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Impact of staggered treatments of novel molecules and ethylene absorbents on postharvest fruit physiology and enzyme activity of 'Santa Rosa' plums

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ABSTRACT

The present investigation was conducted to study the effect of staggered removal of cold stored (2 °C) plums at 7, 14 and 21 days interval and their subsequent treatment with salicylic acid (SA), nitric oxide (NO) and ethylene absorbent (EA) sachets. The fruit were then stored at supermarket conditions (20 ± 1 °C and 90 ± 5% RH) with the objective to know whether delayed EA, SA and NO treatments still have significant beneficial effects on the plum fruit quality. The observations on different physiological and biochemical parameters were taken at 2 days interval. The results showed that staggered treatments enhanced postharvest life and maintained fruit quality. We observed that SA-treated plums showed the highest fruit firmness and lowest decay losses when plums were either removed on 7th, 14th or 21st days of cold storage. Furthermore, SA-treated fruit exhibited lowest rates of respiration and ethylene evolution; phenylalanine ammonia lyase and pectin methyl esterase activities; minimum malondialdehyde content and lowest electrolyte leakage in comparison to those treated either with NO or packed with EA sachets or control fruit. In conclusion, 'Santa Rosa' plum removed after 7th (staggered-I), 14th (staggered-II) and 21st day (staggered-III) from cold storage maintained a shelf life of 10, 6 and 4 days, respectively at subsequent supermarket storage conditions. The overall results submit that even if the plums are not treated immediately or within few days after harvest and placed as such in cold store, they can be still treated with SA, NO or in-package ethylene absorbent (EA) treatment for beneficial postharvest influences.

1. Introduction

The aim of applying any postharvest treatment or technology is to enhance the useful marketing duration of the fruit crop during the handling, storage, transport and distribution to maintain the fruit quality, nutritive quality and the market value of the produce for the final consumption over that attainable by the use of cold storage only. Among many postharvest techniques, salicylic acid, nitric oxide and ethylene absorbent sachets treatments have shown good potential in sustaining the fruit quality and enhancing the postharvest life in many fruit (Huang et al., 2008; Zhang et al., 2008; Singh et al., 2009; Asghari and Aghdam, 2010; Manjunatha et al., 2010; Luo et al., 2011; Sharma et al., 2012a,b; Barman and Asrey, 2014; Barman et al., 2014a,b). Salicylic acid (SA), a well-known endogenous plant growth regulator, is a natural and safe phenolic compound which displays a high potential in controlling postharvest decay losses, maintaining fruit quality and decreasing over all losses of horticultural crops (Asghari and Aghdam, 2010; Luo et al., 2011). The nitric oxide (NO) is a highly reactive free radical gas, which acts as a multifunctional signaling molecule in many of the physiological processes occurring in plants which has also proven to reduce decay losses and extend shelf life of several fruit by various mechanisms (Wendehenne et al., 2004; Manjunatha et al., 2010). The ethylene absorbent (EA) sachets containing $KMnO_4$ in crystals or powder form remove ethylene from the surrounding environment of fruit by absorbing and oxidizing it to produce CO_2 and H_2O.

The plum fruit cultivar 'Santa Rosa' is climacteric in nature (Sharma et al., 2012b). Plums show a rapid softening and deterioration leading to the loss of fruit quality and very limited postharvest life (Singh et al., 2009; Sharma et al., 2012a). The plums are very rich in antioxidants and are termed as super fruit by many due

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