Ecological and evolutionary transmission of gut mutualistic symbionts in wood-feeding termites

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Abstract

While host-microbe symbiotic mutualisms are widespread and play major roles in the functioning of many ecosystems, the mechanisms by which these associations persist and diversify in the course of evolution are poorly understood. In many cases, it is assumed that mutualism stability is insured by a strict vertical transmission of the symbionts (from host parents to offspring). To test this hypothesis, symbiont transmission needs to be characterized at both ecological (from one host generation to another) and evolutionary (from one host lineage to others) timescales.
The present study aims to characterize symbiont transmission patterns in the nutritional symbiosis between *Reticulitermes* termites (Rhinotermitidae) and their mutualistic gut protists of the genus *Trichonympha* (Trichonymphidae). Phylogenetic reconstructions of *Trichonympha* symbionts based on 18S rRNA and ITS sequences revealed that *Reticulitermes* termites have acquired independently 3 to 4 distinct lineages of *Trichonympha*, most probably from another termite group through horizontal transmission. In addition, although congruence tests between the host and symbiont phylogenies were significant, reconciliation analyses suggested numerous host shifts.

Molecular characterization of *Trichonympha* has revealed the coexistence of two *Trichonympha* species (A and B) in the host *R. grassei*. Interestingly, the screen of these symbionts in host populations showed variation in the composition of *Trichonympha* assemblage. Some colonies harbour both A and B symbionts whereas other colonies harbour only B. Furthermore, results showed that future reproductives (i.e., alates) that swarm from their parental colony to found new colonies harbour all possible combinations of *Trichonympha* assemblage (i.e., AB, only A, only B, neither A nor B).
Together, these results suggest that the diversification of *Reticulitermes* – *Trichonympha* symbioses not only includes co-speciation events, but also many host-shifts and symbiont losses. A strict vertical transmission pattern insuring partner fidelity is thus probably not the only mechanism allowing mutualism stability in this system.

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