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EFFECTS OF 1-METHYLCYCLOPROPENE (1-MCP) COUPLED WITH CONTROLLED ATMOSPHERE STORAGE ON THE RIPENING AND QUALITY OF 'CAVENDISH' BANANA

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ABSTRACT

Fresh-fruit banana is well known to have a short-life after harvest. A short pre-pilot study was carried out to test the effect of atmospheric condition exposure to 1-MCP on the quality, limited to CO_2 production, cosmetic and flesh appearance, and shelf life of fresh-fruit bananas. Low level of O_2 (3 kPa) and high level of CO_2 (6 kPa) and 1-MCP (350 ppb for 18 hours), alone or in combination did prevent the browning on the fruit skin after 11 days in Controlled Atmosphere (CA) storage. However, these treatments did not prevent browning on the fruit skin once upon removal from the storage. The appearance of the flesh for all treatments was relatively the same for both in the CA storage and after storage. Fruits treated with 1-MCP and CA storage showed the highest level of CO_2 production followed by fruits treated with CA storage only and untreated fruits respectively.

Keywords: Browning, Controlled Atmosphere, 1-Methylcyclopropene, CO_2 production

ABSTRAK

Buah pisang segar memiliki umur simpan yang pendek setelah panen. Sebuah studi pendahuluan telah dilakukan untuk mengetahui efek dari penyimpanan atmosfir termodifikasi dan pemberian 1-MCP terhadap kualitas yang dibatasi pada produksi CO2, penampilan luar (kulit) dan daging serta umur simpan buah pisang segar. Kadar oksigen yang rendah (3 kPa) dan karbondioksida yang tinggi sebesar 6 kPa serta 1-MCP sebesar 350 ppb yang diberikan selama 18 jam sebelum penyimpanan, diperlakukan secara individual dan kombinasi mampu mencegah pencoklatan pada kulit buah selama penyimpanan pada atmosfir termodifikasi, tetapi tidak dapat mencegah pencoklatan pada kulit buah setelah dikeluarkan dari ruang penyimpanan. Penampakan daging buah pada semua perlakuan relatif sama baik pada saat penyimpanan maupun setelah penyimpanan. Buah yang diperlakukan dengan kombinasi atmosfir termodifikasi dan 1-MCP memiliki tingkat produksi karbondioksida tertinggi diikuti oleh buah dengan perlakuan penyimpanan atmosfir termodifikasi dan buah tanpa perlakuan.

Kata kunci: Pencoklatan, Atmosfir Termodifikasi, 1-MCP, Produksi Karbondioksida

INTRODUCTION

Banana is one of the common table fruits because of its availability year around and its benefit in human diet (Sukasih et al., 2013). The banana fruits are typically harvested at the mature green stage of maturity and ripened artificially with ethylene before being sent to market (Kudachikar et al., 2011). Ripening of banana is an irreversible process which is triggered by exposure to ethylene (Boonyarithongchai et al., 2010; Watkins, 2006). Ripening effects of ethylene is only activated when it goes in contact with fruit cells (Chu et al., 2010). 1-methylcyclopropne (1-MCP) can block the ethylene and therefore inhibits the action of ripening (Chu et al., 2010; Watkins, 2006). Controlled atmosphere (CA) storage is the precise control of oxygen and carbon dioxide concentrations usually with low oxygen and high carbon dioxide to extend the storage life of produce (Chu et al., 2010; Lin et al., 2011; Watkins, 2006). A reduction in O_2 and an increase in CO_2 have been shown to reduce the respiration rate and prolong the storage life of fresh-fruit banana (Boonyarithongchai et al., 2010; Kudachikar et al., 2011; Sukasih et al., 2013). The objective of this research was to investigate the postharvest technology for fresh-fruit banana shelf-life extension using 1-MCP and CA storage.

RESEARCH METHOD

The pre-pilot study was conducted at United States Department of Agriculture (USDA), Agriculture Research Service (ARS) Tree Fruit Research Laboratory in Wenatchee, Washington, USA, from February 14 – 25, 2014 using organic 'Cavendish' banana at green stage of maturity. The concentration of 1-MCP used for this study was 350 ppb for 18 hours and the CA storage was set for 3 kPa O2 and 6 kPa CO2. There were 3 treatments for this purpose; fruits treated with 1-MCP and CA, fruits treated with CA, and control. Seven fresh-fruit organic bananas were used per treatment with 3 replications. The production of CO2 was assessed everyday during storage using 5890 Hewlett Packard Series II Gas Chromatograph, and the skin of the fruits was assessed once upon removal from storage and at day 1 and day 2 after storage. The appearance of the flesh was assessed at day 2 after storage.

RESULTS AND DISCUSSION

Production of CO_2

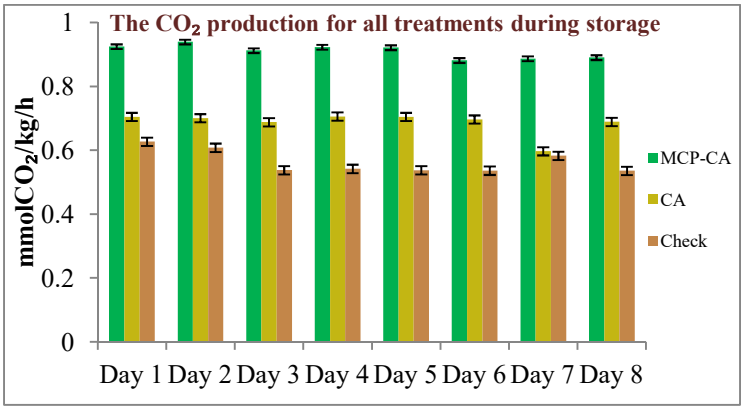

Table 1. The production of CO2 for all treatments during storage.

Table 1 showed that fruits treated with 1-MCP and CA had the highest production of CO_2 followed by fruits treated with CA alone and untreated fruits. 1-MCP and its combination with CA has shown its ability to delay the ripening of fruits during storage. The action of 1-MCP together with CA was effective to block the ethylene production during storage was similar with the research done by Kudachikar et al., (2010).

Gambar 1. Fruit Skin Appearance

Figure 1. The cosmetic appearance of bananas on the last day during storage. Left: fruits treated with 1-MCP and CA, center: fruits treated with CA only, right: untreated fruits.

Figure 2. The cosmetic appearance of bananas once upon removal from the storage. Left: fruits treated with 1-MCP and CA, center: fruits treated with CA only, right: untreated fruits.

Figure 3. The cosmetic appearance of bananas at day 1 after storage. Left: fruits treated with 1-MCP and CA, center: fruits treated with CA only, right: untreated fruits.

Figure 4. The cosmetic appearance of bananas at day 2 after storage. . Left: fruits treated with 1-MCP and CA, center: fruits treated with CA only, right: untreated fruits.

Fruits treated with 1-MCP and CA had the less browning on its skin during storage followed by fruits treated with CA and untreated fruits respectively (Figure 1). The ability of 1-MCP combine with CA to prevent the browning on the skin of bananas has also been shown once upon the fruits have been removed from the CA storage until day 2 after storage (Figure1, 2, and 3). We assumed that the ability to delay the ripening process has a correlation with delaying the browning on the skin of the fruits. The browning process has started to increased in day 2 after storage for fruits treated with 1-MCP and CA (Figure 4). Meanwhile, the browning process has dramatically increased in fruits treated with CA only and untreated fruits at day 1 and day 2 after storage.

Flesh Appearance

Figure 5. Flesh appearance at day 2 after storage. Left: fruits treated with 1-MCP and CA, center: fruits treated with CA only, right: untreated fruits.

Figure 5 showed that the flesh appearance for all treatments were relatively the same. We assumed that the stage of maturity has also affected this condition. The thickness of the fruit skin harvested at green stage of maturity could be possibly prevented the flesh from an unexpected condition such as mechanical damage and that the browning process could not be able to affected the firmness of the flesh in such relatively short term storage.

CONCLUSION

Fruits treated with 1-MCP combine with CA produced the highest rate of CO_2 that showing the ability to delay the ripening of the fruits, and could prevent browning on the skin of the fruits. Surprisingly, the flesh appearance for all treatments were relatively the same.

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