Application of irradiant LED to polyphenol enrichment of plants

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Precursors of nutraceuticals are synthesized through metabolic pathways common to higher plant species. Although light-emitting diode (LED) has recently been applied to "plant factories", we know little what enzyme genes or substances in metabolic pathways are enhanced in response to LED irradiance.

Arabidopsis thaliana and other Cruciferae plants were exposed to blue LED (470 nm), red LED (660 nm), blue LED + red LED, or blue LED (pulsed) at 110-240 μmol m^{-2} s^{-1}, and subjected to DNA array analysis (Affymetrix GeneChip Arabidopsis ATH1) or metabolomics (Agilent 6510 Accurate-Mass Q-TOF LC-MS/MS and others). Expression of gene for biosynthesis of lignin and flavonoids have been enhanced by blue LED, leading to enrichment with kaempferol glycosides and anthocyanins. On the other hand, red LED has stimulated expression of genes for saponin biosynthesis.

We applied this strategy to sprouts of broccoli (*Brassica oleracea* var. italica) and red cabbage *(Brassica oleracea* var. capitata). Kaempferol content increased approx. 3 times by blue LED irradiance for 2 days. Cyanidin and pelargonidin were nearly doubled by the same treatment, indicating that the LED irradiation can be adapted to commercialization of polyphenol-enriched sprouts.

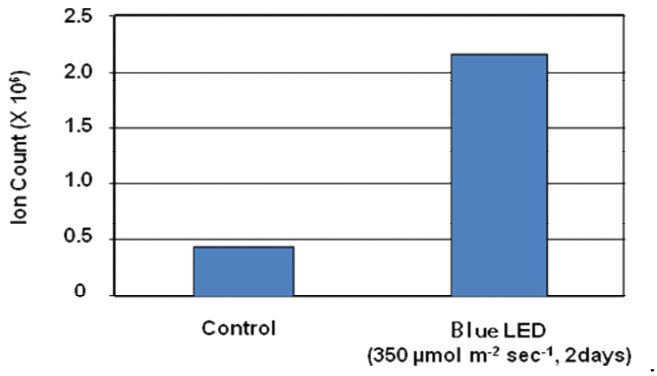

Figure. Kaempferol accumulation in broccoli by blue LED irradiance for 2 days.