Release of fine particles from birch pollen grains following impaction

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Dispersion of pollen allergens in the fine (ie. respirable) particle fraction is a major concern for allergenic asthma. Release of cytoplasmic particles may occur through hydration or germination of the pollen (Schäppi *et al*, 1997). Moreover, air pollution has been shown to facilitate pollen rupture (Motta *et al*, 2006). In this work, we have investigated rupture of the pollen and subsequent release of cytoplasmic particles following a mechanical stress generated with a PM_{10} impactor.

Experimental conditions. Birch pollen grains (ca. 20 µm) were aerosolized in the laboratory into a synthetic air flow of 10 $L.min^{-1}$ and sent into an impactor (Dekati) equipped solely with a PM_{10} stage. Particle size distributions were measured at the outlet of the impactor with an Aerosol Particle Sizer (TSI 3321). Impaction tests were also done with pollen grains artificially polluted with 3 ppm of ozone for 4 hours. Particle size distributions were normalised to show an equal number of pollen grains at 17 µm. All experiments were done in triplicate. For the purpose of FEG-SEM imaging, experiments were done with PM_{10} and PM_1 stages. Particles impacted were collected onto adhesive conductive carbon tapes for investigation of structural damage of the grains.

Results. Comparison of size distributions for native pollen and impacted pollen shows formation of an aerosol composed of fine particles with two size modes centred at 0.7 and 2.0 µm (figure 1). Formation of those particles was surprisingly smaller with ozone-polluted pollen. Pollen has been probably dried by the flow of synthetic air during the ozone exposure suggesting a role of the water content of the grain.

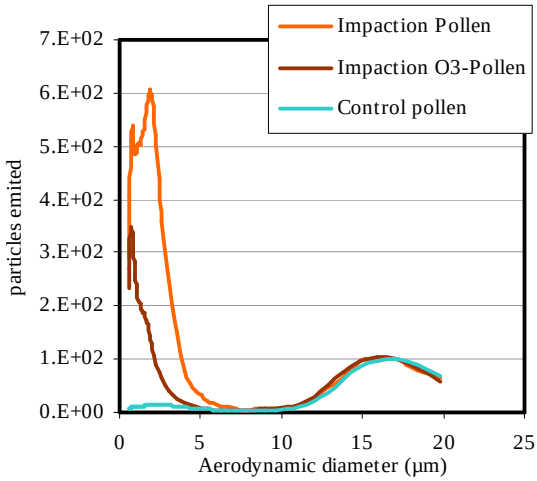

Figure 1. Normalised particle size distributions measured for aerosolized pollen (control run) and for pollen impaction (O_3-polluted or not).

Morphological examination of the sampling on PM_{10} stage by SEM revealed that a number of birch pollens were broken (figure 2). Small particles of micrometric size and ovoid shape were observed in PM_1 fraction (not shown).

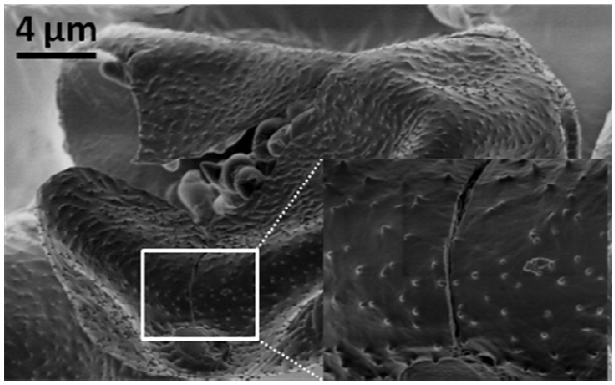

Figure 2. SEM image of a damaged pollen grain exhibiting a large fracture enabling the release of cytoplasmic granules. Insert: enlarged view of a crack in the exine.

Conclusion. Our results show that impaction on a solid surface at wind speed of about 3 $m.s^{-1}$ can induce birch pollen grain rupture. To the best of our knowledge, we gave evidence for the first time of a new mechanism for the release of respirable particles from birch pollen directly in an aerosol phase. Mechanical rupture may occur for pollen through wind transportation but also during pollen sampling by impaction. This latter is of particular importance for an artefact-free detection of allergens on fine particles by use of a multi-stage cascade impactor.

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