Exposure of Tomato Fruit to 1-MCP Improves Quality of Stored Slices

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ABSTRACT

Maintenance of quality, such as firmness, is important during storage of fresh cut produce. This study compared the effects of 1-MCP on the quality of tomato slices when intact tomatoes were treated with 1-MCP and then sliced, or tomatoes were sliced and the slices treated with 1-MCP. In both instances the MCP treatment was 1 μL L^{-1} at 20 °C for 12 h. Tomato cv. 'Revolution' was harvested at the 'pink' stage of maturity, cut into 7-mm slices, and stored as vertical stacks in closed plastic containers at 5°C for up to 7 days after the 1-MCP treatment. Exposure of intact tomatoes to 1-MCP resulted in reduced ethylene production (31%) and firmer (22%) slices than when tomatoes were not 1-MCP treated. The application of 1-MCP prior to slicing of tomatoes appears a useful strategy to retain quality of stored tomato slices.

INTRODUCTION

Stress caused by the slicing of tomato during minimal processing may induce deteriorative processes that alter the physiology and subsequent quality of the product. These processes include increased ethylene synthesis, elevated respiration rates, and faster softening (Watada et al., 1996). Quality can thus be potentially controlled through the use of compounds that minimise these deteriorative processes. The gaseous ethylene antagonist 1-methylcyclopropene (1-MCP) is an effective inhibitor of ethylene action at low concentrations. 1-MCP has been applied to inhibit the action of ethylene and extend the storage life of tomatoes (Hoeberichts et al., 2002; Wills and Ku, 2001). In those studies, 1-MCP was applied to intact tomatoes. The aim of this current study was to compare the effect of applying 1-MCP to tomatoes before and after they were sliced.

MATERIAL AND METHODS

Tomato fruit were selected at the 'pink' stage with hue value 75 – 80° and firmness 20 N. Uniform medium size fruit (weight 175 ± 15 g; diameter 73 ± 2 mm; and length 68 ± 15 mm) were washed with 100 ppm sodium hypochlorite before being sliced using a commercial tomato slicer. All procedures were conducted in a cool room 10 °C. Methods described by Macnish (1999) were followed for 1-MCP treatment and quantification. 1-MCP was generated from Ethylbloc® and stock 1-MCP was quantified by flame ionisation gas chromatography. The 1-MCP gas chromatograph was calibrated using isobutane.

One set of intact fruit was treated with 1 μl l^{-1} 1-MCP at 20 °C for 12 hours. Fruit were left in air for 6 hours to equilibrate and then sliced. A second set of fruit was sliced and then treated with 1 μl l^{-1} 1-MCP at 20 °C for 12 hours. Tomato slices without 1-MCP (control) were held in similar glass jars for the same time. After 1-MCP treatment, five slices of 7-mm thickness were vertically stacked in ventilated plastic containers to ensure an aerobic atmosphere (Wu, 2002) and stored at 5 °C. Samples were analysed after 7 days to evaluate ethylene production (using gas chromatography of the headspace), firmness (using an Instron Food Texture Analyser by penetrating a 3 mm probe at a speed of 1 mm/s), and juice colour of a homogenate using a Minolta chromameter. The experimental design was completely randomised, with five replications.

RESULTS AND DISCUSSION

Fruit and slices treated with 1-MCP had lower ethylene production by 31% and 24%, respectively (Table 1). 1-MCP was found to be more effective at maintaining slice firmness when applied to intact fruit prior to slicing. By contrast, treating fruit with 1-MCP before or after cutting had little effect on juice colour after 7 days (Table 1). Fruit treated with 1-MCP had 22% firmer pericarps than the untreated control. The significantly greater effect of 1-MCP on pericarp firmness when applied to intact fruit implies that 1-MCP is likely to be more effective on fresh cut tomato slices if wound-induced ethylene production and subsequent senescence processes are blocked prior to cutting. Jiang and Joyce (2002) also found a better maintenance of firmness in apples slices when intact apples were treated with 1-MCP.

Table 1. Effect of 1-MCP (1 μL L^{-1}, 20 °C, 12 h) on ethylene production, firmness and juice colour of tomato slices after 7 days storage at 5 °C

Treatment	Ethylene ($nmol\ g^{-1}\ h^{-1}$)	Firmness (N)	Juice colour (Hue angle)
No 1-MCP	0.054 ± 0.004	8.45 ± 0.48	68.04 ± 1.45
1-MCP on slices	0.041 ± 0.002	8.54 ± 0.17	69.42 ± 0.53
1-MCP on intact fruit	0.037 ± 0.002	10.35 ± 0.70	67.26 ± 1.72

CONCLUSION

The application of 1-MCP prior to slicing of tomatoes appears a useful strategy to reduce loss of quality by stored tomato slices. It is possible that blocking wound-related ethylene induced by the cutting procedure may directly extend shelf-life by maintaining tissue firmness.

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