Available online at www.sciencedirect.com
ScienceDirect
ELSEVIER
Postharvest Biology and Technology 46 (2007) 195–198
Postharvest Biology and Technology
www.elsevier.com/locate/postharvbio

Research Note

Ethanol vapour treatment alleviates postharvest decay and maintains fruit quality in Chinese bayberry

WangShu Zhang[a], Xian Li[a], XiaoXiao Wang[a], GuoYun Wang[b], JinTu Zheng[c], Don C. Abeysinghe[a], Ian B. Ferguson[a,d], KunSong Chen[a,*]

[a] *Laboratory of Fruit Molecular Physiology and Biotechnology/The State Agriculture Ministry Laboratory of Horticultural Plant Growth, Development and Biotechnology, Zhejiang University, Huajiachi Campus, Hangzhou 310029, PR China*
[b] *Yuyao Agricultural and Forestry Bureau, Yuyao 315400, PR China*
[c] *Forestry Bureau of Ningbo City, Ningbo 315000, PR China*
[d] *The Horticulture and Food Research Institute of New Zealand, Private Bag 92 169, Auckland, New Zealand*

Received 29 January 2007; accepted 1 May 2007

Abstract

The effect of ethanol vapour treatment on controlling fruit decay was studied on Chinese bayberry (*Myrica rubra* Sieb. & Zucc.) stored at different temperatures over two seasons. Ethanol vapour at a concentration of 1000 μL/L, generated from pre-saturated filter paper sheets using either a 10 mL/L ethanol stock solution at 20 °C or a 40 mL/L ethanol stock solution at 0 °C, proved to be the most effective for controlling postharvest decay of bayberry fruit. The ethanol treatment reduced the decay rate of fruit from 28.7 to 15.8% after 3 days storage at 20 °C and from 27.8 to 16.6% after 5 days storage at 0 °C and 1 day shelf-life at 20 °C. The ethanol treatment did not have any deleterious effects on fruit quality, but resulted in an increase in the accumulation of anthocyanins in the fruit.
© 2007 Published by Elsevier B.V.

Keywords: Ethanol; Chinese bayberry; Fruit decay; Quality

1. Introduction

Postharvest applications of ethanol have been shown to have positive effects on reducing decay, killing insect contaminants and preventing physiological disorders in horticultural products (Pesis, 2005). Ethanol is safe to use for sterilization and fungicidal and insecticidal treatments since it is a natural product and ethanol dips have been reported to control postharvest decay of cherries (Karabulut et al., 2004), grapes (Litcher et al., 2002; Lurie et al., 2006), peaches and nectarines (Margosan et al., 1997). However, when applied commercially, liquid treatments have the potential to spread contaminants and cause osmotic damage. This has led to consideration of the efficacy of applying ethanol as a vapour, and it has been used in this way to treat table grapes (Chervin et al., 2003, 2005; Lurie et al., 2006), control apple lightbrown moth larval mortality (Jamieson et al., 2003), inhibit senescence in broccoli florets (Suzuki et al., 2004), and extend fresh-cut mango storage by decreasing spoilage (Plotto et al., 2006).

Chinese bayberry (*Myrica rubra* Sieb. & Zucc.), a subtropical fruit native to China, is high in anthocyanins and other nutritive properties (Chen et al., 2004). Fruit are currently harvested at or near eating ripe, but only have 2–3 days storage life under ambient conditions or 5–7 days at 0 °C. During storage, fruit sugar and acid levels decrease, although the colour of the fruit will continue to develop to a small extent (Zhang et al., 2005). Fungal decay is the main cause of the rapid and intensive postharvest deterioration of the fruit, with the major decay organisms being *Saccharomyces* spp, *Candida* spp, *Penicillium* spp, *Cladosporium* spp, *Aspergillus* spp and *Fusarium* spp (Qi et al., 2003).

There are currently no effective postharvest treatments in use, including fungicidal applications, which can reduce fruit decay and thus extend storage and shelf-life. The successful published results with grapes (Chervin et al., 2003, 2005; Lurie et al., 2006) have led us to investigate whether ethanol vapour might

* Corresponding author at: Laboratory of Fruit Molecular Physiology and Biotechnology, Huajiachi Campus, Zhejiang University, Hangzhou 310029, PR China. Tel.: +86 571 86971931; fax: +86 571 86971931.
E-mail address: akun@zju.edu.cn (K. Chen).

0925-5214/$ – see front matter © 2007 Published by Elsevier B.V.
doi:10.1016/j.postharvbio.2007.05.001

be effective with Chinese bayberry fruit. Extension of storage and shelf-life by even a few days would have a significant impact on the success of the crop.

2. Material and methods

In both 2005 and 2006 harvest seasons, Chinese bayberry fruit (*Myrica rubra* Sieb. & Zucc. cv. Biqi) were picked at commercial maturity in Yuyao County, Zhejiang Province, China, and transported to the laboratory on the day of collection. In the laboratory, the fruit were screened for uniform size and absence of mechanical damage.

In 2005, ambient ethanol vapour treatments were carried out in a container (20 L) at $20 \pm 0.5\,^{\circ}$C, and in 2006, ethanol vapour treatments combined with low temperature were carried out at $0 \pm 0.5\,^{\circ}$C. Ethanol vapour were generated by filter paper sheets (20 cm × 20 cm) pre-saturated in various concentrations of ethanol stock solutions. To do this, paper sheets were immersed in 2 L ethanol for each concentration and then put into a sealed plastic bag, 30 sheets per bag for 2 h to allow equilibrium to be established. For treatment of fruit, 250 fruit (about 1.5 kg) were placed inside each container without the fruit directly contacting the ethanol-treated paper sheets.

Ethanol with a purity of 99.7–100% was used to make the ethanol/water stock solutions, at 3, 5, 10 or 15 mL/L (v/v) in 2005 for treatments at 20 °C and 10, 20, 40 and 60 mL/L (v/v) in 2006 for the low temperature treatments. Different concentrations of stock solutions were required for the treatments at different temperatures since ethanol evaporated more slowly at low temperature. For example, both the 3 mL/L stock solution at 20 °C and 10 mL/L stock solution at 0 °C gave rise to 200 μL/L ethanol vapour during the treatments. For a 500 μL/L vapour concentration, 5 mL/L stock solution at 20 °C and 20 mL/L at 0 °C were used, and for 1000 μL/L, 10 mL/L at 20 °C and 40 mL/L at 0 °C were used.

Plastic containers (20 L) with lids modified with an inlet and outlet ports were used for the treatments. Ethanol concentrations in the headspace of the containers were measured as outlined below. After treatment with ethanol vapour for 6 h at 20 or 0 °C, the treated fruit were then stored at the same temperature as for the treatment, and in the latter case, subsequently transferred to 20 °C for shelf-life assessment. Preliminary experiments showed that treatment for 6 h with the range of concentrations used was the most appropriate time to determine efficacy of the ethanol treatment. Each treatment of 250 fruit was replicated three times.

To determine levels of decay, samples of 45 fruit per replicate were taken every day during storage at 20 °C or every other day during storage at 0 °C. Decay was assessed as present or absent, and sound fruit in the sample were used for other fruit quality determinations.

Internal ethanol concentrations of the fruit were measured in juice as described by Ke and Kader (1990) with slight modifications. Juice from 5 g of fruit was incubated in a water bath at 60 °C for 2 h, and a 1 mL gas sample was then taken by syringe from the headspace of a 12 mL test tube with a rubber cap for determining ethanol concentration by gas chromatography (model SP 6800; Lunan Chemical Engineering Instrument Co Ltd., Shandong, China) with a flame ionization detector and a GDX-502 activated alumina glass column held at 200 °C, detection temperature 160 °C. Ethanol levels were calculated by comparison with commercially prepared standards.

Anthocyanin contents were determined on 1 g of fresh fruit per replicate, extracted by acid methanol (1% HCl) and anthocyanin was quantified by the pH differential method of Wrolstand et al. (1982).

For fruit firmness, 15 fruit per treatment per replicate were used. Firmness was determined on each fruit at two paired surfaces at 180° separation using a TA-XT2i texture analyzer (Stable Micro Systems, England) fitted with a 5 mm diameter probe. The rate of penetration was 1 mm/s with a final penetration depth of 4 mm and data are expressed in newtons (N). Total soluble solids (TSS) and titratable acids (TA) were also measured on15 fruit per treatment replicate with an Atago digital refractometer (model PR-101, Tokyo, Japan) for soluble solids, and titratable acids were determined as described by Zhang et al. (2005).

Experiments were performed using a completely randomized design. Data are means from three replicates and Duncan's new multiple range method test (DPS version 3.11) was used at the 5% level for means separation.

3. Results and discussion

Ethanol vapour at a concentration of 1000 μL/L had a significant effect on reducing decay of fruit stored at 20 and 0 °C plus 2 days shelf-life (Table 1). At 20 °C, ethanol substantially reduced fruit decay incidence at the first day, and even though rots increased by 3 days, the levels were still only 50% of the control with the most effective concentration (1000 μL/L). During low temperature storage, no decay was found for fruit treated with 1000 μL/L ethanol vapour after 5 days at 0 °C. When fruit were transferred to 20 °C after low temperature storage, severe decay occurred in control fruit, reaching almost 50% after 2 days. Ethanol reduced this level, although even at the most effective concentration (1000 μL/L), the decay levels were greater than 30%.

Up to 1000 μL/L, there was a dose effect. However, treatment with 1500 μL/L accelerated fruit decay under both storage temperature conditions. This higher ethanol concentration might induce phytotoxicity in fruit tissue through osmotic effects or membrane damage. For instance, Chervin et al. (2003) found that the stems of table grapes close to the ethanol source had more severe browning than those further away.

Accumulation of ethanol in the fruit tissue increased with the ethanol treatment (Table 2). However, at 20 °C, the accumulation was transient, with levels declining both in control and 1000 μL/L treated fruit by 18.8 and 24.6%, respectively. In low temperature storage, ethanol accumulated to a greater extent, but declined rapidly during shelf-life. No detectable ethanolic odors were observed in the ethanol-treated fruit after low temperature storage (data not shown), contrary to results from other fruit, such as apples (Bartley et al., 1985). A further secondary effect of ethanol treatments can be the perception of undesirable flavor notes in fruit tissue, such as occurs with mango when exposed

Download English Version:

https://daneshyari.com/en/article/4519509

Download Persian Version:

https://daneshyari.com/article/4519509

Daneshyari.com