Title Effect of chlorine dioxide on ascorbic acid and total polyphenols in model systems and fruit and fruit juices

Author Melanie Goering, Mark T. Morgan, Mario G. Ferruzzi and Peter M. Hirst

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Abstract

Chlorine dioxide (ClO_2) has potential as an effective sanitizer for the food industry because of its strong oxidizing power. However, its capacity as an oxidant means it may also react with beneficial food components and alter nutritional quality. The purpose of this work was to understand the reaction of ClO_2 with nutritionally important food compounds, specifically ascorbic acid (AA) and fruit polyphenols.

The reaction of ClO_2 with AA was first studied in a model system. At concentrations of 0.3-3.2 mg/L ClO_2, corresponding to ratios of 5:1 to 50:1 ascorbic acid to ClO_2 , there was a dose-dependent rapid reduction in AA concentration followed by a slower period of first-order degradation. Reaction of AA with chlorite, a by-product of ClO_2 reduction, followed a similar first-order degradation rate without the initial rapid decrease in concentration. Thus chlorite is likely responsible in part for AA degradation after the initial reaction with ClO_2.

More complex model systems containing AA with glucose and/or polyphenols, catechin and hesperidin, showed variation in AA degradation after reaction with ClO_2 . Glucose and catechin demonstrated a slight protective effect while hesperidin seemed to enhance AA degradation. HPLC-MS analysis indicated that dehydroascorbic acid (DHAA) was a primary degradation product of the reaction between AA and ClO_2.

In commercial orange and apple juices, no significant differences ($p<0.05$) were observed after 6 weeks between AA and total polyphenol (TP) content in controls versus juices treated with 1 mg/L aqueous ClO_2. Furthermore, 5 mg/L gaseous and 115 mg/L aqueous ClO_2 treatments performed on whole apples did not result in significant degradation of AA in apple peels. However, a significant decrease in TP compared to controls occurred in apple flesh after 30 minutes of treatment with 115 mg/L aqueous ClO_2. This work has shown that although ClO_2 will readily oxidize AA in a model system, responsible industrial use of ClO_2 in low concentrations will not likely affect the nutritional quality of fruits and fruit juices.