INFLUENCE OF LIGHTING IN RETAIL MARKETS ON ATMOSPHERIC COMPOSITION IN VEGETABLE PACKAGING

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1. Introduction

World wide, the market for packed, unprocessed or lightly processed vegetables, like corn salad, increases. Modified atmosphere inside the packaging (MAP) and storage under refrigeration help to reduce respiration and decay, and to maintain quality. The atmospheric composition inside the packing depends on the type of packing material, the kind of vegetable and its processing (cutting, shredding), the relation between air volume and vegetable mass, and temperature. Additionally, it is affected by the lighting and the aerodynamic conditions in the display. Usually, the display cabinets in retail outlets are well lighted to improve the sale. In this case, photosynthetic CO_2 uptake may exceed respirational CO_2 losses in fresh green vegetables. Therefore, the conditions for producing or maintaining of MA conditions are reversed.

2. Materials and methods

Packed corn salad (*Valerianella olitoria* Poll.) in different types of packaging (polypropylene trays with either polyethylene stretch film or sealed polyethylene film bags) was purchased from local supermarkets. They were stored in a refrigerator until the start of the experiments. Light, provided by halogen lamps (GU 5.3, Kess, Germany) was set to a photon fluence rate of ca 200 μmol m^{-2} s^{-1} above the packaging. In samples of air, withdrawn from the packaging with a syringe (2 ml), CO_2, O_2 and ethylene concentrations were measured with a gas chromatograph (GC 14B, Shimadzu, Japan), fitted with FID and TCD. Temperatures inside were continuously determined with a thermistor thermometer. Gas exchange characteristics of individual plants were determined by means of a CO_2/H_2O porometer (CIRAS-1, PP-Systems, UK) and a Mini-PAM fluorometer (H. Walz GmbH, Germany).

3. Results and discussion

Steady state oxygen and carbon dioxide concentrations varied to only a small degree within one type of packaging (Fig. 1). Differences were large when different types of packaging were compared. Irrespective of the packaging, illumination (photon fluence rate ca 200 μmol m^{-2} s^{-1}) induced photosynthetic activity which rapidly, within 1 to 2 h, reduced the CO_2 concentration inside the packaging to a level below ambient (Fig. 1). Oxygen concentration changed to a much less degree. Temperature does not exhibit a clear effect. This points out that the corn salad plants were well adapted to low temperatures. Ethylene concentration was relatively high (ca 0.4 ppm) and more or less constant both in packaging illuminated or kept in darkness.

Both CO_2 exchange and photosynthetic electron transport (ETR) were light saturated at photon fluence rates above 300 μmol m^{-2} s^{-1}. In older leaves further increasing the light intensity (Fig. 2) reduced photosynthesis. Light compensation of CO_2 uptake was at a photon fluence rate of 17 μmol m^{-2} s^{-1}. Thus, even low photon fluence rate in display cabinets and the steep light gradient inside the packaging may allow for photosynthetic activity. Photosynthesis of leaves was not saturated at CO_2 concentrations

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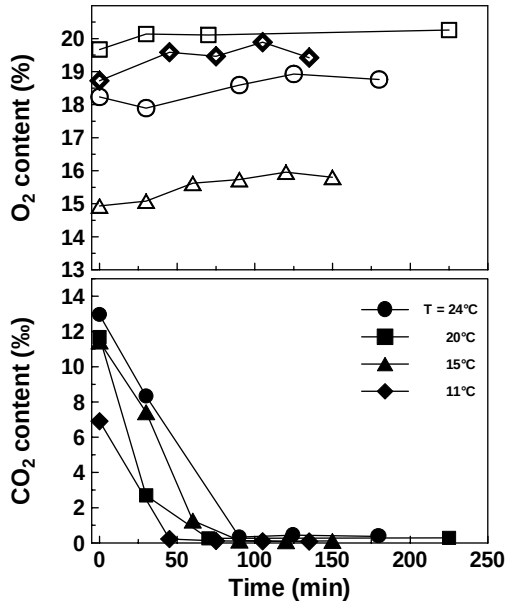
up to 4000 ppm despite low leaf conductance for water vapor diffusion. CO_2 compensation occurred at ca. 123 ppm.

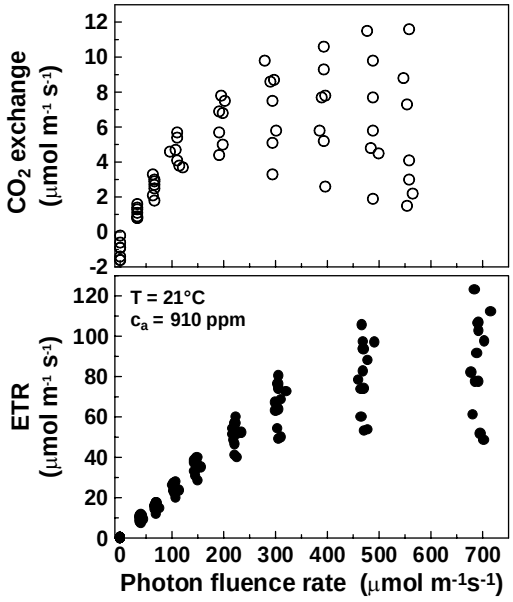
Conclusion

Illumination of packed corn salad with moderate photon fluence rates may rapidly change the atmospheric conditions inside the packaging. The photosynthetically active plants may largely reduce the mean inside CO_2 concentration even at the low light intensities prevailing in display cabinets. The influence on postharvest keeping quality during sale clearly needs further evaluation.

Figures



1. Changes in CO_2 and O_2 content inside a corn salad packaging after illumination at different temperatures.



2. Light responses of CO_2 exchange and photosynthetic electron transport rates (ETR) of leaves of corn salad plants.

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