



Hydroxycarboxylic Acid-Derived Organosulfates: Synthesis, Stability and Quantification in Ambient Aerosol

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We present a simple method for synthesis and quantification of hydroxycarboxylic acid derived organosulfate standards, specifically glycolic, lactic, and malic acid sulfate. These organosulfates were chosen since small hydroxycarboxylic acids are common in the atmosphere and as glycolic acid sulfate ($C_2H_3SO_6^-$) has been identified in ambient and chamber aerosol using a qualitative standard. We discuss the stability of hydroxycarboxylic acid derived organosulfates as well as their previously proposed sulfate hemiacetal isomers in commonly used solvents for filter extraction and with respect to pH. Quantitative results from ambient particulate matter (PM_{2.5}) collected in urban locations in the United States and Mexico City are presented. Malic and lactic acid organosulfates were only found in very low concentrations but glycolic acid sulfate was ubiquitous, demonstrating that organosulfates of small organic molecules can contribute noticeably to ambient particulate matter. $C_2H_3SO_6^-$ has been identified in a number of aerosol field samples from the boundary layer to the free troposphere and as a gas-phase ion. We propose that it represents an important tracer for (photochemical) contribution of small organic molecules to ambient PM.