Spatio-temporal changes in targeted metabolites in overnight fragrant flowers of *Murraya paniculata* (Linn.) Jack

Abstract

Scent profile of ephemeral-nocturnal floral species *Murraya paniculata* was characterized for assessing diel and seasonal plasticity. The floral fragrance displayed a 'fingerprint' set of 15 volatiles dominated by benzenoids, terpenoids and phenylethanoids. Strong nocturnal/diurnal variability was detected due circadian and plastic regulation of 2-phenylethanol, (E)-β-ocimene, 2-phenylethanal, methyl benzoate, methyl anthranilate and germacrene D emission rates. A separate suite of volatiles including linalool, nonanal, decanal, methyl salicylate and methyl palmitate showed significant seasonal variation.

Mapping the floral specialized metabolite contents at 2 h intervals revealed three distinct fragrance-emitting phases viz. 'early bloom', 'mid-bloom' and 'late bloom'. Early and late bloom phases were characterized by high free-radical generation along with enhancement of antioxidant enzymes and phenolic compounds. Increments in free-radical contents during flower opening and petal senescence coincided with intensified channelling of L-phenylalanine ammonia-lyase (PAL) products towards phenolics production. The mid-bloom phase showed maximal fragrance emission, with provision for terpenoid-mediated defence against herbivores. This phase coincided with a large peak in PAL activity, which channels the metabolic precursors towards volatiles production. The late bloom phase merged into senescence with start of diurnal hours, characterized by a different scent composition and enhanced scopoletin accumulation.

Petals were found to contribute over 90% of total fragrance. Sub-epidermal oil cavities on abaxial surfaces of petals contain sesquiterpenes and phenolics. Scent emission was facilitated by structural disintegration of internal petal tissue and loss of cuticle thickness in these stages. Loss of cytosolic material and coalescence of vacuoles in petal cells during scent-emitting stage suggested storage mechanisms taking precedence over metabolic activities with initiation of scent emission. Abundant plastids in the petal epidermis might be sites for biosynthesis of floral monoterpenes. Terpenoids were also found to be emitted from anthers and stigma. Accumulation of phenolics in a large central cavity within stigma and on pollen surfaces indicated the presence of ferulic acid and its derivatives in floral organs associated with scent emission.

Keyword: ephemeral flowers; floral scent; floral phenolics; floral specialized metabolites; *Murraya paniculata*