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A new method to measure amino sugar isomers and amino acids in soil extracts and soil hydrolysates based on AccQ.Tag-chemistry and reversed phase ultra-high-performance liquid chromatography

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Soil microbial necromass represents a significant proportion (>50%) of soil organic matter (SOM). Microbial necromass consists mainly of particulate organic residues from fragmented cells walls and other slow turnover cytoplasmic components of dead fungi and bacteria. Some of the key components of microbial cell walls, such as peptides and amino sugar polymers, can remain and accumulate in the soil over prolonged times. Amino sugars have been used as biomarkers to quantify the contribution of microbial necromass to stabilized SOM. The different amino sugars present in polymeric form in soils can be released by acid hydrolysis and allow the estimation of the contribution of both fungal and bacterial necromass to the SOM pool. Among the amino sugars, hexosamine isomers (glucosamine, galactosamine, mannosamine) and muramic acid (the ether of lactic acid and glucosamine) are the most abundant ones. Muramic acid is specific to bacterial peptidoglycan while glucosamine is an abundant cell wall component of both, fungal chitin and bacterial peptidoglycan.

There are several chromatographic methods to measure free and bound amino sugars and amino acids in soil extracts and soil hydrolysates, but none of them allow the combined determination of amino sugar biomarkers and amino acids simultaneously in a single assay for rapid analysis. This is important as a large fraction of soil necromass N (>50%) consists of non-amino sugar-N, such as proteins and nucleic acids. In this study we therefore adopt a method based on 6-aminoquinolyl-N-hydroxysuccinimidyl carbamate (AccQ.Tag) derivatization of amino compounds and optimized chromatographic (reversed phase) separation to simultaneously measure amino sugars (isomers) and amino acids in soil extracts and soil hydrolysates using ultra-high-performance liquid chromatography coupled to fluorescence or UV detection.

The use of this method allows for fast, robust and highly sensitive quantification of amino acids and amino sugars in environmental samples at sub-micromolar levels. This approach will help to improve our understanding of soil microbial necromass dynamics and their inherent effect on soil C and N sequestration. The AccQ.Tag chemistry also allows compound detection by electrospray ionization (ESI)-mass spectrometry, enabling isotope (^{13}C, ^{15}N) tracing applications.