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Nitrogen isotopic composition of amino acids as a tool for studying food webs: a case study of terrestrial insects

Yoshito Chikaraishi[1*], Nanako O. Ogawa[1], Naohiko Ohkouchi[1]

[1]JAMSTEC

Knowledge of the trophic position of organisms in food webs allows understanding of biomass flow and trophic linkages in complex networks of ecosystems. Stable nitrogen isotope analysis of amino acids is a new method with the potential for estimating the trophic position of consumers in food webs. However, this amino acid method is established by the experimental observations only from aquatic organisms such as phytoplankton, zooplankton, and fish. It is uncertain whether the amino acid method can be applied to food webs in the terrestrial environment. To evaluate the applicability of the amino acid method to studies of terrestrial insect food webs, (1) we investigate the ^{15}N-enrichment factor of amino acids from plant leaves to its consumer herbivores such as caterpillars, and (2) we apply this method to estimate the trophic position of natural insects including herbivorous bees and carnivorous wasps and hornets. Although the isotopic distribution pattern differs considerably between aquatic photoautotrophs and terrestrial C3 and C4 plants, the ^{15}N enrichment factors in herbivores are well consistent with those in the aquatic consumers reported in previous studies. Moreover, the trophic position estimated by the amino acid method is consistent with the biologically expected trophic position of the natural insects (e.g., 2.0 for bees, 3.0 for wasps, and 3.5-4.0 for hornets). Thus, an estimate of trophic position based on the nitrogen isotopic composition of amino acids is applicable to not only aquatic food webs but also terrestrial insect food webs. In the presentation, we briefly review amino acid methods and then show its application to natural insects in terrestrial environments.

Keywords: amino acid, nitrogen isotopic composition, food web, trophic position