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Effect of UV-C Irradiation on selected polyphenols and vitamins in a highly turbid apple juice

Abstract

Introduction: UV-C irradiation is a non-thermal disinfection method, effective against a range of bacteria and viruses, which is being considered as an alternative to pasteurization of fruit juices. The main objective of this study was to investigate the effect of UV-C (263 nm) irradiation on the polyphenolic and vitamin content of apple juice.

Objective: The objective of this study was to compare the UV-C dose response of apple juice samples treated at different exposures at 263nm.

Methods: Optical properties of the samples were measured using a double beam spectrophotometer connected to an integrating sphere. UV-C irradiation experiments were conducted using a light emitting diode (LED) system operating at 263 nm wave--length. Glass beakers containing 5 ml of apple juice were continuously stirred and known UV doses ranging from 0 to 160 $mJ.cm^{-2}$ were delivered. UV dose was calculated as a product of average fluence rate and exposure time (sec). UV gradients in apple juice was accounted in the dose calculations. The concentration of selected polyphenols and vitamins were monitored using LC/MS/MS using single ion monitoring. Each experiment was replicated thrice. Data were statistically analyzed using ANOVA (SAS v 9.4).

Results: The results demonstrated that UV-C irradiation in apple juices at relevant commercial UV doses induced significant reductions in the concentrations of selected polyphenols and vitamins, $p<0.05$. Ascorbic acid was reduced to 32%, at 160 mJ/cm^2 whereas 17% reduction was observed at 40 mJ/cm^2. Riboflavin was observed to be relatively stable. Epicatechin and chlorogenic was significantly reduced at high exposure doses. In contrast minor changes were observed at 40 mJ/cm^2. 40 $mJ.cm^{-2}$ can effectively inactivate vegetative cells by more than 5 log cycles.

Significance: Overall, these results demonstrate the effectiveness of the UV-C technology for treating highly turbid liquid foods such as apple juice. These results suggested that UV LED at 263 nm (germicidal wavelength) could be an effective alternative to conventional thermal processing for production of high-quality apple juice. Additionally, the kinetic data obtained from this study will assist in optimizing product quality.