3-O16-2

Genomic basis of fungal bioluminescence in *Mycena* species

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Bioluminescence is present in many species ranging from marine bacteria to terrestrial fungi, earthworm, and firefly. Currently more than 78 fungal species are known to display bioluminescence. Although the underlying chemical reaction in all bioluminescent species are believed to involve a luciferin and a luciferase enzyme were discovered last year, its regulation and ecological role remains elusive.

To further understand the global view of expression profile of bioluminescence and its evolution, comparative transcriptomics and comparative genomics were conducted. Five species belonging to Mycena genus including four bioluminescent species and one nonbioluminescent species were selected for genome sequencing. In these four bioluminescent fungi, differential expression genes were either identified from comparison between higher and lower bioluminescent mycelium in the same species or identified from the correlation between bioluminescent intensity of tissues and gene expression levels. Our results reveal that that all bioluminescent fungi shared common ancestry. Three gene families including luciferase (luz), hispidin-3-hydroxylase (H3H), and fatty acid desaturase were up-regulated according to the intersect of up-regulated genes among four bioluminescent species. The gene luz is absent in the nonbioluminescent species. There are 6-30 paralogues of h3h in the four bioluminescent fungi but with different gene expression levels. These systematically understanding will further unravel the roles of fungi in ecological niches and evolution in the bioluminescence of Mycena fungi in general.