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

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Abstract

The contribution of fungal spores to organic matter (OM) in aerosols was assessed in an urban-fringe site and in an urban traffic dominated site in Vienna, Austria. Sampling was performed during 24 hours, (4-fold higher volume compared to the original AGI-4) for the collection of fungal spores. 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 PM10 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.

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.

Contribution of airborne fungal spores to aerosol OC and PM10 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 PM10 mass amounted around 7% in at the UF site and around 3.5% at the UT site, respectively.

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 cellulose1-2, primary biological aerosol particles (BPAPs)1,4, bacteria3 and fungal spores2-5. Fungal spores have been found even in very clean environments such as an Austrian mountain plateau in early spring. 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 factor6. OC was calculated as the difference between TC and EC.

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.

Detection of Organic Carbon

For determination of total carbon (TC) aerosol samples were combusted at 1050°C in a pure oxygen flow and the resulting CO2 was detected by a non-dispersive infrared (NDIR) analyzer (MAHAK Unor 6N). Elemental Carbon (EC) was determined with a two step combustion method, based on Cachier et al.9 (more details are given in7). OC was calculated as the difference between TC and EC.

Conversion Factors

The carbon content of fungal spores was calculated by multiplying the number of spores with a conversion factor of 13 pg C/spore7. 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 around 7% in at the UF site and around 3.5% at the UT site, respectively.

Conclusions

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 16 measurements. Thus, fungal spores are the major contributors to coarse OC in the warm season in Eastern Austria.

Table: Spores Counts

<table>
<thead>
<tr>
<th>Sample number</th>
<th>Spore Count (Spores/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UF UT UF UT UF UT UF UT</td>
<td>10,000 24,000 18,000 27,000</td>
</tr>
</tbody>
</table>

Table: Conversion of spores to Coarse OC and PM10 mass

<table>
<thead>
<tr>
<th>Sample number</th>
<th>% of OC</th>
<th>% of PM10</th>
</tr>
</thead>
<tbody>
<tr>
<td>UF UT UF UT UF UT UF UT</td>
<td>14.0 7.7</td>
<td></td>
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</table>

References


Acknowledgements

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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

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