ผลของเมทิลจัสโมเนทต่อการลดอาการสะท้านหนาวของผลลองกองระหว่างการเก็บรักษา
Effect of Methyl Jasmonate on Alleviation of Chilling Injury in Longkong Fruit During Storage

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Abstract

Longkong is a non-climacteric tropical fruit with short shelf life at ambient temperature. However, low-temperature storage can cause chilling injury (pericarp browning) which is unacceptable to consumers. Therefore, the objective of this experiment was to investigate the influence of fumigating longkongs with 10, 20 or 30 µmol/l methyl jasmonate (MeJA) at 25°C for 24 h on the alleviation of chilling injury during subsequent storage. Both fumigated and non-fumigated (control) fruit samples were stored at 13°C and 85% RH. It was found that the pericarp lightness and yellowness were decreased whereas the pericarp redness was increased continuously throughout the storage period of 16 days. However, the control sample had an extreme change in pericarp color ($p<0.05$). Pericarp phenolics content was decreased during storage and the control had the highest level of these compounds (70.87 mg gallic acid equivalent/100 g, $p<0.05$). The enzymes involved in pericarp browning such as phenylalanine ammonia lyase, polyphenol oxidase and peroxidase had low activities in the MeJA-treated fruit samples while in the control, the activities of these enzymes increased with increasing chilling injury ($p<0.05$).
Keywords: longkong, methyl jasmonate, chilling injury

บทคัดย่อ

ลองกองเป็นผลไม้เมืองร้อนที่ไม่สามารถบ่มให้สุกได้ มีอายุการเก็บรักษาสั้นที่อุณหภูมิห้อง อย่างไรก็ตามการเก็บรักษาที่อุณหภูมิต่ำสามารถก่อให้เกิดอาการสะท้านหนาว (เปลือกมีสีน้ำตาล) ทำให้ผู้บริโภคไม่ยอมรับ ดังนั้นในการทดลองนี้จึงศึกษาอิทธิพลของการรมผลลองกองด้วยเมทิลจัสโมเนท ความเข้มข้น 10, 20 และ 30 ไมโครโมล/ลิตร ที่อุณหภูมิ 25 องศาเซลเซียส เป็นเวลา 24 ชั่วโมง เพื่อลดอาการสะท้านหนาวระหว่างการเก็บรักษา โดยเก็บรักษาผลลองกองซึ่งผ่านและไม่ผ่านการรมด้วยเมทิลจัสโมเนทที่อุณหภูมิ 13 องศาเซลเซียส ความชื้นสัมพัทธ์ร้อยละ 85 ผลการทดลองพบว่า สีเปลือกมีค่าความสว่างและค่าสีเหลืองลดลงในขณะที่ค่าสีแดงเพิ่มขึ้นอย่างต่อเนื่องตลอดระยะเวลาการเก็บรักษาเป็นเวลา 16 วัน ทั้งในตัวอย่างที่ผ่านและไม่ผ่านการรมด้วยเมทิลจัสโมเนท อย่างไรก็ตามพบว่า ลองกองชุดควบคุมมีการเปลี่ยนแปลงสีดังกล่าวสูงสุด ($p<0.05$) ส่วนสารประกอบฟีนอลในเปลือกของผลลองกองในทุกชุดการทดลองมีปริมาณลดลงระหว่างการเก็บรักษา โดยปริมาณสารประกอบนี้ในเปลือกของชุดควบคุมมีปริมาณสูงสุด (70.87 มิลลิกรัมของกรดแกลลิกต่อ 100 กรัมตัวอย่าง $p<0.05$) เอนไซม์ที่เกี่ยวข้องกับการเกิดสีน้ำตาลเช่น เฟนนิลอะลานีนแอมโมเนียมไลเอส พอลิฟีนอลออกซิเดส และเพอร์ออกซิเดส มีกิจกรรมต่ำในทุกชุดการทดลองที่ผ่านการรมด้วยเมทิลจัสโมเนท ในขณะที่ชุดควบคุมมีกิจกรรมของเอนไซม์ดังกล่าวเพิ่มขึ้นตามการเพิ่มขึ้นของอาการสะท้านหนาว ($p<0.05$)
คำสำคัญ: ลองกอง เมทิลจัสโมเนท อาการสะท้านหนาว

Introduction

Longkong fruit is a tropical fruit of economic importance. It contains high level of antioxidant activities, nutritional and health benefits (Venkatachalam and Meenune, 2012). However, the longkong fruit is highly perishable at ambient temperature due to pericarp browning and off-flavour symptoms. Longkong fruit stored below the ambient temperature has a longer shelf life (more than a week). However, too low temperature during storage can cause chilling injury. Previous reports suggested that longkong fruit stored under 13°C had a chilling injury disorder (Ketsa and Paull, 2008).

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Methyl jasmonate (MeJA) is considered as an endogenous plant regulator that plays a vital role in the stress response, plant growth and development. It has been widely used in postharvest application for alleviation of chilling injury in many harvested horticultural crops. MeJA is an inexpensive treatment and easy to apply on various fruits. MeJA is alleviating chilling injury by increasing the expression of a set of defence genes and enhancing the antioxidant capacity in horticultural crops. However, the information on chilling injury of longkong fruit is still very limited. Therefore, the objective of this study was to determine the effect of MeJA on controlling the chilling injury in longkong fruit during storage at 13^{o}C and 85% relative humidity.

Materials and Methods

1. Plant material

Longkong fruits at 13th weeks after anthesis were purchased from a contact garden at Songkhla province, southern Thailand. The fruits were cut off from raceme and the defected fruits were discarded. Then, fruits were washed in a tap water and dipped in the mixed solution of 500 ppm benomyl and 1.5% citric acid solution for 15 min and dried at ambient temperature.

2. MeJA treatment and storage

Longkong fruits were separated randomly into 4 groups. The first group (control) was not fumigated with MeJA, while the second, the third and the fourth groups were fumigated with 10, 20 and 30 µmol/L MeJA, respectively. All the groups were fumigated in an air-sealed container for 24 h at ambient temperature and then ventilated for at least 2 h. Thereafter, in each treatment, 15 individual longkong fruits were placed on a polypropylene tray. Each experiment was carried out with three replicates. Then, the fruits were stored in cold room at 13°C and 85% RH for 16 days. Longkong fruits were monitored at 4-day intervals for quality evaluation, such as fruit pericarp colour (L*, a* and b* values) (Sapii *et al*., 2000), fruit pericarp total phenolic content (Lichanporn *et al*., 2009), pericarp PAL enzyme (Lichanporn *et al*., 2009), pericarp PPO enzyme (Tian *et al*., 2002), pericarp POD enzyme (Jiang and Joyce, 2003) and protein determination (Bradford, 1976)

3. Statistical analysis

All the experiments were conducted in triplicates. Significant differences among the means were estimated by Duncan's new multiple range test (DMRT), with a level of significance of 0.05. Statistical Package for Social Science (SPSS version 6.0 for windows, SPSS Inc., Chicago, IL,USA) was used for data analysis.

Results and Discussion

Longkong pericarp lightness (L*) and yellowness (b*) was continuously decreased in all the treatments (Figures 1a-b). Conversely, the redness (a*) on fruit pericarp was increased throughout the storage (Figure 1c). At the end of storage, control fruits were observed with more decreased L* (34.52) and b* (10.36) values and increased a* (10.92) values ($p<0.05$) as compared to treated fruits. The increased a* value and decreased L* and b* values in control fruits confirmed the increased browning on fruit pericarp. The increased browning on pericarp at low temperature is the primary symptom of chilling injury in longkong fruit (Ketsa and Paull, 2008). MeJA-fumigation might strengthen the plant cell wall, therefore the substrate, and the oxidoreductase enzymes interaction were reduced (Zhang *et al*., 2012) and consequently, fruit pericarp browning was controlled in the treated fruits. The higher level of pericarp total phenolics (70.87 mg gallic acid equivalent/100 g) was observed in the control fruits as compared to MeJA-treated fruit at the end of storage (Figure 2a) ($p<0.05$). The MeJA-treated fruits could suppress the increase of PAL (Figure 2b), PPO and POD (Figures 2c-d) enzyme activities and consequently, the decreased phenolic content and browning were observed in longkong pericarp ($p<0.05$). PAL

is a key enzyme in the first step of the phenylpropanoid pathway and directly involved in the synthesis of phenols. PPO and POD have been shown to be responsible for producing browning by oxidising the phenolics in longkong fruit pericarp (Venkatachalam and Meenune, 2012). The increased activities of PPO and POD during storage in the control fruits could be involved in the protecting effect against fungal infections during low temperature and higher RH storage. MeJA itself has an antimicrobial activity. This finding is also a reason that, MeJA maintained the PAL, PPO and POD activities in the treated fruit as compared to the control (Zhang *et al.*, 2012).

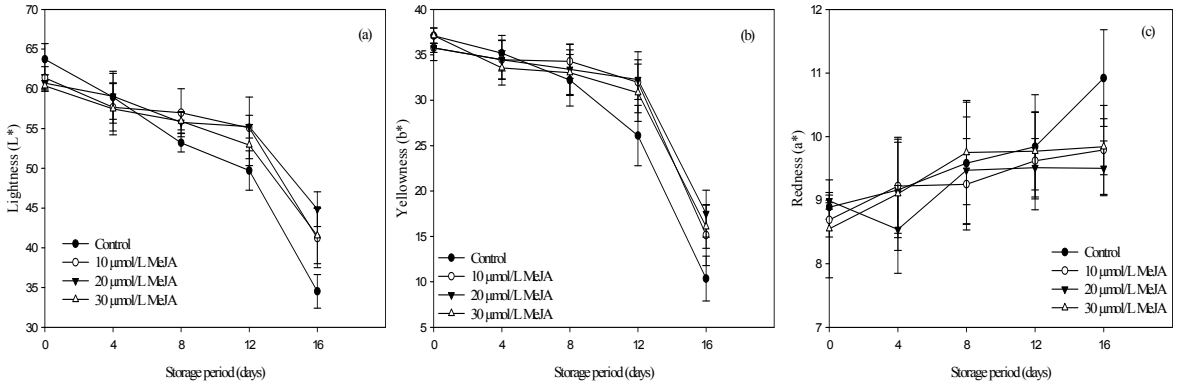

Figure 1 Effect of methyl jasmonate on longkong pericarp colour (L* (a), b* (b) and a*(c) changes during storage at 13°C and 85% relative humidity.

Note: The vertical bar indicates standard error.

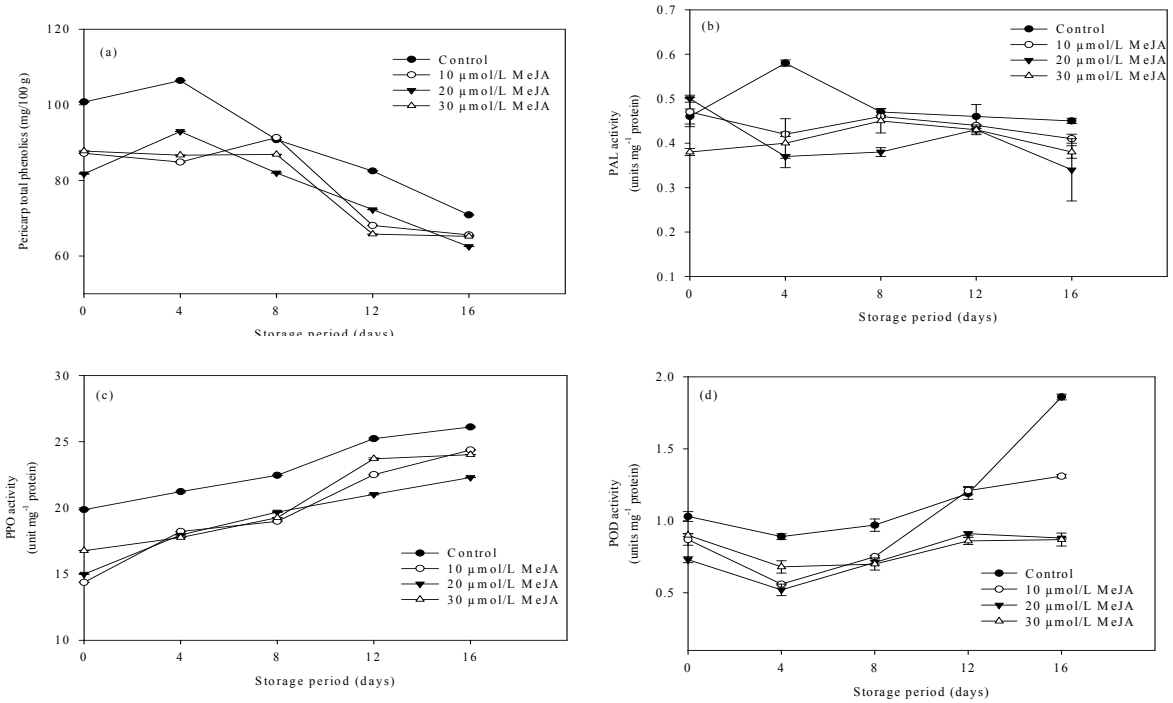

Figure 2 Effect of methyl jasmonate on longkong pericarp phenolics content and browning-related enzymes activities during storage at 13°C and at 85% relative humidity.

Note: The vertical bar indicates standard error.

Conclusion

MeJA treatment alleviated longkong fruit chilling injury and effectively controlled and maintained the quality throughout the storage period. The different concentrations of MeJA treatment had a significant effect on sustaining the fruit quality. The controlled action of MeJA on chilling injury that induced browning on longkong fruit pericarp was due to the suppressed action against the increased of browning-related enzymes (PAL, PPO and POD) activities.

Acknowledgements

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