

## 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 CO<sub>2</sub> enrichment (400, 800 and 1,200  $\mu\text{mol mol}^{-1}$ ) for 15 weeks. The treatment effects were solely contributed by CO<sub>2</sub> enrichment levels; no varietal differences were observed. As CO<sub>2</sub> 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 CO<sub>2</sub> 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 CO<sub>2</sub>; Photosynthesis; Maximum quantum efficiency of photosystem II (fv/fm); Medicinal herb Kacip Fatimah; Total non structural carbohydrates.