IsoLife
Stable Isotope Labelled Plant Products for the Life Sciences
university of groningen

U^{13}C Plant Materials Expand Probing Capacities in Complex Ecosystems

New Developments in Stable Isotope Applications

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Uniformly (>98 at%) ^{13}C-Labelled Higher Plants

Stable isotopes like ^{13}C and ^{15}N have been used in ecology for decades in tracer studies of plant materials in organic environments like natural soils or human gut systems. They are used to trace C & N or to reveal trophic levels in complex food webs.

Although De Visser *et al.* (2008) successfully identified trophic levels in natural abundance studies, low isotope-enriched plant materials have drawbacks:
1. Low resolution caused by dilution of the tracer in the natural background of organic matter pools;
2. Inadequacy for modern techniques like SIP requiring a high, uniform enrichment (e.g. U^{13}C-cellulose).

De Visser *et al*. 2008. Trophic inter-actions among invertebrates in termitaria in the African savanna: a stable isotope approach. *Ecol. Entomol*. 33: 758.

Such U^{13}C-labelled plant materials are only produced since 2005 by **Iso*Life***. They open up new ways in studying trophic relations, decomposition of plant materials, and functional relationships in complex ecosystems (see examples A). Moreover, they improve our measurement techniques (see examples B&C).

Uniform labelling of plants with stable isotopes is like ringing birds.

Not a few, but all.

Iso*Life*'s goal is to supply Life Science research with ^{13}C- and ^{15}N-labelled plants and plant components.

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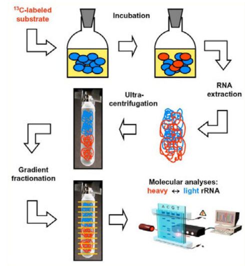
A) New Tools in Trophic Studies

i) Stable Isotope Probing (SIP) enables detection of active organisms growing on ^{13}C-labelled substrates – either primary consumers or predators by using density gradient centrifugation to separate ^{12}C- from ^{13}C-DNA or -RNA. Subsequent sequencing of the ^{13}C-bands will reveal the active, functional species in a food web. **Trophic interactions** in food webs can thus be studied with a new focus.



Example: U^{13}C-labelled starch enables identifying gut bacteria. (Kovatcheva *et al.* 2009. Linking phylogenetic identities of bacteria to starch fermentation. *Environm. Microbiol.* 11: 914).
AWARD WINNING PUBLICATION.

ii) Decomposition studies with U^{13}C-labelled lignin or cellulose can yield detailed information about the fraction respired, the distribution among fractions, and transformations. Moreover, the *same* experiments may yield information on active organisms by using SIP (i).

Example: Waldrop & Harden. 2008. Interactive effects of wildfire and permafrost on microbial communities and soil processes. *Global Change Biology* 14: 1.

B) New Internal Standards in MS

^{13}C-Internal standards function as absolute yardsticks in MS analyses. Degradation of metabolites during the analyses and variations in sample processing are accounted for by spiking your samples with a U^{13}C-labelled standard during processing.

Example: Erk *et al*. 2009. A novel method for the quantification of quinic acid in food. *Journal of AOAC International* 92: 730.

C) New Detection of Trace Gasses

Trace gas detection based on laser systems enable to monitor real time gas emission of trace-gasses like methane. Measurement of **^{13}C-labelled gasses** in combination with uniform ^{13}C-labelling of plants provide new powerful tools.

Example: U^{13}C-labelled sage (*Salvia officinalis* L.) in a study of aerobic methane emission by plants. (Dueck *et al*. 2007. No evidence for substantial aerobic methane emission by terrestrial plants: A ^{13}C-labelling approach. *New Phytol.* 175: 29).