The ripening strawberry

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The role of ethylene

Iannetta, Laarhoven, Harren, Davies

Ethylene (C_2H_4, a planar hydrocarbon) is a gaseous phyto-hormone produced by plant tissues and detected by a membrane-bound receptor.

Confusion
The peer-reviewed literature conflicts regarding the role of ethylene during ripening.

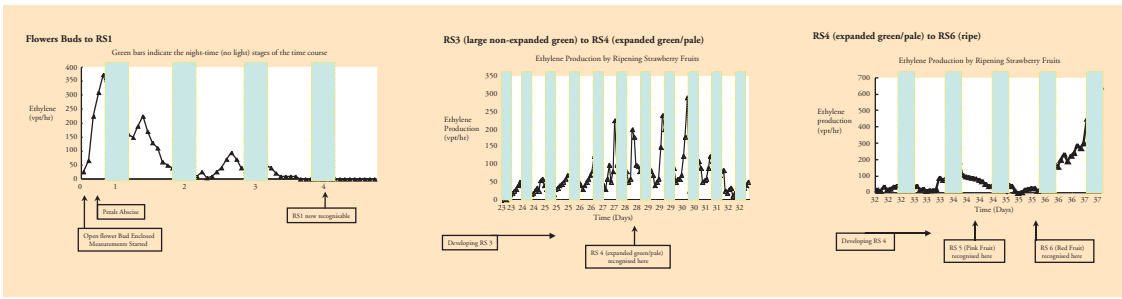
Why the confusion?
Strawberries evolve low levels of ethylene that are difficult to detect with accuracy.

Solution?

- Studies are often performed upon detached tissues that are enclosed in gas-tight containers for prolonged periods
- Alternatively, some researchers use extracted tissue: extrapolating enzyme activity data.

However, numerous problems are associated with either of these approaches.

CO_2-photoacoustic (PA)-LASER spectroscopy has allowed the ***accurate*** and ***continuous*** determination of low ethylene concentrations from a range of whole attached ripening stages.



Ethylene is evolved throughout ripening in a predictable manner

- With the exception of ripe fruit, ethylene evolution during ripening exhibits a diurnal cycle.

Ethylene is evolved as:

- Flowers senesce or ovules are fertilised.
- Fruit expand from small dark-green fruits to pale-green fruits.
- As diurnal night-time peak, coinciding with fruit reddening.

Ongoing Research.
These results are correlative and work testing a causal role for ethylene has still to be done.

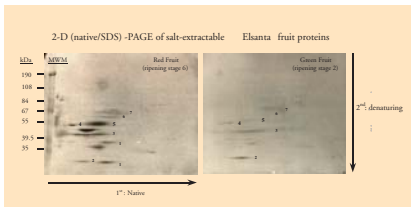
To identify ethylene responsive genes in harvested fruit.

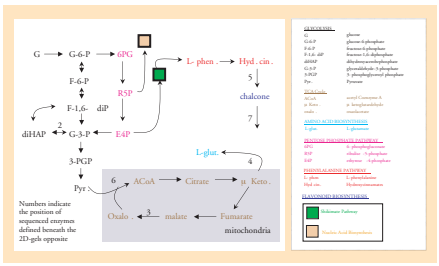
The identification of ethylene responsive genes

Ethylene hastens post-harvest decay and Botrytis proliferation

Fruit metabolism

Iannetta, Medina-Escobar, Ross, Souleyre, Hancock, Taylor and Davies.





Molecular versus proteomic analysis?

- Many different strawberry cDNAs have been cloned.
- Many of these are differentially expressed during ripening.
- Few cloned cDNAs encode proteins involved in fruit flavour.

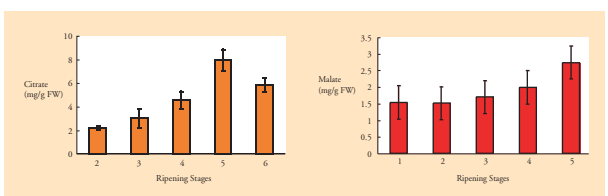
A non-molecular strategy was therefore adopted to identify differentially expressed proteins.

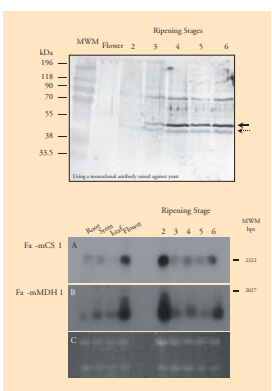
The enzymes mCS and mMDH were the focus of further analysis.

- The major strawberry organic acids are citrate (ca. 80 %) and malate (ca. 20 %).
- mCS and mMDH play important roles in energy production via the TCA-cycle.

  The TCA cycle is also involved in the production of secondary metabolites
- The secondary-metabolites include flavour components such as volatiles and amino acids.

The cDNAs that encode each of these enzymes were cloned from ripe strawberry fruit and a biochemical and molecular characterisation of each enzyme/cDNA carried out.





The effectiveness of complementary (proteomic plus molecular) approaches is demonstrated.
The findings by Northern analysis are contrary to the other measurements made: is the translation of mCS and mMDH transcripts blocked during the early ripening stages?

Many important aspects of strawberry fruit ripening remain poorly understood. This poster presents research aimed to identify the biology underlying ethylene, metabolism and packaging.

Effective packaging strategies

Iannetta and Davies

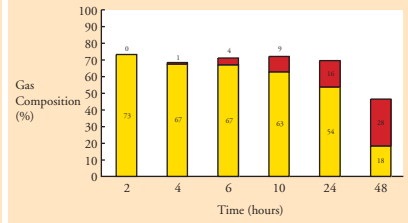
Modified atmosphere packaging techniques frequently use supra-ambient levels of O_2 and/or CO_2 to increase the shelf life of fresh produce.

Previous modified atmosphere packaging research

Strawberry fruit packed into a high (80%) oxygen atmosphere exhibit a prolonged shelf-life (ca. 14 days).
The effectiveness of such strategies may be due to the supra-ambient levels of O_2 and/or CO_2.

High-oxygen (80%) modified atmosphere packaging

Headspace analysis of containers originally packed to contain 80% O_2/20% N_2. changes in O_2 (yellow) and CO_2 (red) over time.



Current research….
… is aimed to identify novel genes whose expression is regulated by O_2 and CO_2.

RNA from control and 2-24 hours (high O_2/CO_2) treated fruit is being used in a subtractive (SSH) molecular analysis.

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