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Environmental influence on pollen grains - Molecular and cell-function studies

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Introduction

The prevalence of allergic diseases has increased dramatically over the last decades. There have been many different studies to explain this phenomenon. Pollution is a major aspect to be considered in this area. The main focus of this study was to characterise pollen grains with regard to different environmental exposure. Given the hypothesis that pollen grains can be altered by pollution leading to a greater negative impact on human health two approaches were introduced in the study: firstly, molecular analysis to reveal the differences in the proteome from rural to urban pollen grains (a screening method with the allergen carrier itself) and secondly, cell biological analysis to compare the chemotactic activity from pollen extracts made from urban and rural pollen grains on human neutrophilic granulocytes (studying the potential health issues).

Methods

Birch pollen grains were collected from urban and rural sites in April 2003. To evaluate the environmental exposure, nitrogen dioxide levels were measured with passive samplers for one week in April. For the pollen grain proteome analysis 2D electrophoresis was performed in combination with the highly sensitive new technology differential gel electrophoresis (DIGE) for quantification of the proteins. Migration assays were used to compare the chemotactic activity from pollen extracts on human neutrophils.

Results

The analysis of the pollen grain proteome with DIGE revealed 34 differences between rural and urban pollen samples in spot protein intensity in the t-test with a significance level of $p \leq 0.05$. One protein was identified which was of particular interest, because it interacts with the lipid metabolism. Pollen-associated lipid mediators which derive from this metabolism showed proinflammatory and immunomodulatory effects on human neutrophilic granulocytes. Furthermore urban pollen extracts had greater chemotactic activity on human neutrophils than rural pollen extracts.

Conclusion

The study established a link between exposure to pollution and molecular changes in pollen grains with potential impact on human health. Especially interestingly was the upregulation of the protein 14-3-3 in urban areas since it is connected to the metabolism for the proinflammatory and immunomodulatory substances in pollen grains. Furthermore, the higher migration of neutrophils to urban pollen extracts points to a higher proinflammatory activity of pollen grains grown in polluted areas.