F, Peláez T, de Miguel J, Bouza E (June 2010). "Pulmonary aspergillosis in patients with chronic obstructive pulmonary disease: incidence, risk factors, and outcome". Clin Microbiol Infect 16(7): 870–7.)

Lyratzopoulos G, Ellis M, Nerringer R, Denning DW, 2002. Invasive infection due to penicillium species other than P. marneffei. The Journal of Infections, 45(3):184-95.

Botkin and Keller, D.B. Botkin, E.A. Keller, 2007, Environmental science: Earth as a living planet.

Chao et al.. H.J. Chao, J. Schwartz, D.K. Milton, H.A. Burge, 2003, The work environment and workers health in four large office buildings, Environmental Health Perspectives, 111 (2003), pp. 1242–1248.

Daisey J.M., Angel W.J., Apte M.G., 2003, Indoor air quality, ventilation and health symptoms in schools; an analysis of existing information Indoor Air 13,53.

Khan and Karuppayil, A.A.H. Khan, S.M. Karuppayil, 2011, Practices contributing to biotic pollution in Airconditioned indoor environments, Aerobiologia, 27 (2011), pp. 85–89.

Fleischer M, 2006, Microbiological control and airborne contamination in hospitals, indoor and built environment, 15 (1), 53.

Künzli et al., 2000, N. Künzli, R. Kaiser, S. Medina, M. Studnicka, O. Chanel, P. Filliger, et al., Publichealth impact of outdoor and traffic-related air pollution: a European assessment, Lancet, 356 (9232) (2000), pp. 795–801.

La Serna I., Dopazo A., Aira M.J. , Airborne fungal spores in the Campus of Anchieta (La Laguna, Tenerife/Canary Is.), Grana 41, 119, 2002

Ling et al., 2011, Z. Ling, H. Guo, H. Cheng, Y. Yu, Sources of ambient volatile organic compounds and their contributions to photochemical ozone formation at a site in the Pearl River Delta, southern China, Environmental Pollution, 159 (2011), pp. 2310–2319.

L.T. Wong, K.W. Mui, W.Y. Chan,2007, An energy impact assessment of ventilation for indoor airborne bacteria exposure risk in air- conditioned offices, Original Research Article, Pages 1939-1944.

Marmot et al., 2006, A.F. Marmot, J. Eley, S.A. Stafford, E. Warrick, M.G. Marmot, Building health: an epidemiological study of sick building syndrome in the Whitehall II study, Occupational and Environmental Medicine, 63 (2006), pp. 283–289.

Nevalainen and Seuri, A. Nevalainen, M. Seuri,2005, Of microbes and men, Indoor Air, 15 (2005), pp. 58– 64.

Yang et al., 2011, J. Yang, M. Xu, X. Zhang, Q. Hu, M. Sommerfeld, Y. Chen, Life-cycle analysis on biodiesel production from microalgae: Water footprint and nutrients balance, Bioresour. Technol., 102 (2011), pp. 159–165.

*** SC 2009-16219/16.07.2009. "Determining of the pathogens species of indoor air from Timisoara's public and educational institutions". Elaborated by S.C. „SMART LAB DIAGNOSTICS" S.R.L Timişoara.