Effects of hydrogen peroxide on oxidative damage and programmed cell death of guava fruit during chilling injury development

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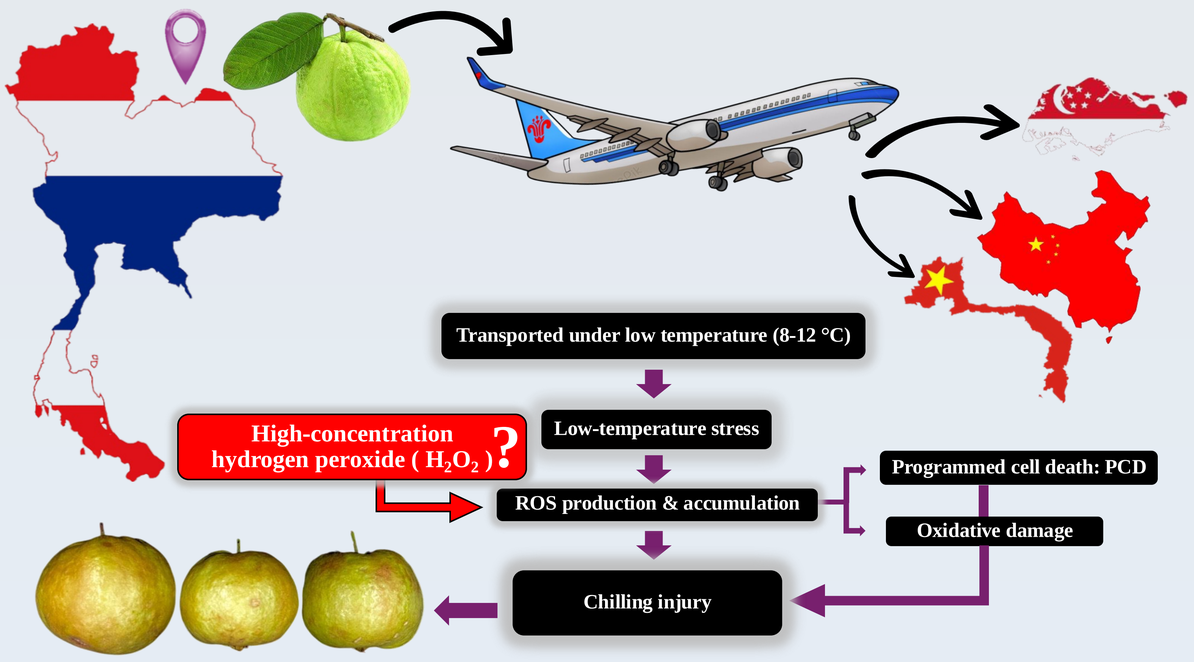
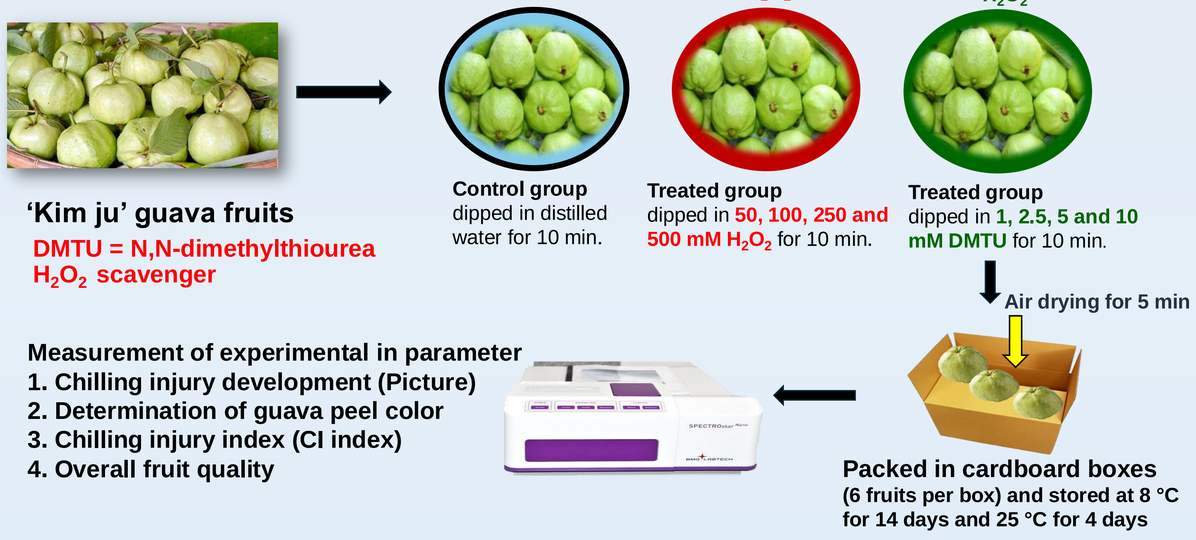
Introduction

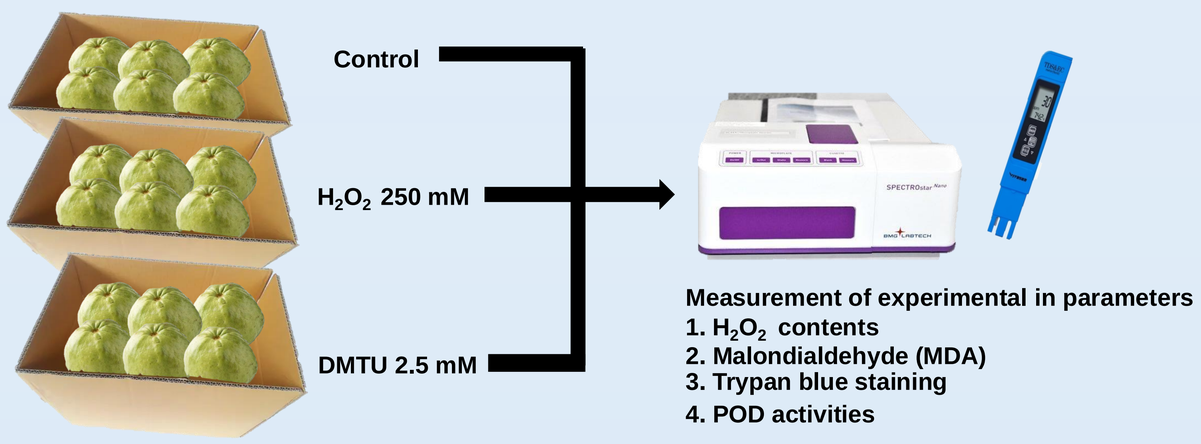


Methods

Experiment 1 the effects of hydrogen peroxide on chilling injury and fruit quality of 'Kim ju' guava fruit during storage



Experiment 2 the effects of H_2O_2 on oxidative damage and programmed cell death



Results & discussion

H_2O_2 plays a crucial role in triggering oxidative stress and chilling injury in guava by causing membrane damage and lipid peroxidation, which results in quality loss during storage. The use of DMTU, a ROS scavenger, helps reduce H_2O_2 accumulation, preventing membrane damage and extending shelf life. Research on 'Guifei' mangoes stored at 4°C and kiwifruits stored at 0°C shows that chilling injury increases H_2O_2 and MDA levels, causing oxidative damage [1,2]. Additionally, guava stored at low temperatures exhibits increased H_2O_2 and MDA levels, along with elevated POD enzyme activity, further contributing to chilling injury [3].

Conclusion

H_2O_2 solution can generate reactive oxygen species (ROS), including hydroxyl radicals (OH•) and H_2O_2 itself, leading to increased oxidative damage to cell membranes and subsequent cell death. This process exacerbates chilling injury symptoms in the fruit peel, resulting in lower fruit quality compared to the control group.

Abstract

This study investigated the role of hydrogen peroxide (H_2O_2) in chilling injury (CI) development in 'Kim Ju' guava during cold storage. Fruits were treated with H_2O_2 (0, 50, 250, 500 mM) and dimethyl thiourea (DMTU), an H_2O_2 scavenger (0, 50, 250, 500 mM), then stored at 8°C for 14 days followed by 4 days at 25°C. Results showed that 250 mM H_2O_2 worsened CI symptoms, oxidative damage, and cell death, while 2.5 mM DMTU significantly reduced CI effects. Measurements included CI symptoms, oxidative stress markers, enzyme activities, and total phenolic content. This study confirms H_2O_2 as a key factor in CI-related oxidative damage in guava.

Results

Experiment 1 the effects of hydrogen peroxide on chilling injury and fruit quality of 'Kim ju' guava fruit during storage

Experiment 2 the effects of H_2O_2 on oxidative damage and programmed cell death

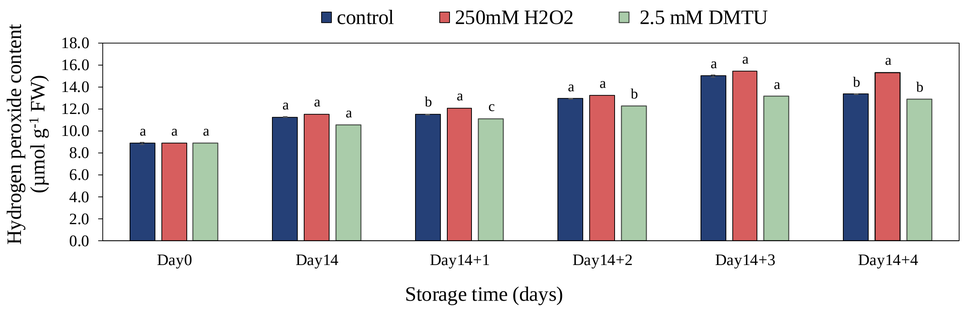


Figure 1: The amount of H_2O_2 in the pericarp of Kimju guava after immersion in H_2O_2 and DMTU solutions, compared to the control group, during storage at 8°C for 14 days, followed by 4 days at 5°C

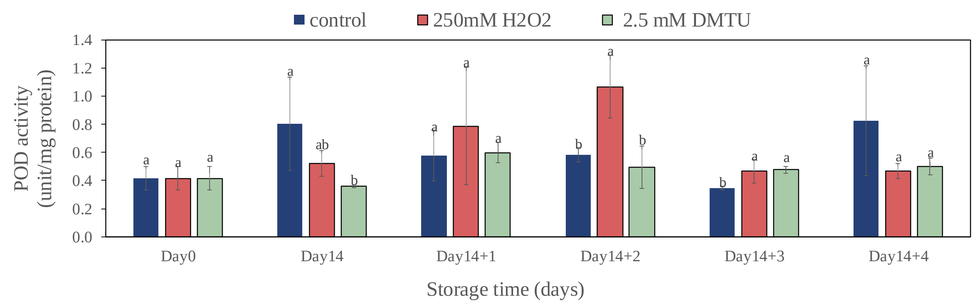


Figure 2: Peroxidase (POD) activity in the pericarp of Kimju guava after immersion in H_2O_2 and DMTU solutions, compared to the control group, during storage at 8°C for 14 days, followed by 4 days at room temperature.

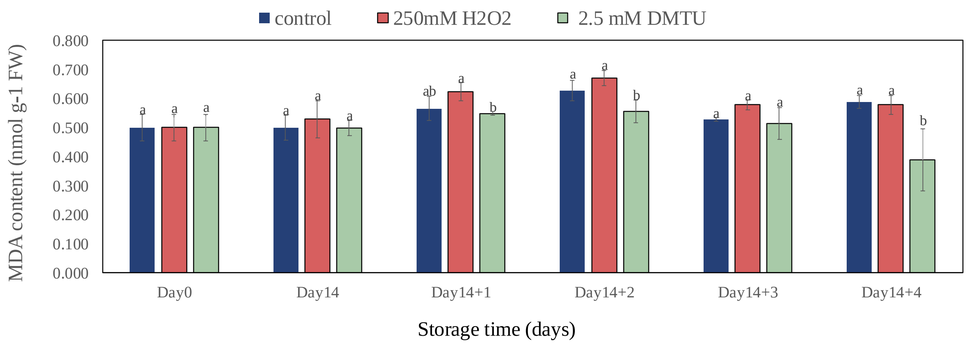


Figure 3: The amount of MDA in the pericarp of Kimju guava after immersion in H_2O_2 and DMTU solutions, compared to the control group, during storage at 8°C for 14 days, followed by 4 days at room temperature.

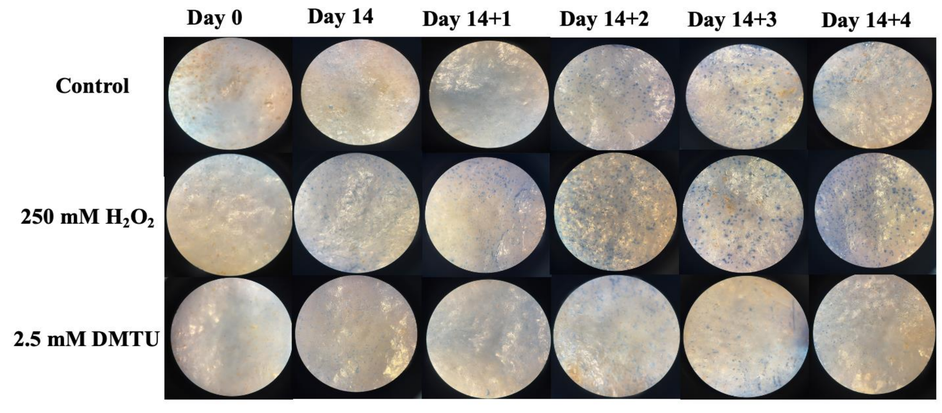


Figure 4: The appearance of Trypan Blue staining in the pericarp of Kimju guava after immersion in H_2O_2 and DMTU solutions, compared to the control group, during storage at 8°C for 14 days, followed by 4 days at room temperature.

References

[1] Huang,T., Liu,G., Zhu,L., Liu,J., Xiang,Y., Xu,X.,and Zhang,Z. 2024. Mitigation of chilling injury in mango fruit by methyl jasmonate is associated with regulation of antioxidant capacity and energy homeostasis. Postharvest Biology and Technology,211,112801.
[2] Wang,F., Yang,Q., Zhao,Q., and Zhang,X. 2020. Roles of antioxidant capacity and energy metabolism in the maturity-dependent chilling tolerance of postharvest kiwifruit. Postharvest Biology and Technology,168,111281.
[3] Zhang,Y. 2024. Post-harvest cold shock treatment enhanced antioxidant capacity to reduce chilling injury and improves the shelf life of guava (Psidium guajava L.). *Frontiers in Sustainable Food Systems*,*8*,1297056