Use of controlled atmosphere in *Prunus persica* postharvest for chilling injuries mitigation: A multi-omics approach

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Introduction

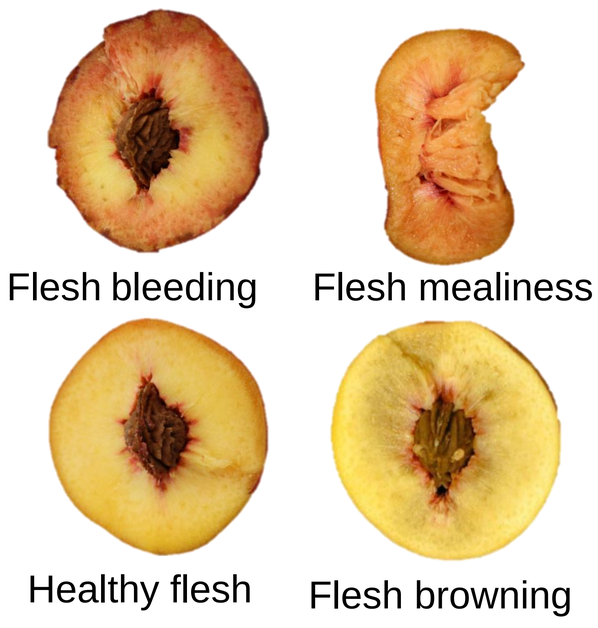

Figure 1. Chilling Injury symptoms in 'Zee Lady' peaches (Source: Manganaris *et al*., 2022).

Chilling Injuries

The fast-ripening process in peach fruits is considered a challenge for the international market. The prolongation of its shelf-life is done by cold storage, usually at 0-5 ºC, however, the use of refrigeration can lead to the development of chilling injuries (CIs). CIs manifest as flesh mealiness, bleeding and browning, which reduce fruit quality and the acceptance of the consumers (**Fig. 1**)

Controlled atmosphere

An alternative of using controlled atmospheric conditions (CA) (high CO_2 and low O_2 concentrations) together with cold storage has demonstrated to help prevent this disorder to happen. The effectiveness of these treatments largely differs between varieties. Several investigations have been carried out to dissect CIs molecular events in different storage conditions, but the epigenetic mechanisms involved are poorly studied.

Main objective

The present work aims to provide insights on how epigenetic regulation is associated with the development or prevention of CIs development in peach during cold storage.

Methodology

Plant Material

First year experiments will be carried out with the peach variety Flaminia, which was selected based on its confirmed susceptibility to CIs (Brizzolara *et al*., 2018).

Treatments

Fruits will be harvested and selected based on maturity degree and size (**E1**). Some fruits will be ripened at 20°C for 7 days (**E2**), another group will be kept for 21 days at 4°C with and without CA (15% CO_2 and 5% O_2) (**E3CA** and **E3**). After the storage period, fruits will be kept at 20°C for 7 days (**E4CA** and **E4**) (**Fig 2**).

Phenotyping

For each treatment, fruit firmness, sugar content, titratable acidity, and ethylene and CO_2 concentrations will be measured. For stages E4CA and E4, a quantitative determination of mealiness will be performed.

Genotyping

For each treatment, RNA-seq, WBGS and ChIP-seq will be performed. The main idea is to use a multi-omics approach with transcriptomics and epigenomics data integration (**Fig. 2**).

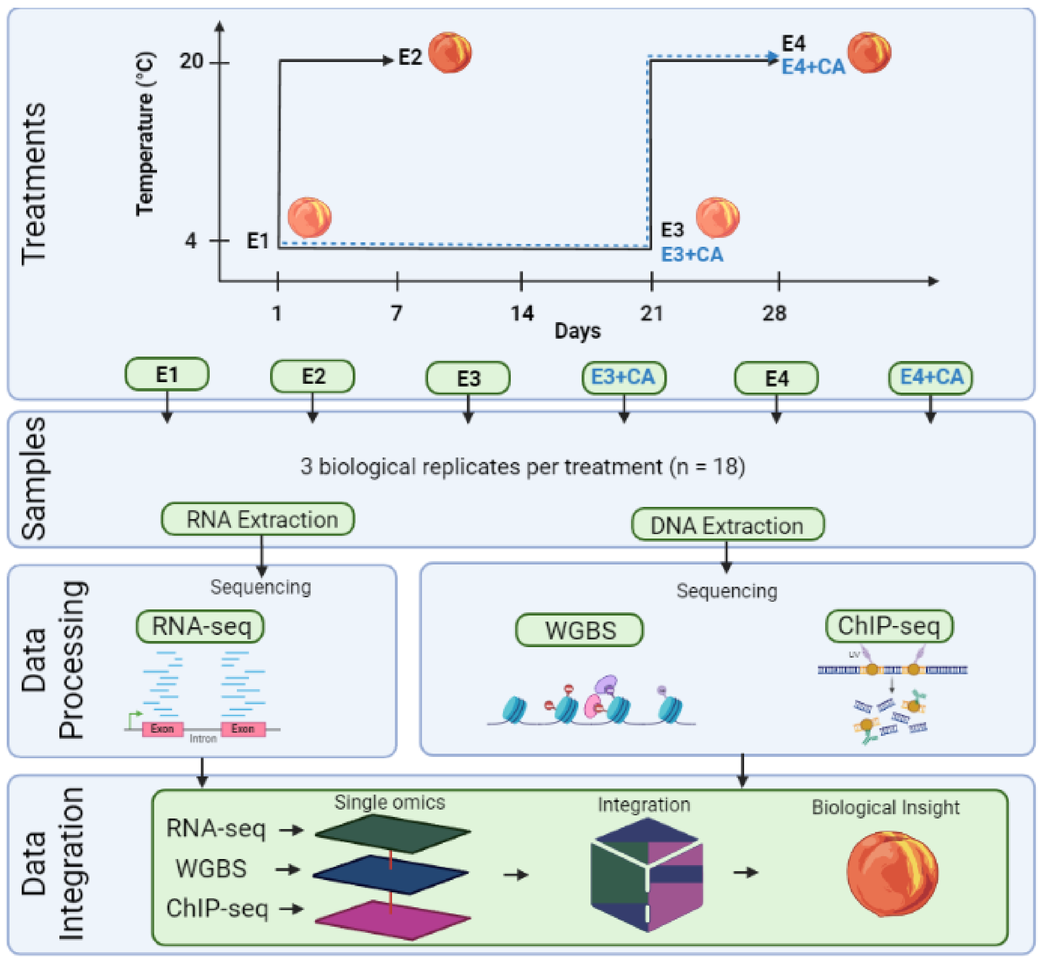

Figure 2. Expected workflow for the multi-omics analysis (Created with BioRender).

Conclusions and Perspectives

Multi-omics approach

This multi-omics approach will deepen our understanding on the biological context of CIs development. This will be the first approach to investigate DNA methylation and histone post-transcriptional modifications (HPTMs) in response to CA to prevent CIs development in peach fruits.

- The transcriptomics analysis will help to identify differentially expressed genes (DEGs) during cold storage with and without CA conditions. Furtherly, we can recognize potential genes involved in CIs mitigation.
- The epigenomics analysis will unravel all the methylation and chromatin modifications during cold storage with and without CA conditions.
- By performing data integration, we intend to identify epigenetically regulated genes involved in the development or mitigation of CIs.

Expected outcome

- Identify novel genetic and epigenetic markers, that can be further tested and implemented in peach breeding programs.
- Enhance our knowledge on peach postharvest treatments to reduce losses related to CIs.

References

Brizzolara, S., Hertog, M., Tosetti, R., Nicolai, B., Tonutti, P., 2018. Metabolic Responses to Low Temperature of Three Peach Fruit Cultivars Differently Sensitive to Cold Storage. Frontiers in Plant Science 9. https://doi.org/10.3389/fpls.2018.00706

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 101034319 and from the European Union - NextGenerationEU

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