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Exogenous putrescine treatment delays chilling injury in okra pod (*Abelmoschus esculentus*) stored at low storage temperature

Surisa Phornvillay[a], Nutthachai Pongprasert[a,b], Chalermchai Wongs-Aree[a,b], Apiradee Uthairatanakij[a,b], Varit Srilaong[a,b,*]

[a] Division of Postharvest Technology, School of Bioresources and Technology, King Mongkut's University of Technology Thonburi (Bangkhuntien), 49 Tientalay 25, Thakam, Bangkhuntien, Bangkok 10150, Thailand

[b] Postharvest Technology Innovation Center, Office of the Higher Education Commission, Bangkok 10400, Thailand

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ABSTRACT

Okra as tropical crop is susceptible to chilling injury (CI), which limit the usage of low storage temperature. Polyamine, particularly putrescine (Put) has been proposed to play important role in plant to cope with cold stress. Thus, the aim of this study was to determine the effect of polyamines treatment specifically Put on alleviating the CI in okra when exposed to low storage temperature. Okra pods were dipped into Put at 0, 0.5 mM, 1 mM and 2 mM and stored at 4 °C. The results showed that 2 mM Put effectively reduced CI symptoms of okra. Interestingly, seed browning increased with severity of CI. Meanwhile, Put treatment significantly reduced seed browning by retarding the activity polyphenol oxidase (PPO) and peroxidase (POD) enzymes. Additionally, Put treatment elevated total phenolics, total antioxidant activity (DPPH radical scavenging activity and FRAP), antioxidant enzymes (CAT and SOD) activity and contributed to low hydrogen peroxide and malondialdehyde content.

1. Introduction

The use of low temperature to extend storage life of tropical and subtropical crops is challenged by the development of physiological disorders, namely called chilling injury. Chilling injury (CI) defined as damage to cold-sensitive plants caused by exposure to low but non-freezing temperature (Lukatkin, 2005) poses a great threat, economically and storability, in maintaining quality of these cold sensitive produces. As one of the cold-sensitive crops, okra pods which are commonly harvested at immature stage have short postharvest life and suffer from CI when stored in low temperature below 10 °C (Finger et al., 2008). The chilling disorder in okra is usually manifested as pitting, translucency, browning and eventually result in postharvest decay (Huang et al., 2012). The progression of these disorders causes a decline in consumer acceptance, thus shorten the storage time. Therefore, it is crucial to find ways to prevent or alleviate the development of this chilling disorder.

Many postharvest treatments have been used to reduce CI and maintain the quality of fruits and vegetables. Heat shock treatment has been proven to reduce CI in okra (Ribeiro et al., 2017). Additionally, heat treatment is also found to be beneficial in alleviating CI in bell peppers (González-Aguilar et al., 2000) and tomato (Zhang et al., 2013) by increasing the endogenous level of polyamines (PA) to cope with cold stress. Similarly, treatments such as salicylic acid and UV-C radiation have resulted in CI reduction through promoting the content of PAs in plum (Luo et al., 2011) and pears (Gonzalez-Aguilar et al., 2004), respectively.

Polyamines are low molecular weight plant growth regulators which found are in the form of aliphatic amines. The major common amines found in plants consisted of putrescine (Put), spermidine (Spd) and spermine (Spm). Their proliferation in the cells are considered to be able to help plant to thrive from abiotic tensions due to their polycationic and antioxidant properties (Gupta et al., 2013). Thus, the interest in exogenous application of the PAs as postharvest treatment to maintain quality of agriculture crops increase worldwide. Several studies have demonstrated that exogenous application of PAs have diminished CI symptoms as well as extend postharvest storage life of zucchini (Palma et al., 2015), mango (Nair and Singh, 2004) and apricot (Saba et al., 2012). Some other research reported that PAs treatment maintains quality of pear (Hosseini et al., 2017) and strawberry (Khosroshahi et al., 2007).

However, the information on the exogenous application of PAs on

* Corresponding author at: Division of Postharvest Technology, School of Bioresources and Technology, King Mongkut's University of Technology Thonburi (Bangkhuntien), 49 Tientalay 25, Thakam, Bangkhuntien, Bangkok 10150, Thailand.

E-mail address: varit.sri@mail.kmutt.ac.th (V. Srilaong).

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