Contribution of Fungal Spores to Organic Carbon in Urban and Urban-Fringe Aerosols

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Introduction

Primary biogenic particles are important contributors to the organic aerosol. Quantitative assessments in terms of the amount of bio-aerosol-carbon in relation to the organic carbon fraction of the aerosol has been reported for primary bio-components such as cellulose[1,2], primary biological aerosol particles (BPAPs)[3,4], bacteria[5,6] and fungal spores[6,7].

Fungal spores have been found even in very clean environments such as an Austrian mountain plateau in early spring[6]. Their contribution to OC and amounted to around 1%.

The aim of this study was a quantitative assessment of the contribution of fungal spores to organic carbon based on experimentally derived number count / OC mass conversion factor[7] at an urban and an urban-fringe site in Vienna, Austria. We show that fungal spores take part to a considerable extent in the organic carbon balance of the PM_{10} aerosol in spring and summer.

Experimental

Sampling

Sampling was performed in parallel at an urban-fringe site situated in a park-type living area in the north-west of Vienna, Austria, adjacent to a park and public bath, with nearby forests (UF) and an urban traffic dominated site (UT) situated near a city highway. The experiment was carried out from April to July 2005.

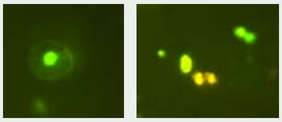
Sampling sites in Vienna, Austria

Samples were taken in parallel with a Hi Vol filter sampler (Digitel DH70) and an impinger (4-fold higher volume compared to the original AGI-4) for the collection of fungal spores. Filters were analysed for PM_{10} mass, EC and OC. Sampling was performed during 24 hours, the sampling flow rate of the impinger was 12 L/min, the sampled volume was around 16 m³. Bioaerosols were collected into sterile water.

At the urban-fringe site size classified aerosol samples were taken with six stage low pressure impactors (Berner LPI 80/17)[8] in the size range of 0.1 – 10 µm aerodynamic equivalent diameter. These samples were analyzed for aerosol mass and EC/OC.

Spores Counts

The spores were enumerated by epifluorescence microscopy (Leitz Wetzlar, Germany) after dying with 1 µL/10 mL SYBR® Gold (Invitrigen, USA). Exc. wavelength: 450 nm; magnification: 1000.



Conversion Factors

The carbon content of fungal spores was calculated by multiplying the number of spores with a conversion factor of 13 pg C/spore[7]. The transformation of fungal carbon to fungal mass was calculated with a carbon content of 50% of the fungal dry mass and a water content of 20 vol% resulting in an average mass per spore of 33 pg.

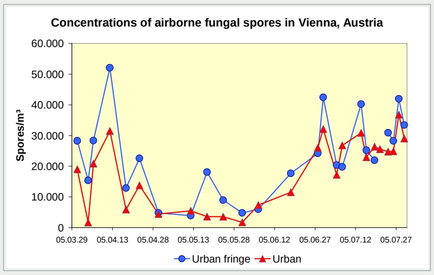
Determination of Organic Carbon

For determination of total carbon (TC) aerosol samples were combusted at 1050°C in a pure oxygen flow and the resulting CO_2 was detected by a non-dispersive infrared (NDIR) analyzer (MAIHAK Unor 6N). Elemental Carbon (EC) was determined with a two step combustion method, based on Cachier et al.[9] (more details are given in[7]). OC was calculated as the difference between TC and EC.

Results

Concentrations of airborne fungal spores

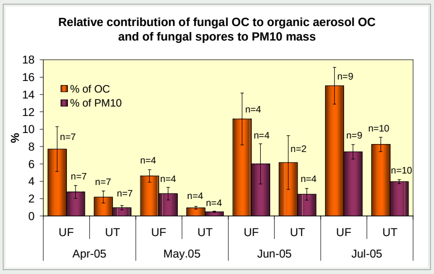
At the urban-fringe site average number concentrations of airborne fungal spores amounted to 18,000 and 27,000 spores/m³ in spring (April, May) and summer (June, July). At the urban traffic site mean concentrations of 10,000 and 24,000 spores/m³ were measured.



The OC from fungal spores was in the range of 22-677 ng/m³, with a summer mean value of around 350 ng/m³ at UF and 320 ng/m³ at UT. More details are given in [10].

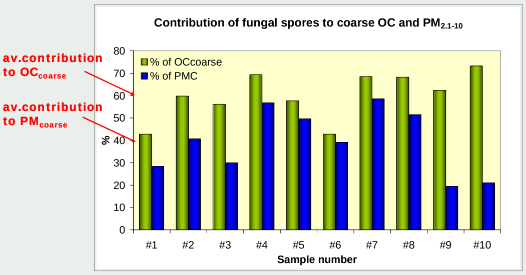
Contribution of airborne fungal spores to aerosol OC and PM_{10} mass

At both sites the contributions of airborne fungal spores to OC were higher in summer (June and July) than in spring. On average 14 and 7.7% of aerosol OC could be attributed to fungal spores at UF and UT, respectively. The derived contribution of fungal spores to PM_{10} mass amounted around 7% in at the UF site and around 3.5% at the UT site, respectively.



The contribution of spores to both OC and PM_{10} mass was around two times higher at the urban fringe than at the urban traffic site. During summer highest contributions of nearly 21% were measured at the UFS site, compared to around 10% at UT.

Contribution of spores to coarse OC and $PM_{2.1-10}$



Fungal spores are the major constituents of OC in the coarse (2.1-10 µm) size fraction with an average contribution of 60%, as obtained in a summer sampling (July 2005) at UF, averaged from 10 measurements. Thus, fungal spores are the major contributors to coarse OC in the warm season in Eastern Austria.

References

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Acknowledgements

We want to thank Prof. Puchinger for help and access to the fluorescence microscope, and Dr. Zibuschka for advice with the staining method. Access to the stations and infrastructure support was provided by the Environmental Protection Department of the City of Vienna (MA22). The project was funded in part from AQUELLA – Wien.