Poster session c6

APPLIED AEROBIOLOGY: CULTURAL HERITAGE

Aeromycological study of the Cathedral of Santiago de Compostela (Spain)

Aira M. J.[1]; Herves M.[1]; Rodríguez-Rajo F. J.[2] & Jato V.[2]

[1] University of Santiago de Compostela, Spain.
[2] University of Vigo, Spain.

Bacteria, fungal spores, mosses or ferns, lichen propagules, algae, cyanobacteria and other kinds of organic particles can be transported through the air and settle on the surface of monuments or works of artistic interest, thereby altering them. These organisms can use different materials as a physical medium for their growth and, in many cases, as a nutritional source (e.g. of trace elements) for their development. Consequently, they release metabolites (organic acids or chelate compounds), which dissolve the substrate and determine the appearance of cracks, pitted areas, chromatic patinas of alteration, inter-granular growth with the disintegration of materials, etc, whose magnitude or intensity may vary according to climatic factors and the condition of the monuments. *Bio-deterioration* studies are of special importance in relation to the conservation of Historical-Artistic Heritage, since the control of airborne biological particles, especially fungi, bacteria and algae, along with physical and chemical parameters, enable the cause of damage to be identified and the evaluation of the potential risk to works of art.

In Galicia, the *bio-deterioration* studies carried out to date have been exclusively centred on lichen activity on the stone substrates of churches and megalithic monuments (Prieto, 1996, Prieto et al 1995). However, there are no studies on the impact of aero-mycobiota on the Monumental Complex of the Cathedral of Santiago de Compostela, which is the subject of this paper.

The main objective of this study is evaluating the atmospheric fungal content in the Cathedral of Santiago de Compostela and the Cathedral Museum, both quantitatively and qualitatively, in order to characterise the agents that may damage organic and inorganic materials.

Sampling was carried out from October 2001 to December 2002, seasonal and monthly, by using volumetric methods (Andersen and Burkard Portable Air for Agar Plates –BPC-) and by swabbing.

Highest values of CFUs were recorded in spring, both with Andersen and BPC. The Corticela Chapel showed very high CFUs in every sampling, reaching in spring 2943 CFUs and being 1470, 1547 and 509 CFUs the values recorded in autumn, summer and winter respectively.

From a qualitative point of view, Acremonium, Botrytis cinerea, Cylindrocarpon, Emericella quadrilineata, Eurotium amstelodami, Microsphaeropsis pseudospora, Penicillium spinulosum and P. thommi (between other specie), Rhizopus stolonifer and Stachybotrys atra, were identified in the outdoor. Arthrinium sphaerospermum, Aspergillus niger, A. oryzae, A. terreus and A. versicolor (between other specie), Chaetomium globosum, Chaetomium indicum, Emericella nidulans,, Paecilomyces varioti, Penicillium citrinum, P. crustosum, P. funiculosum, P. glabrum , P. pinophyllum and P. aurantiogriseum, Talaromyces, Trichoderma brachiatu and Trichoderma viridae in the indoor. Finally_Alternaria alternata, Aspergillus. flavus and fumigatus (between other specie), Cladosporium, Eupenicillium,, Mucor mucedo, Neurospora, Paecilomyces lilacinus, Penicillium purpurogenum were identified both in the outdoor and outdoor.

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Bioaerosol as air masses indicator. A case study: the ozone inside the National Gallery of Marche (Ducal Palace) Urbino, Italy

De Nuntiis, P.[1]; Geniali, A.[2]; Lattanzi, C.[1]; Malone, M.[2]; Mangani, F.[2]; Mandrioli, P.[3] & Vitali, C.[3]

[1] Faculty of Environmental Sciences, University of Urbino, 61029 Urbino, (Italy).
[2] Inst. of Chemical Sciences, University of Urbino, 61029 Urbino, (Italy).
[3] Institute of Atmospheric and Oceanic Sciences, National Reseaech Council (CNR-ISAC), 40129 Bologna (Italy).

Problems related to the occurrence of specific pollutants inside museums, art galleries, and libraries are due to the role they play in the decay of the objects of art displayed in these buildings. Among the atmospheric pollutants that can be found in a Museum environment, ozone was recognized as one of the most aggressive, due to its capability to induce fading in organic artists' pigments and dyes, and to spoil textile fibers, textile colours, and cellulose. Even if ozone is generally transferred into buildings from outside, for this contaminant different indoor sources can be hypothesized, especially from electrical devices. Recommended limits on ozone concentrations in the indoor air of museums, art galleries, and libraries is much lower that those assessed for health-based air quality standard, due to the long-term exposure of objects of art to this contaminant, and being the fading process scaled according the product of ozone concentration by the duration of exposure. Therefore, meanwhile ozone limits for health protection have been fixed at 55 ppbv (or 110 $\mu g\ m^{-3}$), suggested ozone concentration limits for the above cited environments are no higher than 1 to 13 ppbv, with the most frequent recommendation being 1 ppbv.

The case study here presented is the National Gallery of Marche sited in the Renaissance Ducal Palace of Urbino, built by Francesco Laurana during the second half of the fifteenth century. Therefore the container itself is an outstanding work of art. The gallery is not provided with a air conditioning system, and ventilation inside the museums is simply assured by opening doors and windows that, especially during the warm season, when higher ozone levels are generally found, are always open. The ozone monitoring campaign has been carried out since August 2001, using passive samplers then analyzed by UV-Vis Molecular Absorption Spectrophotometry. Passive sampler were placed in different rooms and also in some outdoor locations. The average exposure time was one week. The above cited ozone concentration limits were shown to be frequently exceeded, with significant variations of the indoor/outdoor concentration ratios in the different rooms monitored. This study was aimed at identifying the ozone source, using bioaerosol as outdoor air masses tracer. Different aerobiological monitoring campaigns were carried out using a cascade 6-stage impactor. The biological samples underwent culture techniques analyses and optical microscope observations. Results obtained confirmed the efficacy of the proposed approach.

Biological, chemical and microclimatic monitoring in the conservation and management of the Basura cave at Toirano, Italy

Meucci, C.; Nugari, M. P. & Roccardi, A.

Istituto Centrale per il Restauro, Piazza San Francesco di Paola, 00184 – Rome, (Italy).

The Basura Cave in Liguria is a valuable testimony to prehistoric times containing bones and scratch marks of bears, human foot and fingerprints, as well as calcitic concretions. The conservation and visitor management of this site, as in generally all underground environments, poses a not easily solvable problem due to the delicate equilibrium that exists within their interiors. The disturbance factors in these cases, such as the entry and permanent physical presence of visitors and staff, risk seriously affecting their state of conservation. The establishment of times and periods when the cave is open and closed to the public must therefore be carefully assessed.

An environmental monitoring campaign of the physical, chemical and biological parameters was carried out in order to establish the optimum conditions for site management. Possible risk factors for the conservation of the site and the wellbeing of staff and visitors and their development over time have been taken into consideration. In particular, continuous monitoring of the microclimatic parameters and periodic

measurements of the concentrations of carbon dioxide and airborne microflora in the air have been made. Aerobiological and chemical monitoring was carried out at six different points located along the visitor path. Studies were conducted when the cave was both open and closed to the public.

Results of the chemical and biological studies show that the average values of carbon dioxide and of the total concentration of bacteria and fungi are well above the safety threshold. Maximum values of CO^2 and of heterotrophic bacteria and fungi were recorded when the cave was open to the public. Analysis of the microclimatic trends show that most of the cave is subject to high levels of relative humidity, and as a result, conditions of saturation with phenomena of condensation on the walls occur during a large part of the year.
As far as the distribution of chemical and biological pollutants is concerned, the areas where materials and human health is exposed to maximum risk are those furthest inside along the visitor path (Cavern of Cybele and Cellar of Cybele).

The overall analysis of the results obtained show the need to strictly control the flow of visitors with regard to number and amount of time spent within the cave environments. Periodically, the cave should be totally closed to the public to allow its interior environment to reach ideal "physiological" conditions of equilibrium.

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Poster session c7

APPLIED AEROBIOLOGY: CLIMATIC CHANGES

Climatic changes: advanced flowering of Graminaceae and Urticaceae recorded in Modena (North of Italy), preliminary study

Natali, P.

Arpa Emilia Romagna – Sez. Prov.le di Modena (Italy) – e-mail: pnatali@mo.arpa.emr.it

From the end of the 1800 the medium surface temperature of the earth it is increased of approximately 0.3-0.6°C. Records since 1860 demonstrate global warming. The 1990s was the hottest decade yet recorded, and the warmest summer was in the 2003.

The United Nations Intergovernmental Panel on Climate change (IPPC) predicts a 1.4 to 5.8°C rise by 2100. Already there is the glacier retreat, poleward shift of animal and plants, and more extreme weather events. The IPPC position that most climate change since 1950 is human induced and will have far-reaching environmental and health effects. Global warming results from interactions between greenhouse gases, the Earth's atmosphere, and the sun. The main greenhouse gases are carbon dioxide ad methane. These along with nitrogen oxides, sulfur oxides, ozone, and halocarbons, are produced by fuel combustion and agricultural activities. Greenhouse gases trap energy in the atmosphere, causing global warming. A baseline level of gases is necessary for a habitable environment, but industrial activities have increased concentrations to levels that induce warming. The upper ranges of carbon dioxide and methane are the highest levels in 420000 years. Concentrations of CO2 are now one third higher than pre-industrial levels. Methane concentrations are twice those of the pre-industrial era, and ground-level ozone levels are unprecedented.

The climate change induces thermal extremes and weather disasters and causes, moreover, longer-term ecologic changes that food availability, allergy and disease exposure, ad emerging infectious diseases.
Climate's influence determine which type of life will develop in every specific area of the Earth especially as concerns vegetables.

Finding out good pointers in order to record the climatic change is very difficult because climate natural fluctuations are remarkable. These are greater if the examination area is reduced. Beyond chemical pointers (CO2 concentration, NO2, CH4, O3, HFC, PFC, SF) and physicists (the minimal and maximum temperature, solar radiation, etc), it can be useful estimate what effects are produced on living organisms, in particular on vegetables essences that, for they characteristic, are extremely sensitive to climatic variations (also inside seasonal periods).

Materials and methods. The present study considers 19 years (1985-2003) of collected pollens data from the monitoring station MO1 in Modena, (a little city in the middle of the Po valley, North of Italy).
In particular we analyse how the beginning of the pollination of Graminaceae and Urticaceae (herbaceous essences abundantly present between April and September) have been changed during the years.
There are many factors and variously interlaced that influence the beginning of the flowering such as the season minimal and maximum temperature, degree/days, wet and dray weather, solar radiation; anyway we have found an advanced flowering trend of these two essences in the considered period.

Results. Applying the Cox and Stuart test, the obtained results evidence a flowering advance of 0,82 days/year (p=0.14) for the Graminaceae and of 0,85 days/year (p=0.09)for the Urticaceae.
Conclusions. The observed advance of the beginning flowering, could be correlated to the increase of the temperature. The pollens, therefore, could be considered as a pointer of the climatic changes. Also knowing that 19 years are a relatively short period in the climate changes study, this preliminary results, however, induce to keep on with the efforts in this direction.

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Start of the pollen season in some arboreal taxa and winter climate change in Turin (Northern-Italy) from 1983 to 2003

Caramiello, R.[1]; Siniscalco, C.[1]; Mercalli, L.[2]; Fossa, V.[1] & Arobba, D.[3]

[1] Dipartimento di Biologia vegetale, Università di Torino and CEBIOVEM, Viale Mattioli, 25 –10125 Torino, (Italy).
[2] Società Meteorologica Subalpina, via Re, 86- Torino. (Italy).
[3] Ist. Int. Studi Liguri, Museo Archeologico del Finale, Finale Ligure. (Italy).

In recent years, winter temperatures (December-March) in North Western Italy increased of about 1 °C if compared to the previous 30 years. In Turin the period 1983-2003 presented a mean value of the four winter months of 6,1°C,while in the long period 1880-1980 the value is of 4,9°C. In detail, the 1989-90 winter season registered a mean temperature of 8,0°C, the 1996-97 accounted for a 7,8°C mean and the 1997-98 had a mean of 7,0°C, both the highest of the 1753-2003 period. Mild winter temperatures were also accompanied by severe