1-Methylcyclopropene Delays Softening in Tomato Slices

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ABSTRACT

1-Methylcyclopropene (1-MCP) has the potential in tomato to reduce ethylene-associated changes in texture. Tomato cv. 'Revolution' was harvested at the 'pink' maturity stage and whole fruit treated with 0, 0.1, 1.0 or 10.0 $\mu L.L^{-1}$ 1-MCP at 20 °C for 12 h. Slices of 7-mm thickness were cut using a commercial slicer, and the slices stored in vertical stacks in plastic containers at 5°C for 7 days. The application of 1-MCP reduced both ethylene production and respiration rate of slices and resulted in firmer pericarp firmness. Ethylene production was 24%, 40%, and 62% lower following 0.1, 1.0, 10.0 $\mu L\ L^{-1}$ 1-MCP, respectively, compared with controls. In addition, respiration rate was reduced 6%, 10% and 20% by those 1-MCP treatments. 1-MCP treatments produced 20%, 34%, and 24% higher pericarp firmness, respectively, than in fruit not treated with 1-MCP.

INTRODUCTION

Softening is the major quality problem with fresh cut tomato slices during storage. Ethylene is known to promote this problem and therefore an ethylene-blocking agent such as 1-methylcyclopropene (1-MCP) might reduce the rate of softening at low level concentration (Sisler and Serek, 1997). Mostofi et al. (2003) demonstrated that a single application of 1-MCP (250 nL L^{-1}; 24 h; 20 °C) led to significant delays in ripening of green tomatoes as measured by changes in tissue firmness. This paper focuses on effect of different concentrations of 1-MCP on ethylene, respiration and rate of softening of tomato slices.

MATERIAL AND METHODS

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

Intact fruit were treated with 0, 0.1, 1.0 and 10.0 µl L L^{-1} 1-MCP for 12 hours at 20 °C. Fruit were left in air for 6 hours to equilibrate and then sliced. After 1-MCP treatment, five slices of 7 mm thickness from each fruit 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 and respiration rate (using gas chromatography of the headspace) and pericarp firmness (using an Instron Food Texture Analyser by penetrating the pericarp with a 3 mm probe at a speed of 1 mm/s). The experimental design was based on a completely randomised design with five replications.

RESULTS AND DISCUSSION

Ethylene production was 24%, 40%, and 62% lower, and respiration rate reduced 6%, 10% and 20% by these 1-MCP treatments. In addition, firmness of tomato slices was increased 20%, 34%, and 24%, following 0.1, 1.0, 10.0 μL L^{-1} 1-MCP, respectively, compared with the controls after 7 days storage (Table 1). This is consistent with results by Jiang and Joyce (2002) who also found reduced ethylene production and greater firmness of apple slices treated with 1-MCP before cutting. 1-MCP treatments have also been found to reduce respiration rates in pineapple slices (Budu and Joyce, 2003). Despite the quantitative decrease in both ethylene production and respiration rate with increasing 1-MCP concentration, there was little difference in tissue firmness within the 0.1-10 μL L^{-1} 1-MCP range tested.

Table 1 Effect of 1-MCP (20 °C, 12 h) on ethylene production, respiration rate, and firmness of tomato slices after 7 days storage at 5 °C

MCP concentration	Storage time (days)	Ethylene (nmol g^{-1} h^{-1})	Respiration (μmol g^{-1} h^{-1})	Firmness (N)
0.0 μL L^{-1}	1[1]	0.094 ± 0.008	0.420 ± 0.009	6.346 ± 0.184
	7	0.069 ± 0.004	0.144 ± 0.016	5.985 ± 0.534
0.1 μL L^{-1}	1	0.066 ± 0.007	0.382 ± 0.008	6.847 ± 0.407
	7	0.052 ± 0.002	0.136 ± 0.004	7.164 ± 0.218
1.0 μL L^{-1}	1	0.079 ± 0.006	0.314 ± 0.019	8.966 ± 0.407
	7	0.041 ± 0.002	0.131 ± 0.021	8.057 ± 0.296
10 μL L^{-1}	1	0.068 ± 0.006	0.200 ± 0.026	7.340 ± 0.584
	7	0.026 ± 0.001	0.115 ± 0.007	7.429 ± 0.192

[1] Measured 24 hours after treatment

CONCLUSION

Application of 1-MCP to intact tomato fruit was effective in depressing ethylene production, respiration rate and maintaining firmness of subsequently cut slices. 1-MCP treatment within the range 0.1-10 μL L^{-1} 1-MCP produced a similar effects on slice softening.

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