Impact of elevated CO2 on leaf gas exchange, carbohydrates and secondary metabolites accumulation in Labisia pumila benth

ABSTRACT

Aims: The aim of this study was to investigate different levels of CO 2 availability alters total phenolic and flavonoid, total available carbohydrate (TAC) and to determine how elevated CO 2 influences gas exchange of Labisia pumila seedlings. Study Design: The 3-months Labisia pumila seedlings of var Alata, var Pumila and var Lanceolata were put under 1 month to acclimatize in a nursery until ready for the treatment. Carbon dioxide enrichment treatments started when seedlings reached 4 months old by exposing them to three levels of CO 2 , viz., ambient CO 2 (400 µmol/mol), twice ambient (800 µmol/mol) and thrice ambient CO 2 (1200 µmol/mol). The split plot 3 x 3 factorial experiment was designed using randomized complete block design with CO 2 levels being the main plot and varieties as the sub-plot replicated Original Research Article Ibrahim et al.; ARRB, 19(6): 1-16, 2017; Article no.ARRB.36673 2 three times. Place and Duration of Study: Ladang 2, Universiti Putra Malaysia Glasshouse complex between July to November 2011. Methodology: The experiment was conducted for 15 weeks. The measurement of photosynthesis was obtained from a closed infra-red gas analyzer LICOR 6400XT Portable Photosynthesis System (IRGA, Licor Inc., USA). Total phenolics and flavonoid were determined using Follin-Ciocalteau reagent and total available carbohydrate using anthrone reagent. Results: It was found that the treatment effects were contributed by CO 2 levels in all weeks measured in leaf gas exchange properties (Net photosynthesis (A), stomatal conductance (g s), transpiration rate (E), intercellular CO 2 (C i) and Instantaneous water use efficiency, WUE). A combination of increases rates of A and E was responsible for enhancement of WUE by 50% in elevated treatment (800 and 1200 µmol/mol). Total available carbohydrate, total phenolics and flavonoid were also influenced by elevated CO 2 in all weeks of measurement. At end of 15 weeks after treatment (WAT), 44% increase in total available carbohydrate had increased total phenolic and flavonoid by 56% and 149% respectively than ambient treatment. At end of 15 WAT It was found, that the photosynthetic capacity of Labisia pumila was enhanced under elevated CO 2 by significantly have higher maximum electron transfer rate, J max and Rubisco CO 2 fixation capacity V cmax than ambient seedlings. Conclusion: In this work, it was observed that the increase in production of total phenolics and flavonoid in L. pumila might be due to increase in production of total available carbohydrate in the present study. The upregulation of photosynthesis in the present study was supported by enhancement of Maximum electron transfer rate, J max and Rubisco CO 2 fixation capacity V cmax than ambient seedlings that showed this plant has high sink strength to cope with high level of CO 2.

Keyword: Medicinal plant; Carbon assimilation; Carbohydrate accumulation; Plant secondary metabolites