New Insights into the Plastome Evolution of Lauraceae Using Herbariomics

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Background: The family Lauraceae possesses ca. 50 genera and 2500-3000 species that are distributed in the pantropics. Only half of the genera of the family were represented in previously published plastome phylogenies because of the difficulty of obtaining research materials. Plastomes of Hypodaphnideae and the Mezilaurus group, two lineages with unusual phylogenetic positions, have not been previously reported and thus limit our full understanding on the plastome evolution of the family. Herbariomics, promoted by next generation sequencing technology, can make full use of herbarium specimens, and provides opportunities to fill the sampling gap.

Results: In this study, we sequenced five new plastomes (including four genera which are reported for the first time, viz. Chlorocardium, Hypodaphnis, Licaria and Sextonia) from herbarium specimens using genome skimming to conduct a comprehensive analysis of plastome evolution of Lauraceae, sampling representatives of all major clades of the family. We identified and recognized six types of plastomes and revealed that at least two independent loss events at the IR-LSC boundary and an independent expansion of SSC occurred in the plastome evolution of the family. Hypodaphnis possesses the ancestral type of Lauraceae with trnI-CAU, rpl23 and rpl2 duplicated in the IR regions (Type-□). The Mezilaurus group shares the same plastome structure with the core Lauraceae group in the loss of trnI-CAU, rpl23 and rpl2 in the IRa region (Type-□). Two new types were identified in the Ocotea group: 1) the insertion of trnI-CAU between trnL-UAG and ccsA in the SSC region of Licaria capitata and Ocotea bracteosa (Type-□), and 2) trnI-CAU and pseudogenizated rpl23 inserted in the same region of Nectandra angustifolia (Type-□). Our phylogeny suggests that Lauraceae are divided into nine major clades largely in accordance with the plastome types. The Hypodaphnideae are the earliest diverged lineage supported by both robust phylogeny and the ancestral plastome type. The monophyletic Mezilaurus group is sister to the core Lauraceae.

Conclusions: By using herbariomics, we built a more complete picture of plastome evolution and phylogeny of the family, thus providing a convincing case for further use of herbariomics in phylogenetic studies of the Lauraceae.