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Molecular investigations about the Peach post-harvest ripening processes and VOCs biosynthesis pathways: a review focused on integrated genomic, transcriptomic and metabolomic approaches

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Peach and the supply chain

FRUITY

Chilling injury (CI) symptoms

Lurie *et* Crisosto, 2005

Background of the work

- Peach is a model plant with a small genome
- Economically important crop with still low consumption
- Its quality and aroma is affected during storage periods.
- Research on the characterisation of the regulatory mechanisms during **peach fruit post-harvest ripening**
- Insights about molecular functions of peach genes have been gained by next generation sequencing.

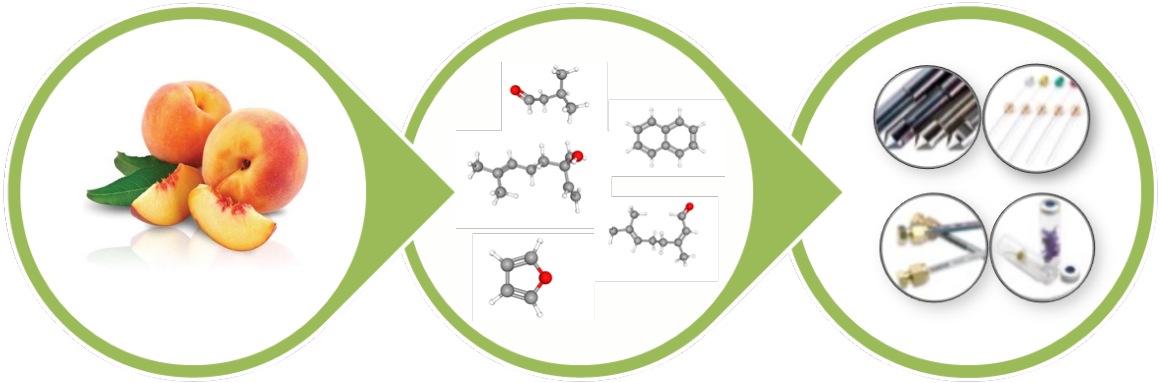
Aims of the work

- Review the most relevant research results in peach **fruit post-harvest ripening**, focusing on **multi-omics approach, combining genomic, transcriptomic and metabolomic methods.**
- Provide a useful starting point for researchers in the field and future perspectives for improving peach quality.

Peach ripening process

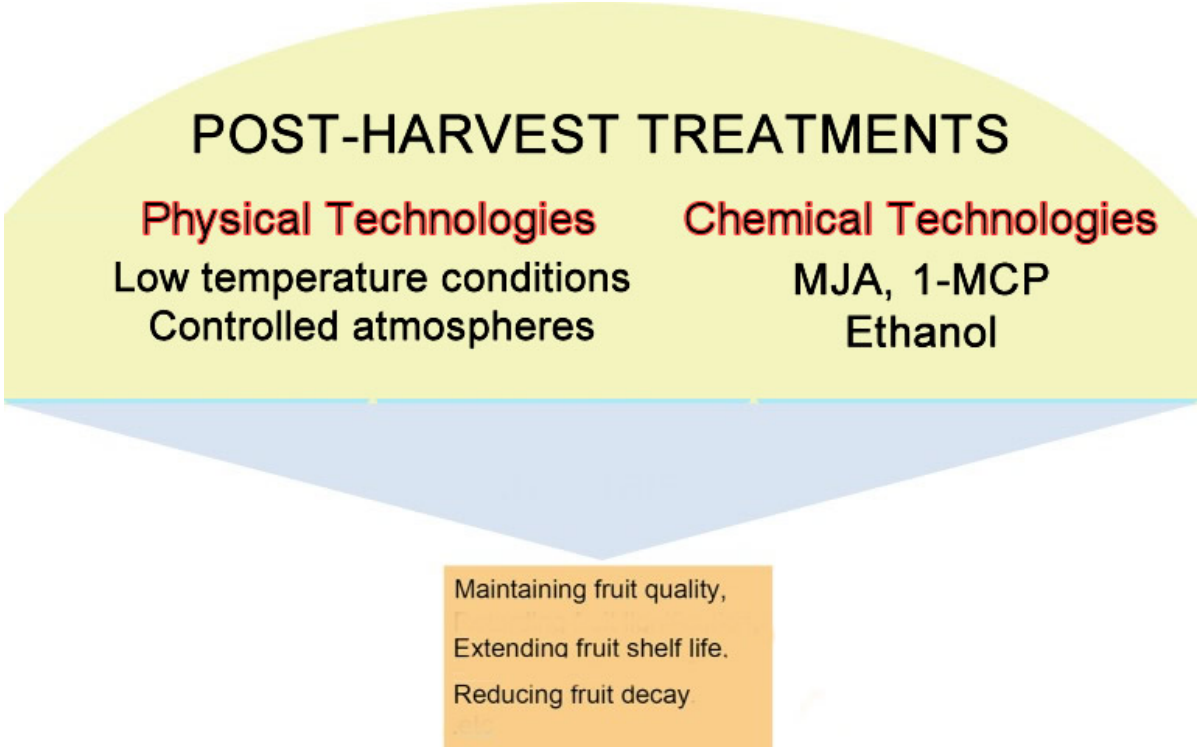
- Peach ripening is a complex developmental process controlled by a plethora of genetic and epigenetic factors.

Volatile Organic Compounds (VOCs)



- VOCs are generated during the ripening process through the catabolism of compounds like fatty acids, proteins and carbohydrates
- Their profile changes during ripening, cold storage and post-harvest treatments

Peach post-harvest treatments



Molecules involved in peach ripening process

- The integrated action of auxins, gibberellins and cytokinins plays a fundamental role
- Abscisic acid (ABA) and ethylene are responsible for strong effects during fruit ripening in all Prunus species
- Fatty acids composition varies during peach ripening and influences aroma production
- Flavonoids and carotenoids content varies during the peach ripening process

(Bonghi et al., 2011; García-Gómez et al., 2020).

Metabolomics and post-harvest peach ripening

- Correlation networks analysis (CNA) used to study multi-traits relationships.
- Peach volatiles clustered based on their chemical nature or known biosynthetic pathways.
- VOCs clusters showing similar structures have been identified as well as those belonging to specific metabolic pathways.

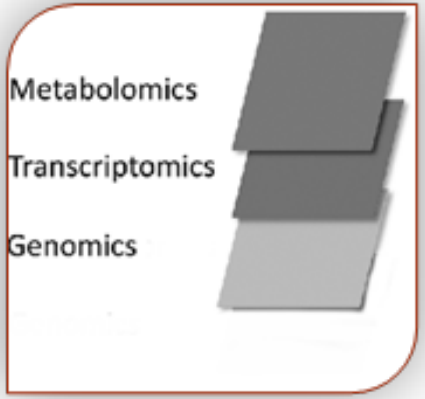
Peach Genomic profile

- Peach v1.0 was released in 2010 followed by v2.0.a1, based on the DNA from the doubled haploid cultivar 'Lovell'
- Subsequently, peach ESTs databases and NCBI entries were developed.
- Genetic mapping and quantitative trait loci (QTL) were identified
- The relevance of using these genomics approaches in post-harvesting biology was largely highlighted.

Peach Transcriptomic profile

- Peach gene expression profiling during ripening was initially based on microarrays.
- The first peach microarray (named µPEACH1.0) included about 4,800 probes for genes involved in fruit development.
- In 2016, RNA-seq was performed to investigate different peach maturation stages
- In 2021, DEGs in peach fruit treated with 1-MCP and high CO2 were studied

Multi-omics approach to investigate peach post-harvest ripening and VOCs



- NGS technologies have deeply revolutionized plant biology.
- Combined approaches, based on the relationship among genomics, transcriptomics and metabolomics methods, were facilitated.
- Multi-omics applications were developed

Gapper et al., 2014 ; Sanchez et al., 2014

Conclusions

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- Advances in novel biotechnologies made it possible to combine genomics, transcriptomics, metabolomics approaches, allowing a deeper understanding of the mechanisms underlying the complex architecture of fruit expression changes in pre- and post-harvest ripening stages.
- In peach, several studies about the post-harvest ripening stage and volatiles were based on multi-omics approaches.
- Albeit the achieved results can be considered significant, they are far from elucidating all underlying aspects and molecular mechanisms related to post-harvest, making further studies still necessary.

Thank you

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https://www.researchgate.net/project/Multi-trait-approach-to-enhance-FRUit-quallTY-in-post-harvest-storage-conditions

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