Ensuring quality in tropical vegetables: Addressing chilling injury through antioxidant systems

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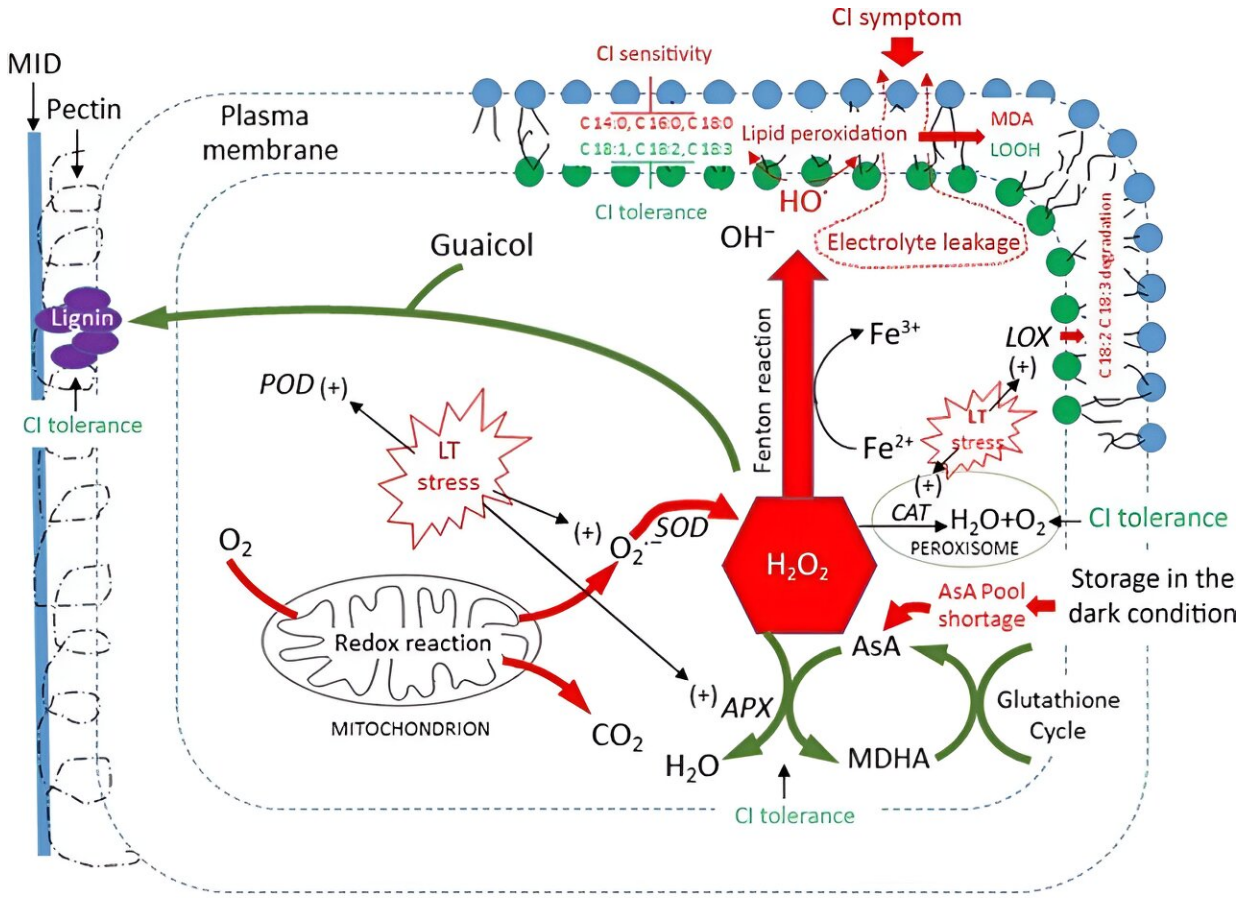

Mechanism of CI development in plants during LT storage

The proposed chilling injury (CI) sensitivity and tolerance in immature sponge gourd fruit during storage at low temperature conditions: induce [+] and inhibit [–]. Credit: *Vegetable Research* (2024). DOI: 10.48130/vegres-0024-0013

A research team has found that optimal storage temperatures are crucial for preserving vegetables' quality, with tropical plants particularly susceptible to low temperatures, leading to a "chilling injury" (CI) condition.

This new study highlights the importance of inducing antioxidant systems to mitigate CI, which causes surface pitting, water succulence, and abnormal ripening. This research could potentially improve storage practices and enhance the resilience of tropical vegetables to chilling temperatures, ultimately reducing post-harvest losses.

Vegetables, derived from various plant parts, serve as essential edible components or food ingredients. Botanically, fruits originate from flowers, while other plant parts are classified as vegetables, although their classification often depends on cultural significance or culinary use.

Current research indicates that chilling temperatures cause stress and physiological disorder or damage in tropical plants of various vegetable species, leading to CI. Tropical vegetables and fruits are more susceptible to low-temperature stress than their temperate counterparts.

The study, published in *Vegetable Research* on 3 June 2024, aims to comprehensively analyze the defensive mechanisms and triggers of CI in both tolerant and sensitive cultivars.

This review explores the effects of chilling stress on tropical horticultural crops, which thrive in hot climates on both sides of the equator. Low storage temperatures can extend the shelf life of these crops by reducing respiration and metabolism. However, inappropriately low temperatures consistently below 13°C can lead to CI, which is particularly detrimental to tropical produce.

CI symptoms vary among commodities, including color shading, surface pitting, surface browning, water-soaking, water succulence, and internal browning. Research indicates that mature leaves of sweet basil (Ocimum basilicum L.) develop severe browning symptoms at 4°C, accompanied by increased polyphenol oxidase (PPO) levels and lipoxygenase (LOX) activities.

The review also highlights the impact of reactive oxygen species (ROS) generated by low temperatures, which cause significant cellular damage through lipid peroxidation and disruption of membrane integrity. The susceptibility of crops like cucumbers, mangoes, and bananas to CI underscores the need for careful temperature management to maintain quality and prevent decay.

In addition, the review discusses the varying responses of different tissues, such as the peel and flesh, to chilling stress, and the physiological mechanisms involved in ROS metabolism and membrane stability. The insights from this review emphasize the importance of understanding and mitigating CI to enhance the post-harvest quality of tropical horticultural crops.

According to the study's lead researcher, Sompoch Noichinda, "This review aims to comprehensively analyze the mechanisms, localization, and structural composition of the membranes found in both CI-tolerant and sensitive cultivars. This will examine the defensive mechanisms employed by these cultivars and the various triggers that initiate these mechanisms."

In summary, optimal storage temperatures are essential for preserving vegetable quality, especially for tropical plants susceptible to CI. CI causes oxidative stress, leading to surface pitting, browning, water succulence, and abnormal ripening symptoms. ROS damages cell membranes and macromolecules, with advanced stages causing

irreversible damage. Future research should enhance antioxidant systems, develop CI-tolerant cultivars, and improve storage technologies to reduce losses and improve food security.

More information: Chalermchai Wongs-Aree et al, Structural membrane alterations in tropical horticultural crops under postharvest chilling stress, *Vegetable Research* (2024). DOI: 10.48130/vegres-0024-0013

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