Preparative chromatography for specific δ13C isotopic analysis of individual carbohydrates in environmental samples

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Carbohydrates are among the most abundant organic molecules on the Earth and are present in all geochemical systems. Despite their high abundance in the environment, very few studies assessed their origin using molecular carbohydrate isotopic analyses. In contrast with bulk stable isotope analysis (BSIA), which gives the isotopic signature of the entire sample without any specification about its chemical composition, compound specific 13C isotopic analysis of individual sugars (CSIA) offers valuable information about the origin of single molecules. Previous investigations used gas or liquid chromatography coupled with isotope ratio mass spectroscopy (GC-IRMS; HPLC-IRMS) for CSIA of sugars however the former requires δ13C corrections due to the carbon added to the sugar (derivatization) while the later does not provide always adequate separations among monosaccharides. Here we used cation preparative chromatography (Ca2+, Pb2+ and Na+) with refractive index detection in order to produce pure monosaccharide targets for subsequent EA-IRMS analyses. Milli-Q water was used as eluant at a flow rate 0.6 ml min-1. In general, three successive purifications (Ca2+, Pb2+, Ca2+) were sufficient to produce pure compounds. Pure monosaccharides were compared with authentic monosaccharide standards using 1H NMR and/or mass spectroscopy. The detection limit of our technique was about 1μM/sugar with a precision of ~10% (n=6). Blanks run with Milli-Q water after three successive purifications resulted in carbon content of 0.13 to 2.77 μgC per collected sugar. These values are much lower than the minimum required amount (5 μgC) of the EA-IRSMS system with a precision of $\pm$ 0.35 ‰Application of our method to environmental samples resulted in δ13C values of glucose, fructose, and levoglucosan in the range of -24 to -26 ‰ (PM10 atmospheric particles), and -15‰ to -22 ‰ for arabinose, glucose, and xylose (marine high molecular dissolved organic matter). These results fall in the range of previous reported values for terrestrial and aquatic ecosystems.