

Alleviation of Internal Browning in Queen Pineapple Fruit by Peduncle Infiltration with Solutions of Methyl Jasmonate During Cold Storage

Jedsada Chaishome, Sutikarn Srimuk and Suriyan Supapvanich

Abstract— The effect of methyl jasmonate solution (MeJA) and methyl jasmonate gel on procreation internal browning (IB) of ‘Trad-see-thong’ pineapple (‘Queen’ group) fruit was investigated. The pineapple fruit were peduncle-infiltrated parallel with 1 mM MeJA, 1 mM and 10 mM MeJA-gel, then stored at 10°C for 12 days. The results showed that internal browning symptom of pineapple fruit with treatment was visible following 4 days of storage. On day 12 of storage, control treatment (no solution), internal browning score of 4 (almost maximum score), that was significantly higher than other treatments ($p < 0.05$). The 1 mM MeJA solution had internal browning score of 3.8, expected that the amount of MeJA solution with peduncle-infiltration in pineapple fruit had too exorbitant (overdose). Moreover, the 1 mM and 10 mM gel-treated had internal browning score of 3.2 and 3.4, respectively. It was found that the amount of MeJA solution with peduncle-infiltration in pineapple fruit is able to alleviate better than the other. The 1 mM and 10 mM MeJA-gel had lightness in pulp tissues significantly higher than other groups worthy 44.95 and 46.74, respectively.

Index Terms—‘Queen’ pineapple, MeJA and chilling injury

I. INTRODUCTION

PINEAPPLE (*Ananas comosus* L. Merr) is a popular tropical fruit worldwide and an essential commercial fruit in Thailand. In 2017, an exportation of pineapple fruit made earnings for Thailand around 39,600 million baths [1]. However, the processed pineapple was used to transport exceeding fresh pineapple due to a postharvest problem [2]. This obstacle is occurrence a chilling injury symptom during storage of them at low temperature (8-10°C). Although maintaining the pineapple fruit at low temperature act they

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retarding deterioration, reducing incidence of disease and helps to maintain quality, it causes chilling injury as internal browning consequence [3-5]. Chilling injury was commended on deterioration of cell membrane and the activities of the polyphenol oxidase (PPO), which stimulants the phenolic compounds for large molecules. For this reason, the pineapple fruit has procreated internal browning (IB) resulting consumers not acceptable [6, 7]. The pineapple cultivar in ‘Queen’ group are chilling sensitive over than the ‘Smooth Cayenne’ group, making distressed transportation. In spite of, its present sweet taste, pleasant flavor and a crispy texture, that suitable for fresh consumption [8].

Methyl jasmonate (MeJA) is plays a role plant defense mechanism [9]. In addition, the applications of MeJA is alleviate chilling injury symptom because of increasing integrity of membrane, cumulative heat-shocked protein and enhancing activity of the antioxidant system. The researchers found that immersion of pineapple fruit in MeJA solution could alleviate chilling injury and extending shelf-life. However, that treatment expensive principal production and time exportation [6-10]. Youryon, et al. (2018) reported the application of peduncle-infiltration with CaCl_2 solution (2%) and CaGlu solution (2%) for 48 hrs. in pineapple fruit could alleviate chilling injury [11]. Therefore, the creation a package for peduncle-infiltration with MeJA solution, will reduce these problems. Notwithstanding, a shipment transportation may cause the MeJA solution to flow out from package.

Alginate is exopolysaccharides (polymers chain of sugar) that presents comprising of mannuronic (M block) and guluronic acid (G block) units’ arrangement in blockwide. Alginate could extract from plants, especially in a cell wall of seaweed or brown algae. It is dissolving in hot and cold water with the derivatives of various salts such as Ca^{2+} , K^+ and Na^+ etc. Alginate was applied in the food industry to provide progressive texture [12, 13].

In this research proposes to investigate the influence of pineapple peduncle-infiltration parallel with 1 mM MeJA solution, 1 mM and 10 mM MeJA gel for chilling injury in pineapple fruits cultivar ‘Trad-see-thong’ (‘Queen group’), storing at the low temperature (10°C). Moreover, from results are able to manage effective package for progressive alleviation IB and exportation in pineapple fruits.

II. MATERIALS AND METHOD

A. Materials and Treatments

Preparation of the solution

for using in the experiments as follows:

1.) The 1 mM MeJA solution, preparation with a dosage of MeJA 220 μ L was stirred into distilled water 1 L until they mixed.

2.) The gel solution, preparation with a sodium alginate 20 g was stirred into distilled water 1 L until they mixed.

3.) The 1 mM MeJA gel solution, preparation with a dosage of MeJA 220 μ l was stirred into distilled water 1 L, then adding a sodium alginate 20 g into this solution for stirring until they mixed.

4.) The 10 mM MeJA gel solution, preparation with a dosage of MeJA 2,200 μ l was stirred into distilled water 1 L, then adding a sodium alginate 20 g into this solution for stirring until they mixed.

Plant Materials

Pineapple fruit of cultivar 'Trad-see-thong' ('Queen group') were harvested at the mature stage (25% peel yellow) and then delivered to the Laboratory at King Mongkut's Institute of Technology Ladkrabang, Thailand. Cleaning the fruit by tap water, then air-dried at ambient temperature (25°C) for 40 min. The fruit were selected for uniform size (0.8-1.2 kg/fruit) and cancel of any visual defects. The 75 fruit were distributed randomly into five groups (15 individual fruit of each group) for using in 5 treatments as follows: 1.) the control (no solution) treatment, 2.) the 1 mM MeJA solution treatment (the solution-treated), 3.) the gel solution treatment (the gel-treated), 4.) the 1 mM MeJA gel solution treatment (the 1 gel-treated) and 5.) the 10 mM MeJA gel solution treatment (the 10 gel-treated). The fruit were cutted-off peduncle beyond 4 cm of each fruit then dipped the fruit with the solution bags before storage at 10°C for 12 days. Every 4 days of during storage, five fruit of each treatment were randomly sampled for measurement of weight loss (%), internal browning (IB) symptom and color of inner tissues.

B. Measurement of Weight Loss (%)

Loss of fruit weight was analyzed as the percentage of the initial weight and storage weight of each fruit (% Weight loss), during storage at 10°C.

C. Measurement of Internal Browning Appearance and Internal Browning Score

The fruit were split longitudinally to analyze IB symptom. The appraisal IB score of each fruit were calculated by comparing with the areas of procreation IB and total. In addition, a five-point hedonic test was proceeded to assessment IB score of pineapple fruit [14], where 1 = none (no IB), 2 = slight (1-25% of IB area in the fruit), 3 = moderate (26-50% of IB area in the fruit), 4 = moderately severe (51-75% of IB area in the fruit), and 5 = severe (76% and over of IB area in the fruit).

D. Colour of inner tissues

The colour of both the pulp tissues (P) and the pulp adjacent to the core tissues (PAC) were measured by a

Hunter Lab (Color Quest XE) and expressed as lightness (L^* values) and yellowness (b^* value).

E. Statistical Analysis

Experiments were used a completely randomized design (CRD). The data were analyzed by one-way analysis of variance (ANOVA) followed by Tukey's test with a 95% confidence level ($p < 0.05$).

III. RESULTS AND DISCUSSION

A. Weight Loss

Measurement of weight loss (%) by compared with the initial weight and storage weight of each fruit, during storage at 10°C (Fig. 1). The results showed that weight loss of every treatments increased continuously throughout of storage time. At day 12, the weight loss of the control treatment (no solution) reached 12.88% that significantly higher than the other treatments ($p < 0.05$). On the other hand, the weight loss of MeJA-treated slightest reached 9.87%. In results, no significant differences between the treatments of gel, 1 mM and 10 mM gel with reached 11.15%, 10.91% and 10.8%, respectively. Consequently, they showed the amount of MeJA solution with peduncle-infiltration into the fruit were similarly in these treatments. Moreover, the solution-treated had the lowest weight loss, that showing the amount of MeJA solution with peduncle-infiltration into pineapple fruit had too maximum. Similar result was reported to estimate of the amount of salt solutions with transpiration via the peduncles by comparison the difference weight of undipped and dipped fruit [15].

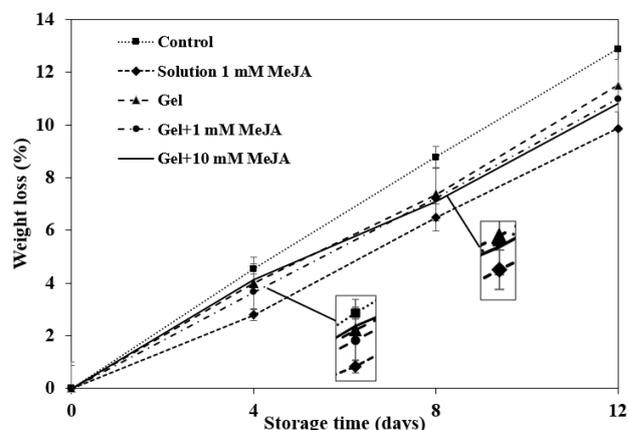


Fig. 1. Weight loss of 'Trad-see-thong' pineapple fruit stored at 10°C for 12 days. Data represent the mean of 5 replications \pm CL. Values with significant differences at $p < 0.05$.

B. Internal Browning and Visual Appearance

The internal browning (IB) of pineapple fruit in every treatment were appearance following 4 days of storage, then the intensity of IB gradually increased after 8 days throughout of storage (Fig. 2). The results showed, the appearance of IB beginning from the PAC tissue then spread out to pulp tissue, is typical symptom in pineapple fruit during cold storage [16, 17]. In addition, the control treatment had IB symptom rather than the other treatments while the 1 gel-treated having IB symptom lower than the other treatments.

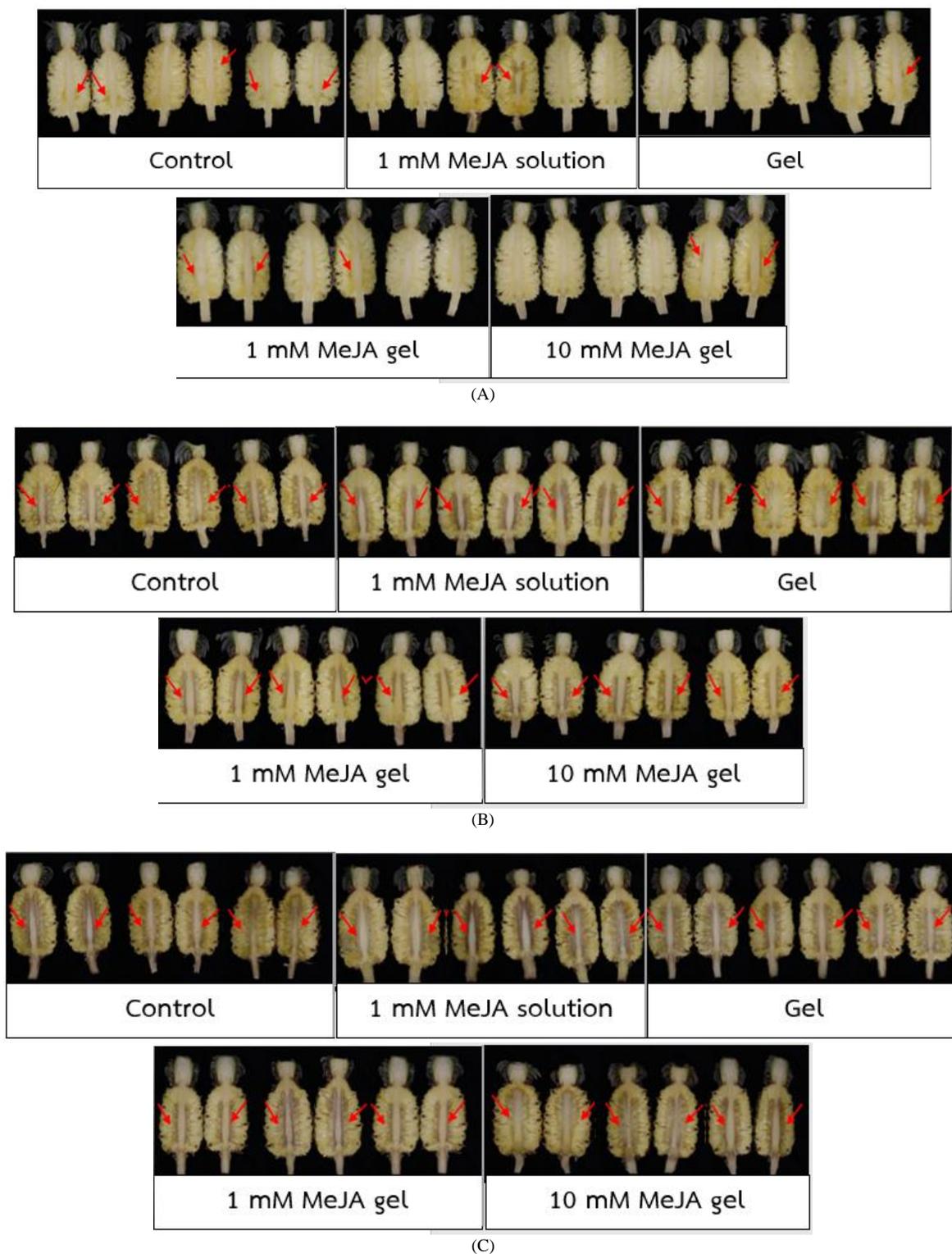


Fig. 2. Internal browning appearance (IB) for storage time (A) 4 days, (B) 8 days and (C) 12 days of 'Trad-see-thong' pineapple fruit stored at 10°C for 12 days.

Remark: The arrows pointing IB symptoms of pineapple fruit

After 4 days of storage, the results showed that the gel treatment had IB score only 1.2, which significantly lower than the other treatments (Fig. 3). In addition, sodium ions (ingredient of sodium alginate) increased the diffusion within cell membrane that affect up integrity of cell membrane [18].

At day 12, the IB score of control treatment reached 4 (almost maximum score) that higher than the other treatments while the IB score of 1 mM and 10 mM gel-treated were significantly lower than the other treatments

because the amount of MeJA solution, which movement from gel structure to peduncle of pineapple capable to alleviate IB symptoms in these fruits. However, the gel-treated had IB score of 3.9 that higher than the 1 mM and 10 mM gel-treated. For this reason, these results designate that MeJA efficient to alleviate IB symptom in the pineapple fruit. Further, the 1 mM solution-treated had IB score 3.8, probably the amount of MeJA solution with peduncle-infiltration had too exorbitant (overdose). According to

figure 1, this treatment showed weight loss significantly lower than the other treatments.

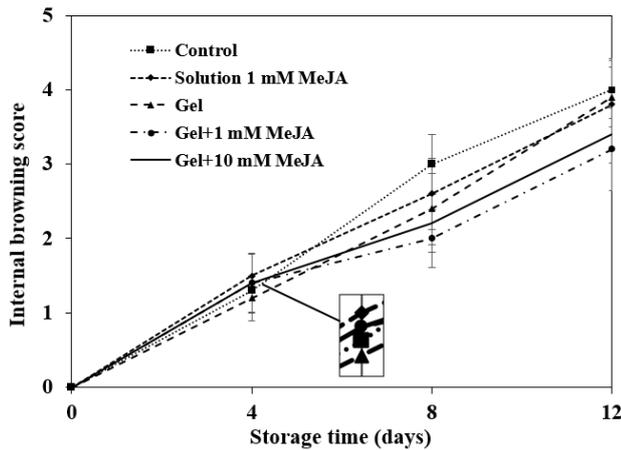


Fig. 3. Internal browning (IB) score of 'Trad-see-thong' pineapple fruit stored at 10°C for 12 days. Data represent the mean of 5 replications \pm CL. values with significant differences at $p < 0.05$.

C. Color of Internal Tissues

The L^* values in P tissue of every treatments had similarly trend at day 4 (Fig. 4). However, the L^* values of the 1 mM and 10 mM gel-treated were significantly higher than the other treatments after day 8 throughout of storage time. At day 12, these treatments had L^* values approximately 44.95 and 46.74, respectively. According to figure 2 because of IB symptom in them lower than the other treatments. In addition, the results showed that the b^* values of control treatment was significantly lower than the other treatments after 8 days of storage (Fig. 5), than the 10 mM gel-treated and control treatments values of b^* values higher than the other treatments after 12 days of storage.

In parts of PAC tissue, the L^* values remained decreasing throughout of storage, which associate with the IB symptoms incidence from a core pulp tissue in pineapple fruits. Further, the trend of b^* values in every treatment were remained constant after day 8, then declined after day 12 and no significantly differences in every treatment throughout of storage time.

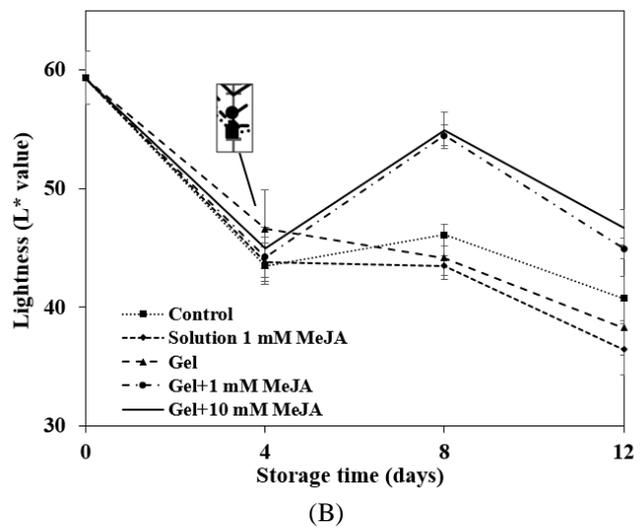
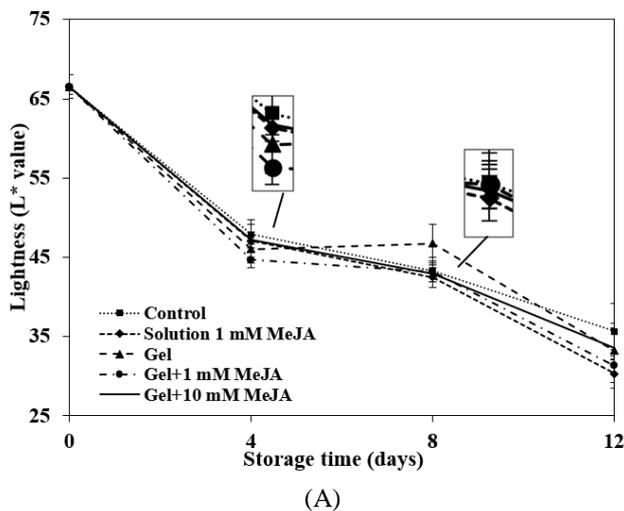


Fig. 4. Lightness (L^* value) of (A) pulp tissue and (B) pulp adjacent core (PAC) of 'Trad-see-thong' pineapple fruit stored at 10°C for 12 days. Data represent the mean of 5 replications \pm CL. values with significant differences at $p < 0.05$.

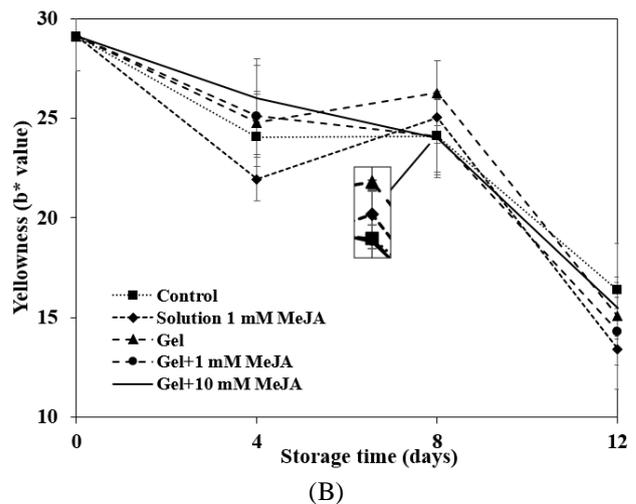
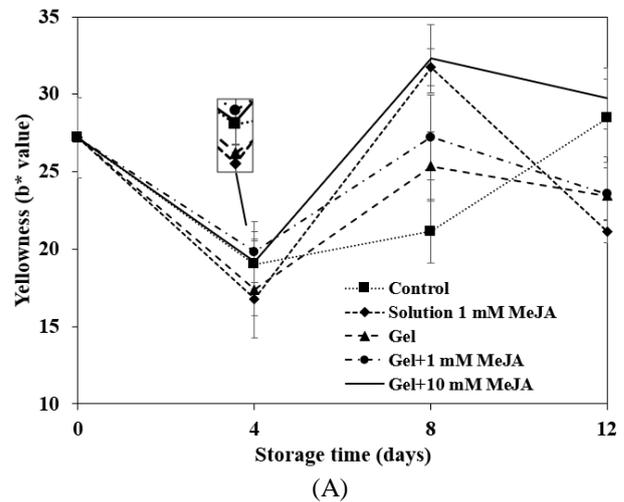


Fig. 5. Yellowness (b^* value) of (A) pulp tissue and (B) pulp adjacent core (PAC) of 'Trad-see-thong' pineapple fruit stored at 10°C for 12 days. Data represent the mean of 5 replications \pm CL. values with significant differences at $p < 0.05$.

IV. CONCLUSION

From this research, indicated the MeJA competent to inhibit the chilling injury symptoms. The results showed that the control treatment (no solution) had IB score of 4, higher than the other treatments. While, the 1 mM solution-treated had IB score of 3.8. Moreover, the 1 gel-treated and the 10 gel-treated had IB score of 3.2 and 3.4, respectively. These treatments were significantly lower than the other treatments.

V. REFERENCES

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