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Molecular Ice Nucleation Activity of Birch Pollen

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Heterogeneous ice nucleation plays a major part in ecosystem and climate. Due to the triggering of ice cloud formation it influences the radiation balance of the earth, but also on the ground it can be found to be important in many processes of nature. So far the process of heterogeneous ice nucleation is not fully understood and many questions remain to be answered. Biological ice nucleation is hereby from great interest, because it shows the highest freezing temperatures. Several bacteria and fungi act as ice nuclei. A famous example is *Pseudomonas syringae*, a bacterium in commercial use (Snomax®), which increases the freezing from homogeneous freezing temperatures of approx. -40˚C (for small volumes as in cloud droplets) to temperatures up to -2˚C. In 2001 it was found that birch pollen can trigger ice nucleation (Diehl et al. 2001; Diehl et al. 2002). For a long time it was believed that this is due to macroscopic features of the pollen surface. Recent findings of Bernhard Pummer (2012) show a different picture. The ice nuclei are not attached on the pollen surface directly, but on surface material which can be easily washed off. This shows that not only the surface morphology, but also specific molecules or molecular structures are responsible for the ice nucleation activity of birch pollen.

With various analytic methods we work on elucidating the structure of these molecules as well as the mechanism with which they trigger ice nucleation. To solve this we use various instrumental analytic techniques like Nuclear Magnetic Resonance spectroscopy (NMR), Matrix-Assisted Laser Desorption/Ionization Mass Spectrometry (MALDI-MS), and Gas-phase Electrophoretic Mobility Molecular Analysis (GEMMA). Also standard techniques like various chromatographic separation techniques and solvent extraction are in use.

We state here that this feature might be due to the aggregation of small molecules, with agglomerates showing a specific surface structure. Our results indicate that the substance is amphiphilic in character leading finally to micelle formation.

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