Stable isotope fingerprinting: a novel method for identifying plant, fungal or bacterial origins of amino acids

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Amino acids play an important role in ecology as essential nutrients for animals and as currencies in symbiotic associations. Here we present a new approach to tracing the origins of amino acids by identifying unique patterns of carbon isotope signatures generated by amino acid synthesis in plants, fungi and bacteria ("13C fingerprints"). We measured amino acid d13C from 10 C3 plants, 13 fungi, and 10 bacteria collected and isolated from a boreal forest in interior Alaska using gas chromatography - combustion - isotope ratio mass spectrometry (GC-C-IRMS). Microorganisms were cultured under amino acid free conditions and identified based on DNA sequences. Bacteria, fungi and plants generated consistent, unique 13C fingerprints based on the more complex amino acids (≥ 5 biosynthetic steps) that are classified as essential for animals. Linear discriminant analysis classified all samples correctly with > 99% certainty, and correctly classified nearly all insect samples from a previous study by diet. Our results suggest that 13C fingerprints of amino acids could provide a powerful in situ assay of the biosynthetic sources of amino acids and a potential new tool for understanding nutritional linkages in food webs.