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The Effects of Low and High Sulfur Concentrations on the Metabolomics of Romaine Lettuce

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[Introduction]
Sulfur is an essential component of cells. In fact, sulfur is contained in all major biomolecules, including proteins, nucleic acids, vitamin cofactors and metabolites, and is required by all living organisms. Metabolomics is a useful tool for determining the chemical changes caused by differences in fertilizer components when growing crops. Therefore, in this experiment, we intend to provide basic data on quality characteristics through metabolite analysis using GC-MS and LC-MS after treating sulfur at low and high concentrations during cultivation of romaine lettuce.

[Materials and Methods]
Romaine lettuce leaves treated with low and high sulfur concentrations is lyophilized and pulverized with liquid nitrogen under the blue and red light of LEDs. The residues were extracted with 20% methanol and terfenadine as an internal standard for LC-MS analysis. After centrifuging, the supernatants were analyzed by ultra-performance liquid chromatography quadrupole time of flight MS (UPLC-Q-TOF MS, Waters Corp., Milford, MA, USA). For GC-MS analysis, all dried samples were dissolved in 70 μL of methoxyamine hydrochloride in pyridine (20 mg/mL) containing dicyclohexyl phthalate as an internal standard and incubated at 37°C for 90 min. The methoxylated samples were then derivatized at 70°C for 30 minutes with 70 L N,O-bis(trimethylsilyl)trifluoroacetamide and 1% trimethylchlorosilane. GC-MS was used to test the derivatized samples (Shimadzu Corp., Kyoto, Japan).

[Resulfts and Dicussion]
To classify metabolites that contribute to the observed discrepancy between the low and high sulfur groups, the p-values of all normalized chromatogram intensities of Romaine lettuce metabolites obtained through GC-MS and LC-MS analysis were analyzed. On the PLS-DA score plot for GC-MS results, twenty-four metabolites were classified as the major contributors to the differences in the groups, including acidic compounds, amino acids, sugars, lipid metabolites, and volatile compounds. A metabolomic pathway was suggested based on the established metabolites, and it was verified that carbohydrate metabolism, the TCA cycle, and lipid metabolism are the key processes that vary at low and high sulfur concentrations. These findings provide useful insights on the physiological and chemical changes that occur in romaine lettuce as a result of treatment with varying concentrations of sulfur.

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