Effect of 1-Methylcyclopropene on Quality and Storability of Cherry Tomato during Commercial Handling Condition

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Abstract

This study was carried out in order to determine the effect of 1-Methylcyclopropene (1-MCP) on quality and storability of vine-ripened light red maturity stage of fresh consumed ‘Unicorn’ tomatoes during commercial handling condition. Tomatoes were harvested and treated by 1-MCP (control, 0.25, 0.50 and 1.00 ppm for 20hrs), packed by carton box (commercial size) and O2 permeability film (20,000 cc/m2 .day .atm) and stored at 5°C for 35 days with 85% relative humidity. The lower respiration and ethylene production rate of tomato were showed by 1.00 ppm 1-MCP than other treatments in carton box storage on the early storage period. In Modified Atmosphere (MA) storage tomatoes, 0.50 ppm 1-MCP showed lower carbon dioxide than other treatments on the early storage period and 0.50 ppm 1-MCP showed lower ethylene concentration than other treatments during the storage period. As storage period progressed, the fresh weight loss was significantly increased. The shelf life was prolonged of MA storage with 1-MCP compared to carton box storage with 1-MCP at 5°C stored tomatoes. The 0.50 ppm 1-MCP treated tomatoes performed higher to delay color development without showing uneven color. The higher firmness and soluble solids showed by 0.50 ppm 1-MCP and control, respectively in both carton box and MA condition tomatoes. The lower concentration (0.25 ppm) showed higher vitamin C whereas; higher concentration (1.00 ppm) showed lower pH in both cartoon box and MA condition storage tomatoes. So, 0.50 ppm 1-MCP treatment in MA storage has the positive effect to maintain visual quality and retention of firmness by delay color development as well as ripeness.

Key words: Cherry tomato, Firmness retention, MA condition, 1-MCP effect, Slow color change, Visual quality.

Introduction

Color development delay and retention of firmness are the most important aspects to retain postharvest quality as well as storability. In postharvest research, one main concern is to maintain the quality of the products so that it fulfills the expectation of the consumer, (Ketelaere et al., 2006) and buyer. Consumers judge the quality of fresh tomatoes by their firmness, color and taste (Rosenfeld et al., 1994). Higher tomato fruits quality increase consumer satisfaction and demand (Hurr et al., 2005). Consumers demand tomatoes with green or light pink color (depending on the cultivar), but the fast acceleration of changes related to ripening can be a limitation to marketing (Guillen et al., 2006).

The 1-Methylecyclopropene (1-MCP) has the positive effect to delay color development and safe keeping of firmness as well as shelf life prolong. Hurr et al. (2005) reported that low concentration (≤ 1 µL/L) and short duration (≤ 24 h) 1-MCP gas application has been shown to delay significantly the onset of ripening in fruit harvested pre-ripe and, in some fruits, to decelerate the progression of ripening once initiated. Sisler (2006) mentioned that at relatively low concentrations of 1-MCP and short exposure periods for prolonged periods after a single exposure and low phytotoxicity has the high efficacy. Following immersion in aqueous 1-MCP (625 µg/L active ingredient, a.i.) for 1 min, the efficacy of the aqueous formulation at delaying ripening of breaker-turning tomato fruit was comparable to that observed in response to exposure to gaseous 1-MCP at 500
nL/L for 9 h (Choi and Huber, 2008). 1-MCP efficacy in delaying ripening in tomatoes was dependent on concentration and duration of treatment, the most effective combination being 0.5 µL/L for 24 h (Guillen et al., 2006). Climacteric fruits have served as the predominant target for investigations of 1-MCP, and the responses of these fruits have confirmed that the antagonist operates in opposition to ethylene (Huber, 2008). This study was carried out in order to determine the effect of 1-MCP on quality and storability of vine-ripened light red maturity stage of fresh consumed cherry type ‘Unicorn’ tomatoes during commercial handling condition.

Materials and Methods

Hydroponic grown vine-ripened light red maturity stage of tomatoes (Lycopersicon esculentum Mill. cv ‘Unicorn’) were harvested, treated by 1-Methylcyclopropene (1-MCP) as control, 0.25, 0.50 and 1.00 ppm for 20hrs, packed by carton box (commercial size) and Modified Atmosphere (MA) condition (20,000 cc/m².day. atm O₂ permeability film), and stored at 5°C for 35 days with 85% relative humidity. Oxygen and carbon dioxide was measured by PBI Dan sensor Check Mate 9900. Ethylene was measured by GC 2010 Shimadzu equipped with Wax column and a flame ionization detector (FID). The detector and injector to operate at 127°C and the oven were 50°C and carrier gas (N₂) flow rate 0.67 mL/s (Park et al., 2000). Two fruit per replicate of carton box storage tomatoes were placed into a sealed 125 mL plastic container for 3 h to measure the respiration and ethylene production rate. In addition, four fruit per replicate of MA condition packed tomatoes were used to measure the oxygen, carbon dioxide and ethylene concentration. The fresh weight loss of tomatoes during the storage period was measured by subtracting sample weights from their previous recorded weights, and presented as % of weight loss. Visible quality was subjectively assessed on fruits based on visual quality determinants likes mould growth, decay, shriveling, smoothness, shininess and homogeneity. Visual quality was observed on the scale of 1 to 5 (1 = very bad, 2 = bad, 3 = good, marketable, 4 = very good, and 5 = excellent) during 5°C storage for 0–35 days. Five panel members were employed to assess the visual quality and fungus of the tomatoes. Fungus affected tomatoes counted and convert as a percentage of fungal incidence. Tomatoes skin color values were measured using a Chroma Meter Model CR 400 (Konica Minolta Sensing, Inc., Japan). In Minolta Chroma Meter, a* and b* value represents the degree of redness and yellowness respectively. In this research, redness of tomatoes were recorded as a*/b* values. Firmness was measured using a Rheo meter (Sun Scientific Co. Ltd., Japan) with a maximum force of 10 kg and a 6 mm diameter round stainless steel probe with a flat end. During measurement, tomatoes were placed on a plastic ring to keep upright. Penetrating force (N) through the skin of the tomatoes flesh and deformation (mm) values were recorded. Soluble solids was measured by Refractometer (Atago U.S.A. Inc., U.S.A.) and results were read directly in °Brix. Vitamin C was measured by RQ flex plus (Merck, Germany) with mg/100 gFW (Arvanitoyannis et al., 2005). The pH of tomatoes juice measured by pH meter (SevenGo pro, Mettler-Toledo GmbH, Switzerland).

Data Analysis

Graphs were produced using SigmaPlot 8 (Systat Software, Inc., USA).

Results and Discussion

In carton box storage tomatoes at 5°C the respiration rate sharply increased until 7th storage day and afterwards gradually decreased until 35th storage day in all 1-MCP treatments (Fig. 1). On the initial storage day (0 day) of carton box, higher concentration 1-MCP showed lower respiration than lower concentration in all 1-MCP treatments even control. It proves that 1-MCP treatments inhibit respiration rate. On the other hand, in MA condition storage the 0.50 ppm 1-MCP treatment showed the lowest carbon dioxide concentration until 12th storage day and afterwards 1.00 ppm showed the lowest carbon dioxide concentration until 35th storage day (Fig. 2). However, control showed higher carbon dioxide concentration than other 1-MCP treatments from 7th to 35th storage day. The 1-MCP treatments both carton and MA condition storage inhibit respiration rate. In relation to this, Golding et al. (1998) indicated that CO₂ production in response to 1-MCP exposure. Our results agreed with those of Guillen et al. (2006), in that when 1-MCP was applied, the respiration rate was significantly lower than in controls and remained almost