

Cold storage of tomato: the good, the bad, and the ugly

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Background

Cold storage at around 12°C is recommended to reduce tomato decay and maintain tomato fruit quality while avoiding a reduction of tomato flavor due to chilling injury. Several reports have demonstrated that tomato storage at 5°C (household refrigerator temperature) affects the production of important tomato volatiles and in a few cases also affected consumer liking. We hypothesized that the original organoleptic quality of the genotype is an important determinant of the effect of storage and low temperature on tomato flavor. In this work, three modern commercial cultivars were selected as a reference of low (Merlice), medium (Brioso) and high (Axiandy) organoleptic quality.

Methods

Red-ripe fruit were harvested in three biological replicates and divided into:

- **T0**: before storage, immediately frozen in liquid N after harvest
- **Control**: fruit stored for 7 days at 15 °C and acclimated at 20 °C for 24h
- **Cold-stored (CS)**: fruit stored for 7 days at 5 °C and acclimated at 20 °C for 24h

For each cultivar, liking of stored fruit (Control and CS) were compared to fruit harvested on the day before (**FH**) by a consumer panel (n≈50). To evaluate the impact of storage and low temperature on fruit quality parameters and levels of volatile aroma compounds (VOCs), data of stored fruit were compared to T0 fruit. In general, T0 data were comparable to FH ones.

Results

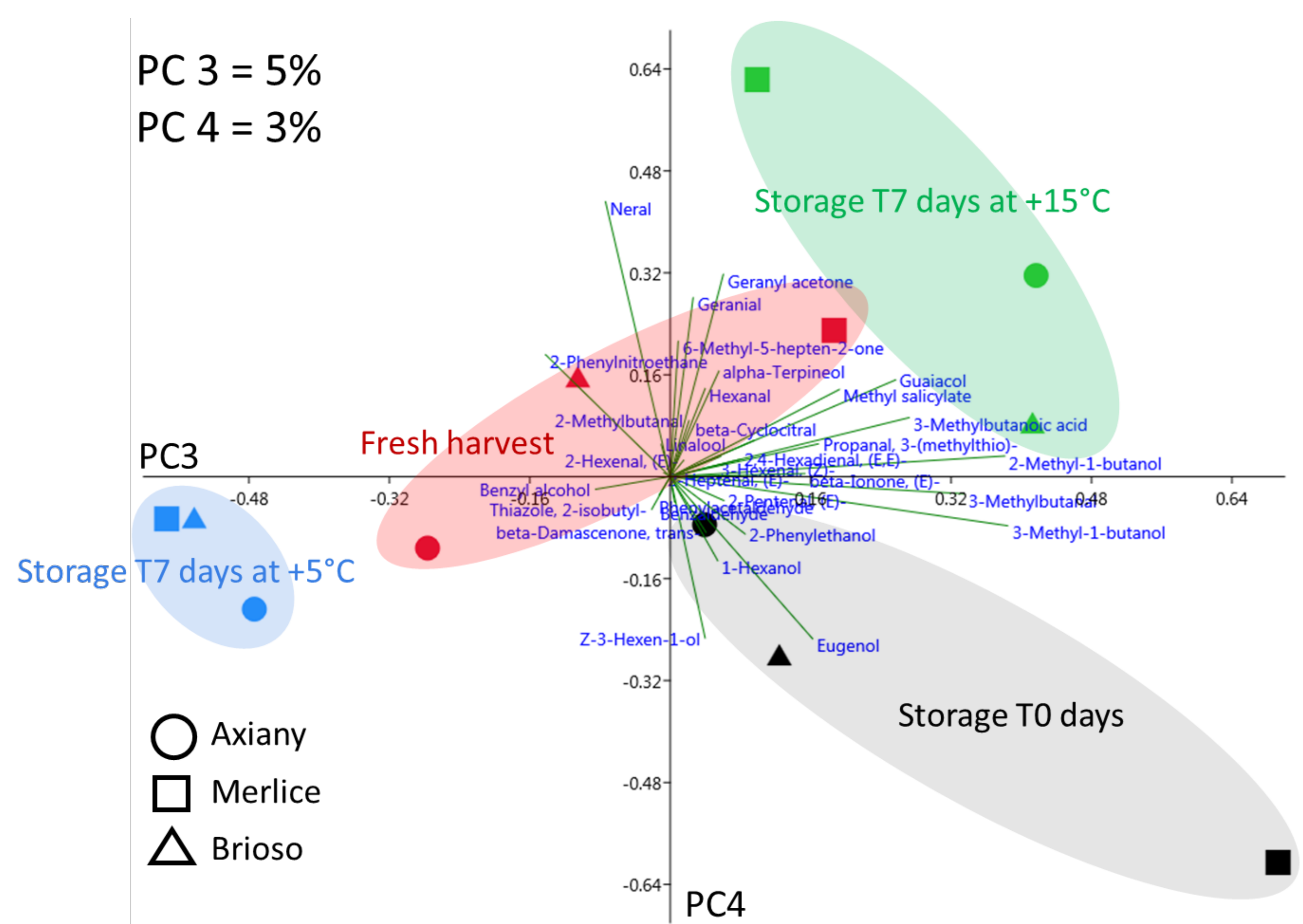


Figure 1. Principal component analysis of 32 aroma-important VOCs assessed by SPME-GC-MS in Merlice, Brioso and Axiandy fruit.

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Results

Fruit quality

- Fruit stored for 7 days at 5 °C maintained similar SSC, TA, and firmness as non-stored fruit (Table 1).
- Storage at 15 °C reduced the TA of Brioso and Axiandy fruit and firmness in Merlice.

Aroma profile

- PCA shows a clear effect of storage, both at chilling and non-chilling temperature on the aroma profile of the three genotypes tested (Fig. 1).
- Lipid derived volatiles have previously been reported to reduce by cold storage. In this experiment they, however, did not show a significant reduction in fruits stored for 7 days at 5°C.
- The VOCs most affected by cold storage in the three cultivars were amino acid and phenolic derived volatiles.
- Carotenoid derived VOCs showed an increase in fruits stored at 15°C, especially in fruits of Merlice, possibly suggesting a more intense carotenoid breakdown at this condition.

Table 1. Changes in total soluble solids content (SSC), titratable acidity (TA), and firmness in Merlice, Brioso, and Axiandy fruit. Different letters for each cultivar indicates that means are statistically different according to Tukey's HSD test ($P=0.05$).

| | SSC (°Brix) | | | | TA (nm H ₂ O/100g) | | | | Firmness (N) | | | |
|----------------|-------------|------|---------|------|-------------------------------|---------|---------|----------|--------------|---------|---------|---------|
| | FH | T0 | Control | CS | FH | T0 | Control | CS | FH | T0 | Control | CS |
| Merlice | 3.60 | 3.43 | 3.62 | 3.41 | 6.79 | 6.70 | 6.78 | 6.81 | 52.87 | 47.50 a | 38.75 b | 53.76 a |
| Brioso | 5.24 | 5.17 | 5.07 | 5.21 | 7.72 | 7.88 a | 7.02 b | 7.59 ab | 101.25 | 83.52 | 60.73 | 85.13 |
| Axiandy | 10.04 | 9.61 | 9.87 | 9.96 | 14.65 | 15.35 a | 13.68 b | 14.40 ab | 240.59 | 275.11 | 301.55 | 280.62 |

Consumer panel

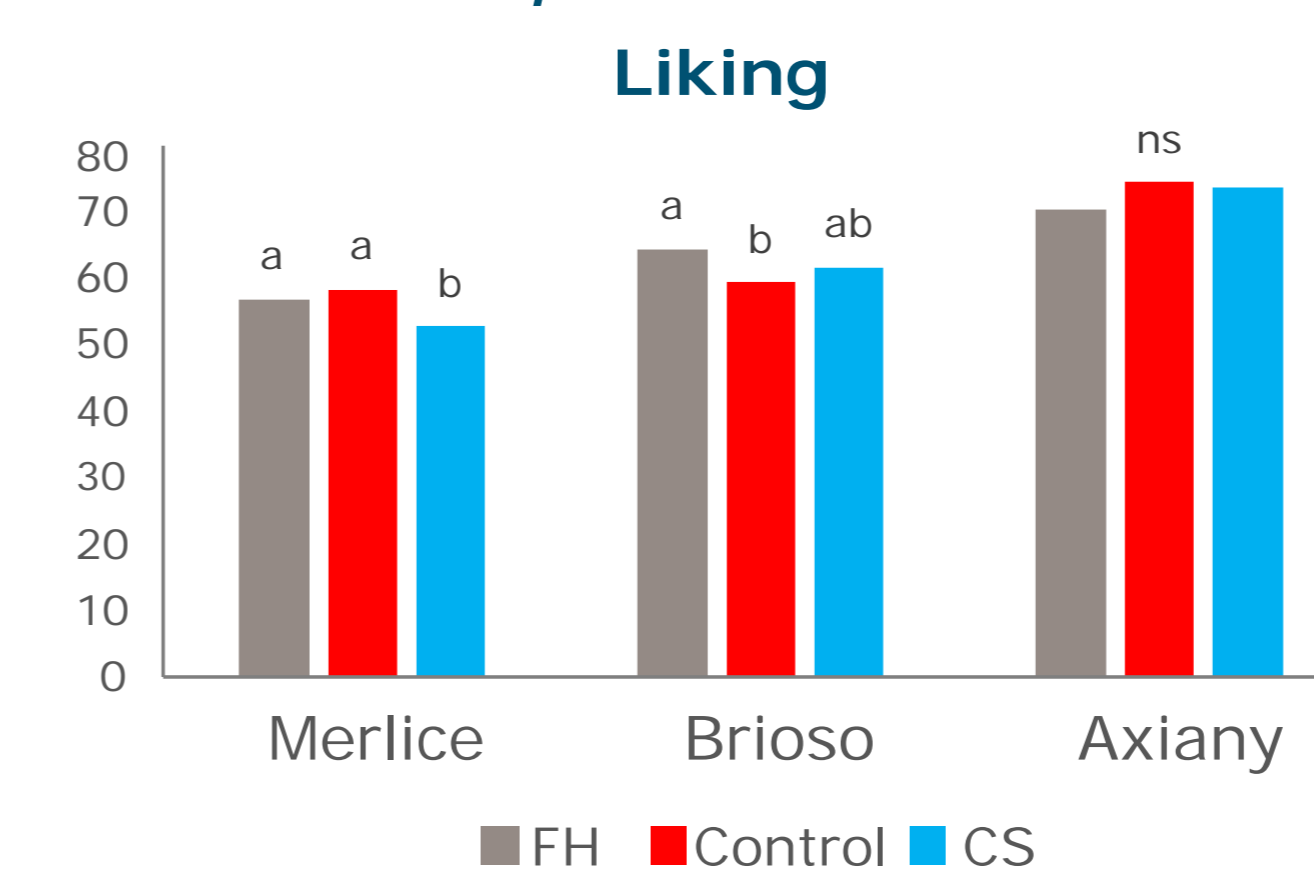


Figure 2. Liking as scored by a consumer panel (n≈50). Different letters on bars for each cultivar indicates that means are statistically different according to LSD test ($P=0.05$).

- Chilled Merlice fruit (low organoleptic quality) were less preferred than fresh and 15 °C stored fruit (Fig. 2).
- Fresh Brioso fruit (medium organoleptic quality) were rated higher than fruit stored at 15 °C
- No changes were detected in Axiandy (high quality cultivar)

Conclusions

- Cold storage maintained better the fruit quality parameters TA and firmness than storage at non-chilling temperature.
- Both storage time and low temperature affected the metabolic profile of modern cultivars of tomato.
- The metabolic changes induced by chilling were only translated in a significant effect on consumer liking in the cultivar with low flavor quality, Merlice.

