

Enhancement of leaf gas exchange and primary metabolites under carbon dioxide enrichment up-regulates the production of secondary metabolites in *labisia pumila* seedlings.

ABSTRACT

A split plot 3 by 3 experiment was designed to investigate and distinguish the relationships among production of primary metabolites (soluble sugar and starch), secondary metabolites (total phenolics, TP; total flavonoids, TF) and leaf gas exchange of three varieties of the Malaysian medicinal herb *Labisia pumila* Blume, namely the varieties *alata*, *pumila* and *lanceolata*, under three levels of CO₂ enrichment (400, 800 and 1,200 $\mu\text{mol mol}^{-1}$) for 15 weeks. The treatment effects were solely contributed by CO₂ enrichment levels; no varietal differences were observed. As CO₂ levels increased from 400 to 1,200 $\mu\text{mol mol}^{-1}$, the production of carbohydrates also increased steadily, especially for starch more than soluble sugar (sucrose). TF and TP content, simultaneously, reached their peaks under 1,200 $\mu\text{mol mol}^{-1}$ exposure, followed by 800 and 400 $\mu\text{mol mol}^{-1}$. Net photosynthesis (A) and quantum efficiency of photosystem II (fv/fm) were also enhanced as CO₂ increased from 400 to 1,200 $\mu\text{mol mol}^{-1}$. Leaf gas exchange characteristics displayed a significant positive relationship with the production of secondary metabolites and carbohydrate contents. The increase in production of TP and TFs were manifested by high C/N ratio and low protein content in *L. pumila* seedlings, and accompanied by reduction in chlorophyll content that exhibited very significant negative relationships with total soluble sugar, starch and total non structural carbohydrate.

Keyword: Elevated CO₂; Photosynthesis; Maximum quantum efficiency of photosystem II (fv/fm); Medicinal herb *Kacip Fatimah*; Total non structural carbohydrates.