Amino acid nitrogen and carbon isotope data: Potential and implications for ecological studies

Hee Young Yun[1], Thomas Larsen[2], Bohyung Choi[3], Eun-Ji Won[4], and Kyung-Hoon Shin[4]

[1]Hanyang University College of Science and Convergence Technology
[2]Max Planck Institute for the Science of Human History
[3]National Institute of Fisheries Science
[4]Hanyang University - ERICA Campus

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Abstract

Explaining food web dynamics, stability, and functioning depend substantially on understanding of feeding relations within a community. Bulk stable isotope ratios (SIRs) in natural abundance are well-established tools to express direct and indirect feeding relations as continuous variables across time and space. Along with bulk SIRs, the SIRs of individual amino acids (AAs) are now emerging as a promising and complementary method to characterize the flow and transformation of resources across a diversity of organisms, from microbial domains to macroscopic consumers. This significant AA-SIR capacity is based on empirical evidence that a consumer's SIR, specific to an individual AA, reflects its diet SIR coupled with a certain degree of isotopic differences between the consumer and its diet. However, many empirical ecologists are still unfamiliar with the scope of applicability and the interpretative power of AA-SIR. To fill these knowledge gaps, we here describe a comprehensive approach to both carbon and nitrogen AA-SIR assessment focusing on two key topics: pattern in AA-isotope composition across spatial and temporal scales, and a certain variability of AA-specific isotope differences between the diet and the consumer. On this basis we review the versatile applicability of AA-SIR to improve our understanding of physiological processes as well as food web functioning, allowing us to reconstruct dominant basal dietary sources and trace their trophic transfers at the specimen and community levels. Given the insightful and opportunities of AA-SIR, we suggest future applications for the dual use of carbon and nitrogen AA-SIR to study more realistic food web structures and robust consumer niches, which are often very difficult to explain in nature.

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