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The potential for high intensity light prior to harvest to influence metabolite concentrations in vertically farmed leafy crops

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Vertical farming can regulate light exposure to crops in controlled conditions[1,2,3]. Increased light intensity exposure before harvest, known as end of period (EOP) light treatment, has been indicated to increase antioxidant content in vertically grown basil and head lettuce[1,2]. The aims of this study were to assess how increased EOP light treatment prior to harvest influences the antioxidant profiles in a variety of vertically farmed crops (herbs and various lettuces).

Samples of herbs (Dill, Greek Basil, Chives, Flat Parsley) and cut salad mixes (Sorrel, Green Lettuce, Spinach, Red Oakleaf lettuce) were assessed for antioxidants following EOP treatment and control treatment (n = 6 per crop per treatment). Crops were grown in an Infarm ACRE growing unit under white/red light (day night cycle of 18/6 hours). Irrigation was conducted every two hours (during day period) using the Ebb and Flow technique. Plant growing cycles were 2 weeks plus nursery time. During the final 4 days of growth, control crops were exposed to 352 µmol photons.m^{-2}.s^{-1}, whereas this was increased to 437 µmol photons.m^{-2}.s^{-1} for treated crops. Total Phenolic content, total carotenoids and chlorophyll, and ascorbic acid/vitamin C were determined in crops using spectrophotometric methods. A one-way ANOVA with Tukey post hoc test was used to verify effects of treatment on antioxidants (RStudio Version 2022.07.2+576). In all cases, significance was achieved when $p < 0.05$.

EOP treatment drove an increase of 20% of total chlorophyll (Control: 746.75 ± 90.69µg/g FW; Treated: 902.3 ± 40.85µg/g FW; $p < 0.05$), and carotenoids (Control: 0.039 ± 0.006mg/g FW; Treated: 0.049 ± 0.003mg/g FW; $p < 0.05$) in Greek Basil. EOP treatment also drove a 29% increase of total chlorophyll (Control: 455.58 ± 60.79µg/g FW; Treated: 587.36 ± 57.92µg/g FW; $p < 0.05$) and carotenoids (Control: 1.19 ± 0.28mg/g FW; Treated: 1.58 ± 0.14mg/g FW; $p < 0.05$) in red oakleaf lettuce. EOP treatment also drove an increase of total ascorbic acid by 37% in Chives (Control: 0.79 ± 0.04mg/g FW; Treated: 1.08 ± 0.30mg/g FW; $p < 0.05$), 27% in Sorrel (Control: 0.55 ± 0.06mg/g FW; Treated: 0.69 ± 0.05mg/g FW; $p < 0.05$) and a notable 95% in Dill (Control: 0.50 ± 0.10mg/g FW; Treated: 0.97 ± 0.39mg/g FW; $p < 0.05$).

Increased light intensity towards the end of the growth period may drive metabolite synthesis in specific vertically farmed crops, particularly ascorbic acid, which has been reported in other studies [2]. The study has shown the potential for modification of nutritional content of vertically grown crops by altering growth conditions, however the implications of these findings for usual dietary intakes of antioxidants and their putative health benefits remains unknown.

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