Title Effect of heat treatment using humidified air on electrolyte leakage in broccoli florets: temperature-time relationships

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Abstract

Broccoli (*Brassica oleraceae*) is one of the most consumed produce among *Brassica* crops because of its content of bioactive compounds such as glucosinolates and flavonoids. Preservation of this vegetable is a challenging task due to its rapid senescence, manifested as floret yellowing. In order to delay this undesirable characteristic, several postharvest treatments have been explored including heat treatment. While various combinations of temperature/time have been found effective to control yellowing, there is no clear foundation for the selection of heat application (temperature/time). The objective of this work was to establish a temperature-time relationship using membrane electrolyte leakage as degree of heat severity. Broccoli florets were treated with humidified air at temperatures from 32 to 52°C for periods ranging from 5 to 1440 min. Electrolyte leakage was determined by measuring conductivity of treated broccoli stems in 0.4 M mannitol solution. The percentage of electrolyte leakage increased with time at each temperature tested and followed zero order kinetics. The rate of electrolyte leakage increased with temperature, but the Arrhenius plot was double-slope linear with a break in the vicinity of 43°C, with higher temperature sensitivity above that temperature. Although equivalent exposure time at different temperatures can be estimated from the kinetics of electrolyte leakage, a choice of temperature for heat treatment above the critical temperature (Tc) may involve anaerobic conditions in the tissue as observed by ethanol accumulation and off-odors. It suggests that the tissue when treated at temperatures above the Tc is subject to not only heat stress but also hypoxic stress. Furthermore, color (Hunter LAB) retention persisted when florets were treated at higher than Tc, suggesting denaturation of enzymes of chlorophyll degradation, possibly mediated by products of anaerobic respiration. Treating florets at temperatures below Tc did not affect color changes with senescence. Results of this work suggest that the selection of temperature should be an important consideration for heat treatment of fresh produce.