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Consumption of terrestrial dissolved organic carbon in microbial mesocosm

Philips Akinwole[1], **H Gandhi** [2], **P H Ostrom**[2], **L Kaplan** [3] and **R H Findlay**[1]
[1]University of Alabama, USA
[2]Michigan State University, USA
[3]Stroud Water Research Center, USA

Dissolved organic carbon (DOC) is the largest organic carbon pool in lotic systems. Current paradigms describing terrestrial DOC in streams depict DOC as both an important carbon and energy source for microorganisms and containing large amounts of chemical and biological refractory humic substances. To better evaluate the reliance of stream microorganisms on terrestrial DOC, we produced ^{13}C-labeled DOC by leaching composted ^{13}C-labelled tulip poplar leaves and twigs in soil columns for 3 months and then leaching the soil with water. This process yields ^{13}C-labeled DOC with size and liability fractions approximating stream water DOC. To determine the microbial groups actively using stream water DOC we incubated streambed sediments in recirculating mesocosm chambers amended with ^{13}C-labeled DOC and examined ^{13}C incorporation into microbial phospholipid fatty acids. Prokaryotes comprised 61% of the mesocosm microbial community and consisted of aerobic, facultative anaerobic and anaerobic bacteria while microeukaryotes comprised the remaining 39%. Comparison by principal component analysis of the microbial communities in stream sediments and stream sediments incubated with or without ^{13}C-labeled humic DOC showed our mesocosm-based experimental design was sufficiently robust to investigate the use of ^{13}DOC by sediment microbial communities. After 48 hours of incubation, phospholipid fatty acids i15:0, 16:0, 16:1w9, 18:1w9c, 18:1w7c (aerobic/facultative anaerobic bacterial biomarkers) and 20:4w6, 20:5w3 (microeukaryotic biomarkers) showed increased abundance of ^{13}C. This suggests that the hetero organotrophic bacteria actively utilized the ^{13}DOC and that microeukaryotic predators consumed those bacteria. These findings indicate that DOC, although generally considered refractory and poorly utilized by microbiota, substantially contributes to the energy and carbon flow in aquatic ecosystems.

Biography

Philips Akinwole is a Senior Researcher at the Department of Biological Sciences, University of Alabama, USA.

poakinwole@crimson.ua.edu

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