Molecular compositions and seasonal variations of sugars and sugar-alcohols in subarctic Alaskan atmosphere

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Sugars and sugar-alcohols are important constituents of water-soluble organic carbon fraction in the ambient aerosols, which can be used as tracers for primary biological aerosol particles (PBAP). In the present study, five sugars and four sugar-alcohols have been measured in ambient aerosols from subarctic Alaska using solvent extraction/TMS-derivatization technique followed by gas chromatography-mass spectrometry (GC-MS) determination.

The average concentrations of primary sugars such as xylose, fructose, glucose, sucrose and trehalose were found to be 1.18, 2.99, 12.0, 30.5 and 4.11 ng m^{-3}, respectively, where sucrose was dominant. We found higher levels of sucrose in spring (ave. 91.3 ng m^{-3}) due to blossoming of plants and emission of pollen to the air. The average concentrations of sugar alcohols such as erythritol, arabitol, mannitol and inositol were also observed to be 1.82, 15.7, 17.0 and 0.38 ng m^{-3}, respectively. They have been proposed as tracers for resuspension of surface soil, unpaved road dust, vegetation and pollen, which contain biological materials including fungi and bacteria. All primary sugars and sugar alcohols, except for erythritol and xylose, exhibited higher-levels in summer and spring. In contrast, erythritol and xylose showed higher concentrations in winter and autumn. Levoglucosan (biomass burning tracer) showed significant correlations with erythritol ($r= 0.75$, $p<0.001$) and xylose ($r= 0.67$, $p<0.001$), indicating that they originate from biomass burning activities. Positive matrix factorization (PMF) analysis also demonstrates that these compounds are mainly derived from airborne pollen, resuspension of surface soil, vegetation and biomass burning. The sugar compounds were found to contribute to 4.0% of water-soluble organic carbon (WSOC) and 1.8% of organic carbon (OC) in aerosols.