Evaluation of calyx senescence during the ripening of 'Rojo Brillante' persimmon by chlorophyll fluorescence imaging

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INTRODUCTION

In persimmon, calyx status is an important fruit quality attribute since it is a very characteristic fruit part from the visual point of view. Persimmon fruit possesses a large green four-lobed calyx around the fruit stem-end, but it darkens during fruit ripening and is associated with commercial quality loss. During calyx senescence, desiccation and browning start from the apical part of sepals toward the base. Leaf senescence in plants is related to the breakdown of chloroplast and the degradation of chlorophylls (Lim et al., 2007). To date, information about the relation between calyx senescence and physico-chemical changes in persimmon during fruit ripening is lacking. . This information could be useful for determining the harvest time with maximum fruit quality.

Chlorophyll fluorescence imaging (CFI) is a widespread rapid non-intrusive technique to evaluate photosynthetic activity. The heterogeneity of photosynthetic activity over the whole leaf area can be analyzed by CFI (Gorbe and Calatayud, 2012).

The present research aimed to characterize the calyx senescence process during the fruit ripening by CFI, and to establish the relation between CF parameters and the most important fruit quality attributes.

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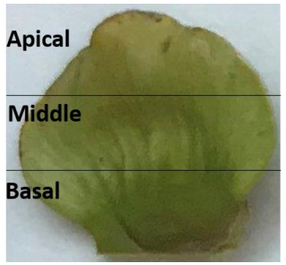
MATERIALS AND METHODS

Rojo Brillante variety

3 Harvests
Nov. 13th (H1)
Nov. 27th (H2)
Dic. 4th (H3)

Two opposite sepals were removed from each calyx

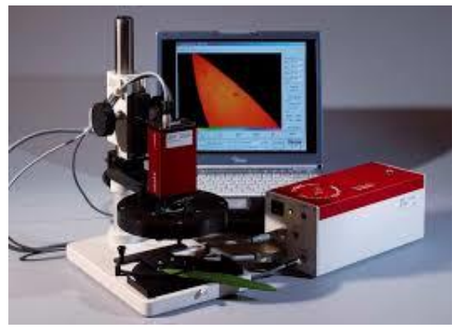
CF parameters were determined for whole sepal

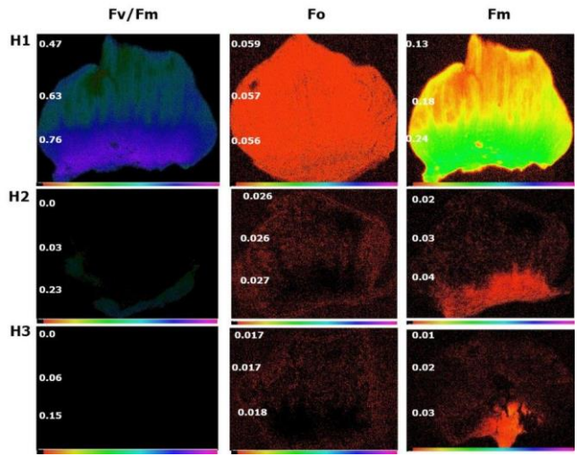


CF parameters were measured in three sepal lobe areas (Basal, Middle, Apical)

CF parameters

- **Fo:** Minimal chlorophyll fluorescence intensity measured in the dark-adapted state
- **Fm:** Maximal chlorophyll fluorescence intensity measured in the dark-adapted state
- **Fv/Fm:(Fm-fo)/Fm:** Maximum quantum yield of PSII photochemistry measured in the dark-adapted state





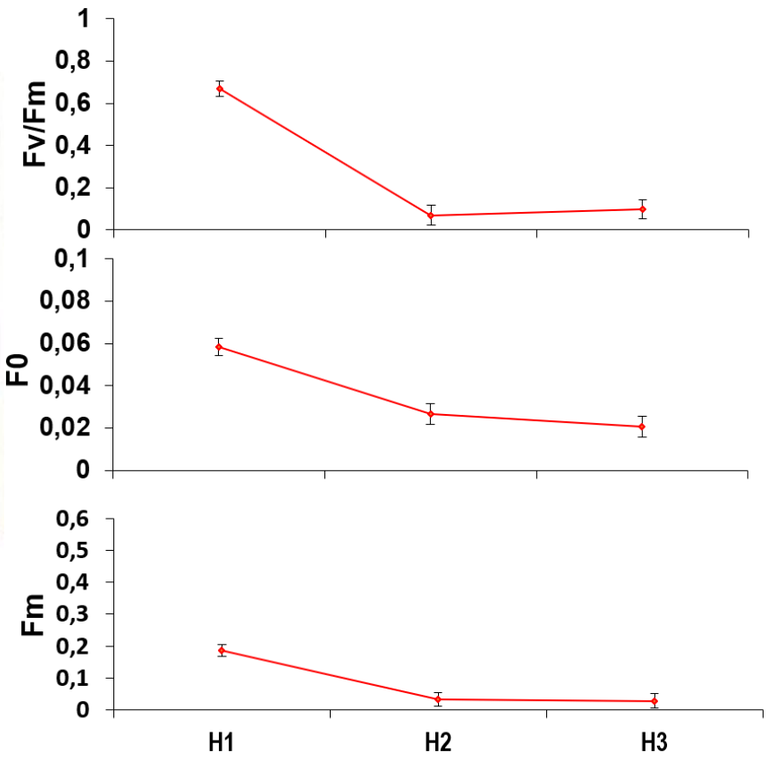
Fruit parameters
- Color (CI = 1000a/Lb)
- Firmness (N)

Pearson correlation and simple linear regression were used to correlate the fruit quality attributes with the CF parameters measured in the fruit calyx.

RESULTS

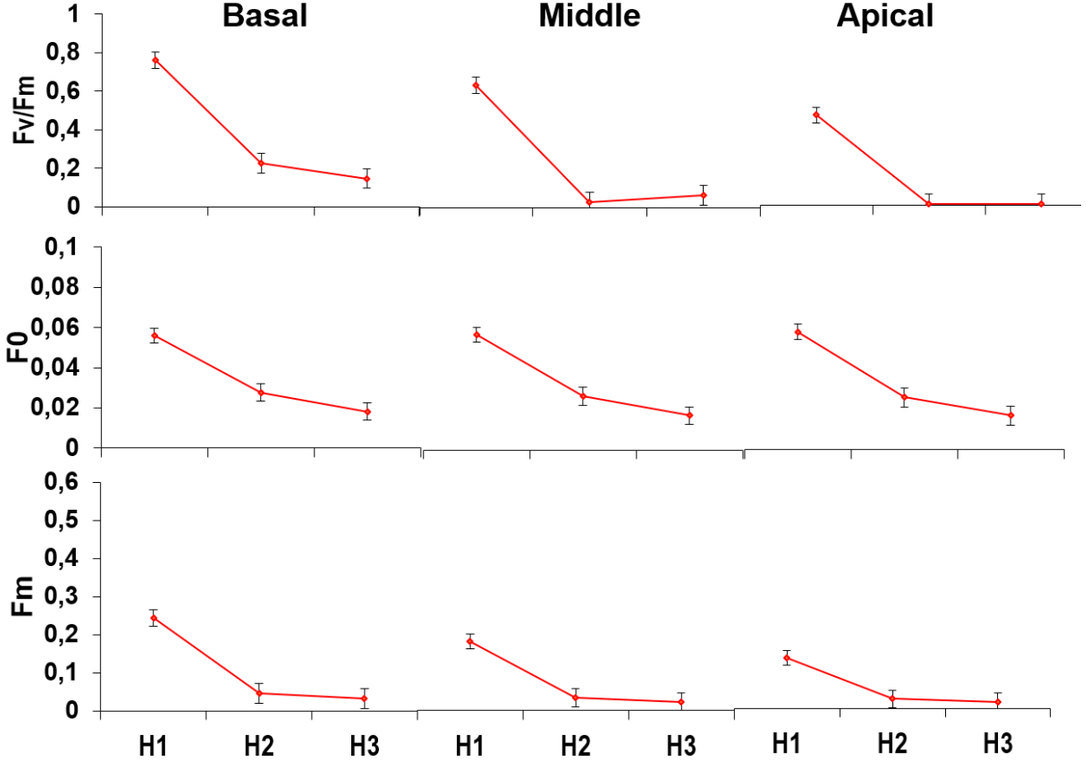
Visual aspect of sepals at three harvest times

CF parameters of the whole sepal at three harvest times



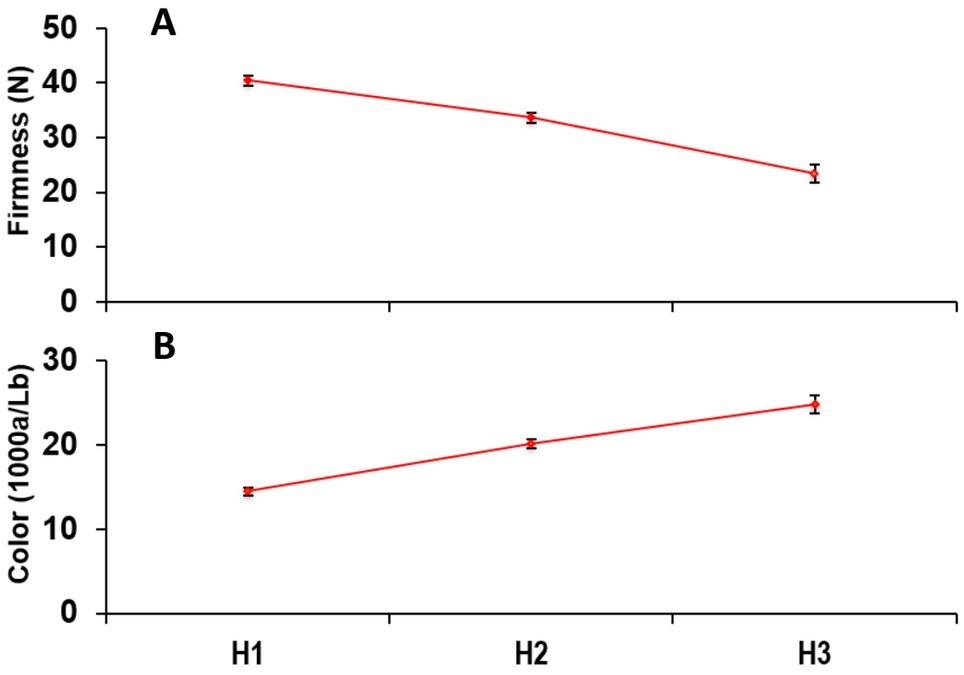
Vertical bars represent SE intervals

CF parameters in three sepal lobe areas (Basal, Middle, Apical) at three harvest times



Vertical bars represent SE intervals

Flesh Firmness (A) and skin color index (B) at three harvest times



Vertical bars represent SE intervals

Correlations between external color index (CI) or firmness and the CF parameters (Fv/Fm, Fm, Fo) of sepals

	Color Index (CI)		Firmness (N)	
	Equation	r	Equation	r
Fv/Fm mean	CI=23,25 - 12,53 × Fv/Fm	-0.809	Firmness= 26.28 + 19.61 × Fv/Fm	0.719
Fv/Fm Basal	CI=24.89 - 13.56 × Fv/Fm	-0.877	Firmness=24.64 + 20.78 × Fv/Fm	0.809
Fv/Fm Middle	CI=23.69 - 13.89 × Fv/Fm	-0.829	Firmness=28.17 + 18.58 × Fv/Fm	0.738
Fv/Fm Apical	CI=22.27 - 15.88 × Fv/Fm	-0.834	Firmness=28.75 + 23.76 × Fv/Fm	0.750
Fm mean	CI=24.02- 51.65 × Fm	-0.875	Firmness= 26.05 + 78.43 × Fm	0.799
Fm Basal	CI=24.06 - 39.91 × Fm	-0.887	Firmness=25.94 + 60.92 × Fm	0.814
Fm Middle	CI=23.98 - 52.88 × Fm	-0.888	Firmness= 26.05 + 81.03 × Fm	0.818
Fm Apical	CI=23.89 - 69.45 × Fm	-0.865	Firmness=26.22 + 105.83 × Fm	0.793
Fo mean	CI=28.28 - 239.22 × Fo	-0.915	Firmness=19.23 + 372.98 × Fo	0.858
Fo Basal	CI=28.03 - 242.04 × Fo	-0.911	Firmness= 19.38 + 384.36 × Fo	0.871
Fo Middle	CI=27.47 - 226.44 × Fo	-0.909	Firmness=20.30 + 358.45 × Fo	0.866
Fo Apical	CI=27.31 - 223.73 × Fo	-0.913	Firmness=20.57 + 354.08 × Fo	0.869

CONCLUSIONS

- In this study, we proposed a novel approach to understand the calyx senescence process of persimmon fruit during ripening through the study of CFI parameters.
- A decline in the CF parameters correlated with calyx senescence and progressed during fruit ripening.
- Spatial-temporal heterogeneity in the CFI parameters clearly illustrated the onset of senescence and necrosis symptoms in apical sepal areas that progressed toward the basal area.
- High correlations between CF parameters measured on the calyx and external color evolution or firmness loss during fruit ripening were found.
- CFI measurements in sepal of calyxes could act as a potential non-intrusive tool to determine persimmon quality at harvest.

REFERENCES

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