MOLECULAR DIVERSITY AMONG BASAL ANGIOSPERMS

Massuo Jorge Kato
Chemistry Institute / University of São Paulo (IQ/USP)
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co-PI: Eny Iochevet Segal Floh

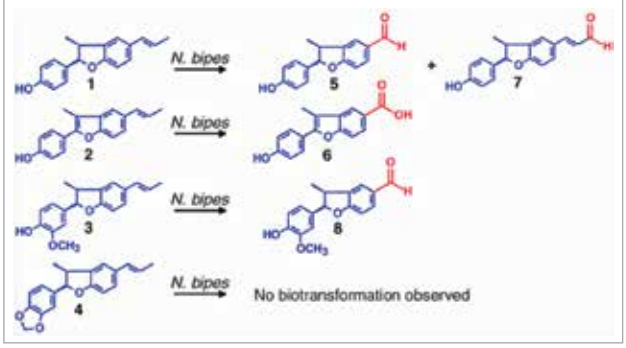

Figure 1. Biotransformation of neolignans 1-4 from Piper regnellii *(leaves and roots) by* N. bipes *beetle (larvae and adult). [Ramos CS, Kato MJ. 2013. Metabolism of neolignans from* P. regnellii *(Piperaceae) in the beetle* Naupactus bipes *(Coleoptera: Curculionidae).* Chemoecology. **23**: *143-148.]*

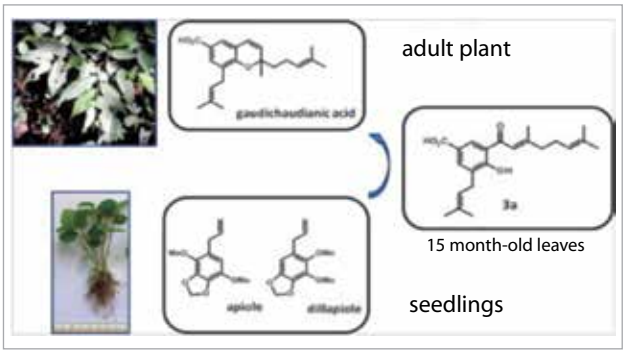

Figure 2. Biosynthetic pathway leading to major secondary metabolites through development of Piper gaudichaudianum. *[Gaia AM, Yamaguchi LF, Jeffrey CS, Kato MJ. 2014. Age-dependent changes from allylphenol to prenylated benzoic acid production in* Piper gaudichaudianum *kunth.* Phytochemistry. **106**, *86-93.]*

The Piperaceae was the model plant to study the evolution of secondary metabolism. The molecular phylogeny of *Piper* (200 species) and *Peperomia* (50 species) based on ITS (nuclear), matK (plastid) + ITS (nuclear), respectively, was compared to the chemical profiling based on ^{1}H NMR, ESI^{+} and HPLC data, using multivariate analysis (PCA and HCA). The major classes of compounds were amides, prenylated benzoic acids, chromenes, polyketides and phenylpropanoid derivatives with some specific occurrence in various clades. Detailed characterization of chemical composition was still a valuable tool to complement the chemical profiling. The bioactivity of amides from Piper and 2-acyl-1,3-cyclohexanediones from Peperomia species had their structure-activity relationship investigated. The synthesis of large number of analogues and cytotoxicity against twelve leukemia cell lines and herbicide against the enzyme HPPD (4-hydroxyphenylpyruvate dioxygenase) revealed structural requirements for activities. The ontogeny of Piper species, i.e. development of seedling until adult plants showed three different patterns: A (*P. tuberculatum*, *P. amalago, P. scutifolium* and *P. reticulatum*), with amides occurring throughout the stages; B (*P. regnellii*, *P. solmsianum*, *P. gaudichaudianum* e *P. caldense*) with phenylpropanoids (dillapiol-apiol or isoasarone) in seedlings while adult plants contained dihydrobenzofuran neolignans, tetrahydrofuran lignans or prenylated benzoic acid derivatives, respectively; C (*P. richardiaefolium*, *P. truncatum* and P. kelleyi) with the amide piplartine in seedlings and furofuran and dibenzylbutyrolactone lignans and prenylated benzoic acids, respectively.

In summary, the variability of Piperaceae species is highly associated with chemical variability, including complex pattern of differentiation during ontogeny with unpredictable consequences against specific or generalist herbivores that has been found predating the species.

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Massuo Jorge Kato

Instituto de Química
Universidade de São Paulo (USP)
Av. Prof. Lineu Prestes 748, B 11-T
CEP 05508-900 – São Paulo, SP – Brasil

+55-11-3091-1886
majokato@iq.usp.br