Involvement of carbohydrate, protein and phenylanine ammonia lyase in up-regulation of secondary metabolites in labisia pumila under various CO 2 and N2 levels.

ABSTRACT

A split plot factorial 2 × 3 experiment was designed to examine and characterize the relationships among secondary metabolites (total phenolics, TP; total flavonoids, TF), carbohydrate content, C/N ratio, protein synthesis and L-phenylalanine ammonia lyase (PAL; EC 4.3.1.5) activity in the Malaysian medicinal herb Labisia pumila (Blume) Fern-Vill. under different CO2 concentrations (400 = ambient and 1,200 μmol mol-1 CO2) and three levels of nitrogen fertilization (0, 90 and 270 kg N ha-1) for 15 weeks. The interaction between CO2 and nitrogen levels imposed a significant impact on plant secondary metabolite production, protein, PAL activity and fructose levels. Highest TP and TF were recorded under 1,200 μmol mol-1 CO2 when N fertilizer was not applied; lowest values were obtained at 400 μmol mol-1 CO2 fertilized with the highest N level. Concurrently, fructose contents increased tremendously. Increase in fructose content might also enhance erythose-4-phosphate production (substrate for lignin and phenolic compounds), which shares a common precursor transdalolase in the pentose phosphate pathway. PAL activity was noted to be highest under 1,200 μmol mol-1 CO2 + 0 kg N ha-1 coinciding with subsequent recording of the lowest protein content. The results implied that the increase in plant secondary metabolites production under the tested conditions might be due to diversion of phenylalanine for protein synthesis to production of secondary metabolites. It was also found that the sucrose to starch ratio was also high under high levels of nitrogen fertilization, indicating an enhanced sucrose phosphate synthase activity (SPS; EC 2.4.1.14) under such condition.

Keyword: CO2 enrichment; Total phenolics; Total flavonoids; Carbon-to-nitrogen ratio; Total non structurable carbohydrates; Total soluble sugar and starch profiling; Kacip Fatimah.