Title Environmental manipulation to increase the nutritional content in leafy vegetables

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Abstract

In plants, carotenoids play critical roles in both light harvesting and energy dissipation for photosynthetic mechanism. In humans, carotenoids have been associated with reduced risk of lung cancer and chronic eye diseases, such as cataracts and age-related macular degeneration. Increasing carotenoid levels in plants that are commonly consumed in the diet would impart health benefits without changing the dietary habits of individuals.

Kale (*Brassica oleracea* L.) ranks highest and spinach (*Spinacia oleracea* L.) ranks second among vegetable crops for the accumulation of the carotenoids, lutein and β-carotene. Limited research is available on the impact of environment and drying method on the production and destruction of secondary plant compounds. Therefore, the objectives of these studies were to determine how leaf age, light (irradiance, photoperiod, radiation cycle and wavelength), nutrition (nitrogen and selenium), and air temperature influences the accumulation of carotenoids, chlorophylls and dry matter in kale and spinach.

Data from the nitrogen nutrition experiment revealed that increased growth through fertilization resulted in increased lutein and β-carotene when measured on a fresh mass basis for one variety of spinach. However, when carotenoid accumulation was measured on a dry mass basis, both varieties were significantly affected by additional nitrogen. Results from this study showed that to accurately understand carotenoid accumulation, values need to be analyzed on both a fresh and dry mass basis. Further studies measuring the influences of air temperature, irradiance, leaf age, photoperiod, radiation cycle and wavelength showed that maximum biomass did not always correlate with maximum carotenoid accumulation and selenium fertilization did not affect carotenoid accumulation in kale.

When plant pigment concentration were analyzed in relation to % dry matter (%DM) a linear trend was observed. Increases in %DM of the plant resulted in measured increases in fresh mass pigment concentration and decreases in dry mass pigment concentration. However, drying plant samples below +25°C had no effect on measured pigment concentration.

Environmental factors can be used to control carotenoids, chlorophylls and %DM in both kale and spinach. Utilizing these cultural practices is important information for growers producing these crops for dry capsule supplements and fresh markets.