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Strength and limits using 13C phospholipid fatty acid analysis in soil ecology

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This presentation on microbial phospholipid biomarkers, their isotope analysis and their ability to reveal soil functions summarizes experiences gained by the author for more than 10 years. The amount and composition of phospholipid fatty acids (PLFAs) measured in environmental samples strongly depend on the methodology. To achieve comparable results the extraction, separation and methylation method must be kept constant. PLFAs patterns are sensitive to microbial community shifts even though the taxonomic resolution of PLFAs is low. The possibility to easily link lipid biomarkers with stable isotope techniques is identified as a major advantage when addressing soil functions. Measurement of PLFA isotopic ratios is sensitive and enables detecting isotopic fractionation. The difference between the carbon isotopic ratio of single PLFAs and their substrate (δ13C) can vary between -6 and +11‰This difference derives from the fractionation during biosynthesis and from substrate inhomogeneity. Consequently, natural abundance studies are restricted to quantifying substrate uptake of the total microbial biomass. In contrast, artificial labelling enables quantifying carbon uptake into single PLFAs, but labelling success depends on homogeneous and undisturbed label application. Current developments in microbial ecology (e.g. 13C and 15N proteomics) and isotope techniques (online monitoring of CO_2 isotope ratios) will likely improve soil functional interpretations in the future. 13C PLFA analysis will continue to contribute because it is affordable, sensitive and allows frequent sampling combined with the use of small amounts of 13C label.