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Posttranslational modification of bioaerosol protein by common gas pollutants: NO_2 and O_3

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Air pollution can exacerbate several medical conditions, for example, hay fever and asthma. The global incidence of hay fever has been rising for decades; however, the underlying reasons behind this rise remain unclear. It is hypothesized that the exposure of pollen to common gas phase pollutants, such as nitrogen dioxide (NO_2) and ozone (O_3), increases the allergenicity of the pollen and thus increases hay fever incidence (Reinmuth-Selzle et al., 2014, Franze, et al., 2005). Since atmospheric pollutants often have greater concentrations within urban areas (in particular NO_2) the hypothesis suggests that greater allergenicity should occur in urban areas. Certainly, several studies do suggest higher hay fever incidence within urban areas compared to rural areas (Schröder et al., 2015).

Previous published work suggests a link between increased allergies and changes in the chemical composition of pollen protein via posttranslational modification of the protein (Reinmuth-Selzle et al., 2014). This study investigates the posttranslational modification of two highly allergenic pollen species (Birch and Ragweed) that are common in Europe. Within the laboratory, we expose pollen grains to atmospherically relevant exposures of gas phase NO_2, O_3 and other common gas phase oxidants under a range of environmentally relevant conditions. The effects of the exposures on the biochemistry of the pollen grains were probed using a proteomic approach (liquid chromatography coupled ultra-high resolution spectrometer).

Our findings indicate the interaction between gas phase pollutants and pollen cause protein specific modifications; in particular nitration that occurs upon tyrosine residues and nitrosylation on cysteine residues. These modifications may affect human immune response to the pollen protein, which may suggest a possible reason for increased allergies in reaction to such chemically altered protein. Quantification of the relative degree of PTMs, from a variety of methodologies, will also be presented. Laboratory-derived results will be supported with a time series analysis of hay fever incidence rates, which will take into account both the pollen count, and pollutant concentrations.

References

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