Low UVA intensity during cultivation improves the lettuce shelf-life, an effect that is not sustained at higher intensity

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Abstract

Sunlight includes UVA (320–400 nm). Since it is irrelevant for driving photosynthesis, less recognition is given to its usefulness in indoor cultivation. We examined how the cultivation under different UVA levels (0, 10 and 40 μmol m^{-2} s^{-1}) affects the lettuce postharvest quality by evaluating the temporal dynamics of several underlying aspects, including weight loss, chlorophyll fluorescence, protein content, primary energy reserves (starch, sugars), pigments (chlorophyll, carotenoids), the activity of enzymes related to enzymatic browning [phenylalanine ammonia lyase, polyphenol oxidase (PPO)], the activity of antioxidant machinery enzymes (superoxide dismutase, catalase), the accumulation of non-enzymatic antioxidants (polyphenols, ascorbic acid) and the accumulation of reactive oxygen species (ROS; H_2O_2, O_2^-). Evaluations were conducted (5 d intervals) on dark-stored excised leaves for 15 d (16 °C, 70 % relative air humidity). Control samples gradually underwent a decrease in both primary energy reserves and protein content. They also suffered from color degradation owing to both a decrease in chlorophyll content and an enhanced PPO activity. Increased electrolyte leakage was also observed as a result of enhanced ROS levels. The low UVA level clearly improved all quality parameters, whereas the application of high UVA intensity caused limited effects in comparison to the control. In the former case, ROS accumulation was counteracted by an enhanced stimulation of the non-enzymatic and enzymatic antioxidant machinery. Overall, the results show that the promotive effect of UVA during cultivation on lettuce nutritional quality and shelf-life is strongly intensity-dependent and is mediated by diverse processes.