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 μmol 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 μmol 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 μmol exposure, followed by 800 and 400 μmol mol -1. Net photosynthesis (A) and quantum efficiency of photosystem II (fv/fm) were also enhanced as CO2 increased from 400 to 1,200 μmol 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.