Microstructural analysis of fresh-cut red bell pepper (*Capsicum annuum* L.) aiming at postharvest quality optimization

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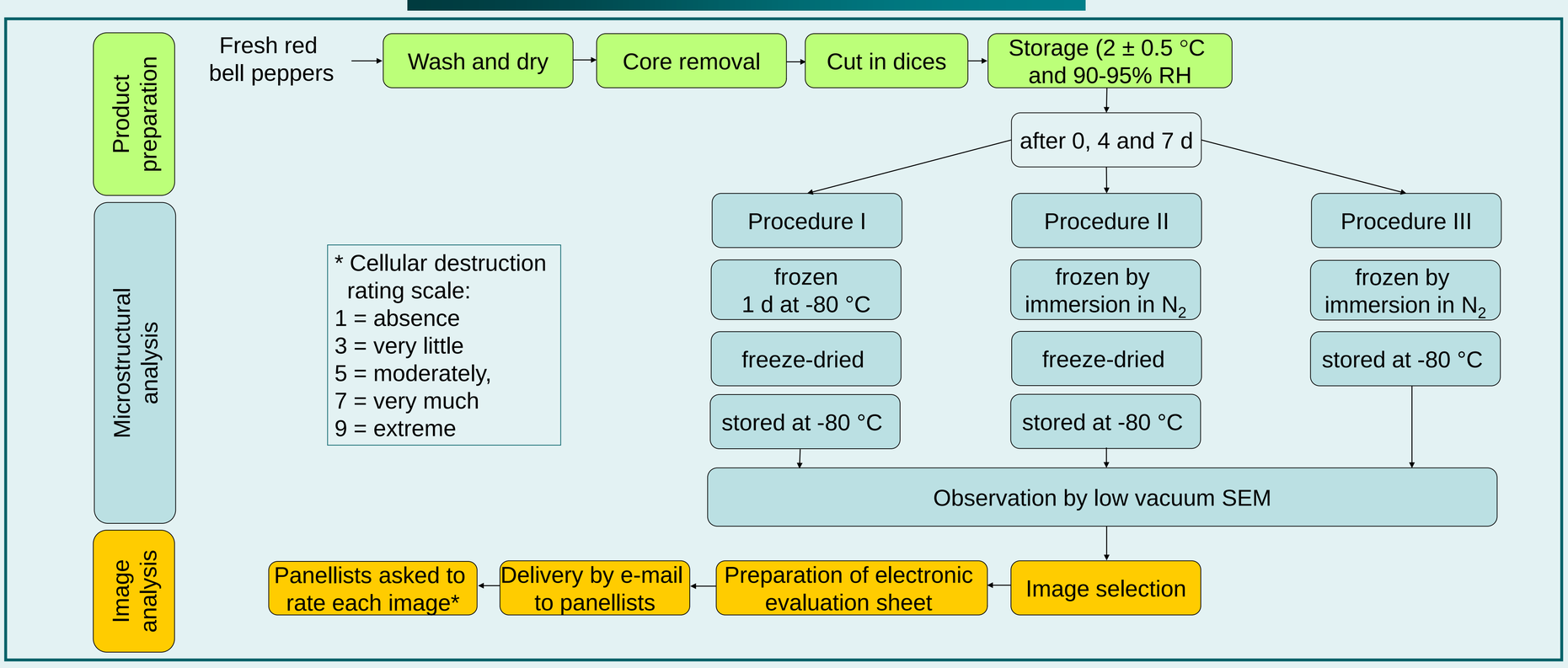
Introduction

- Rationalization of deterioration processes that take place during postharvest of fresh fruits and vegetables, and in particular fresh-cut ones, is essential to optimize postharvest quality and maximize shelf-life.
- This requires understanding microstructure, and relating it to macroscopic quality characteristics of the food product.
- Scarce work has indeed focused to date on the microstructure of fresh and fresh-cut fruits and vegetables.
- Scanning electron microscopy (SEM) is an interesting technique for microstructural studies.

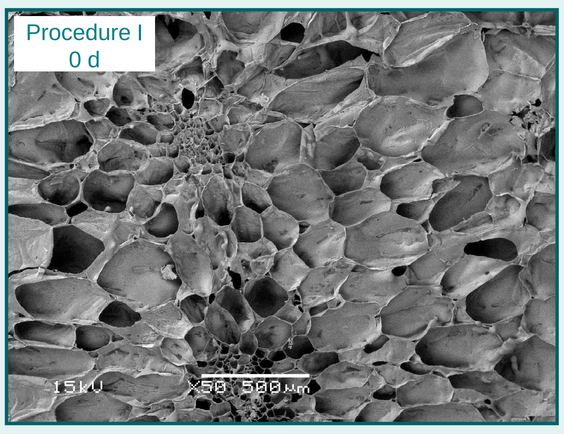
Objective

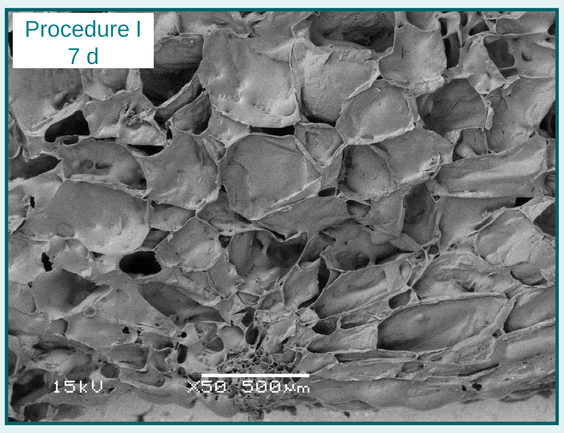
Application of SEM to evaluate microstructure of fresh-cut red bell pepper, after cutting and maintaining (for 0, 4 and 7 d) under refrigerated storage. In order to achieve such a goal, two sub-objectives were addressed: i) to optimise the sample preparation procedure prior to analysis of red bell pepper by SEM, and ii) to develop an adequate methodology to quantify SEM images.

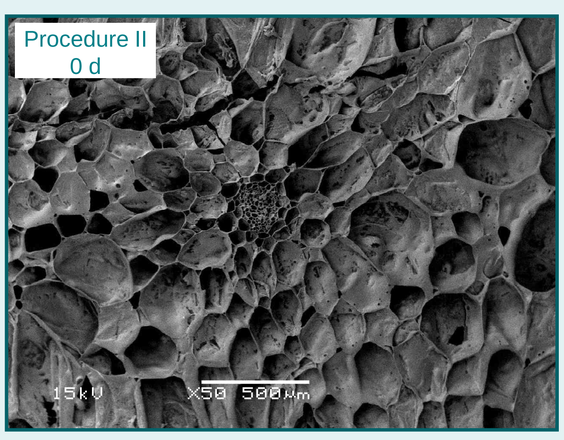
Materials & Methods

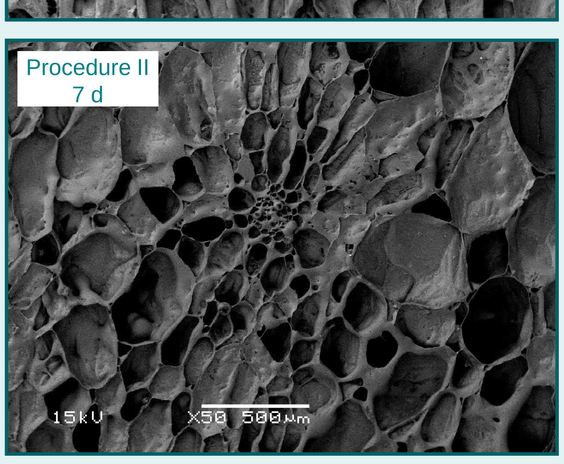


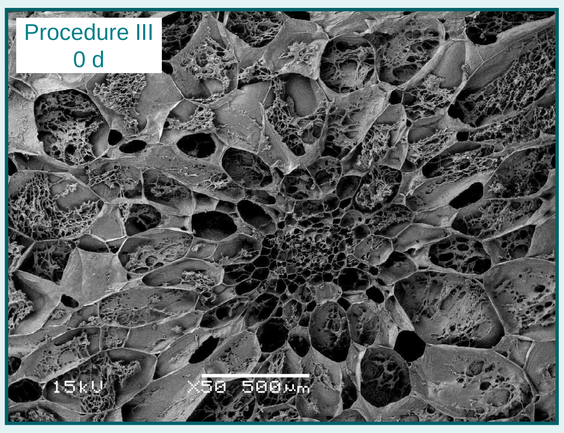
Scanning electron micrographs of fresh-cut red bell pepper, according to different preparation procedures and storage time:

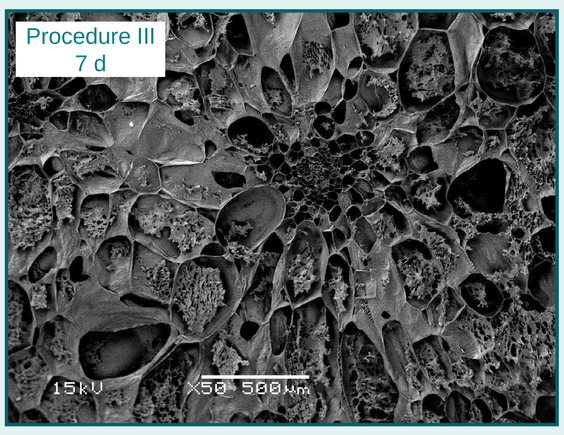




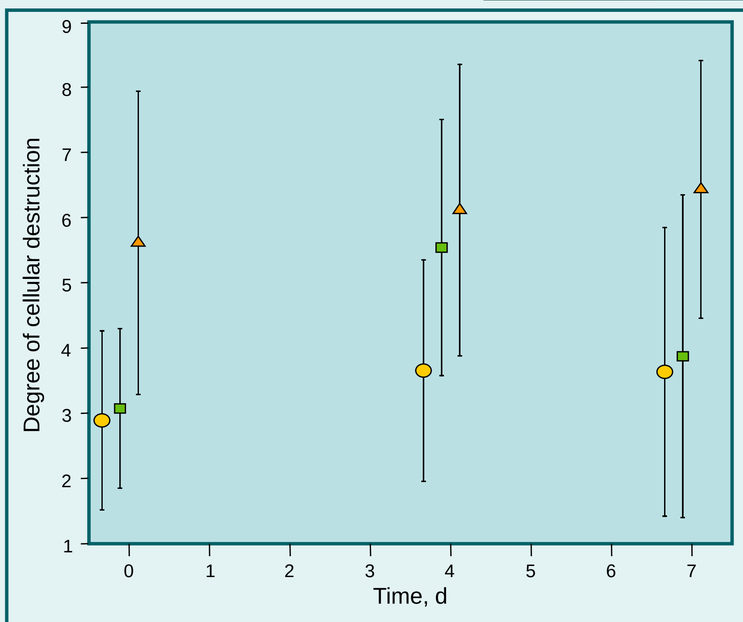








Results



Degree of cellular destruction of red bell pepper over time under refrigerated storage (average±standard deviation), according to different preparation procedures:
(●) procedure I; (■) procedure II; and (▲) procedure III.

- Apparent differences were observed between preparation procedures; in Procedure III, a dendritic structure appeared during ice microcrystal formation inside the cells.
- Differences in microstructural effects associated with time of storage after cutting were also observed; samples cut and stored for 7 d showed a great degree of cell decompartmentation and collapse, reflected by poor definition of cell walls — as compared with samples taken just after cutting.
- Statistical analysis of experimental data generated by the panel pertaining to SEM images indicated that there are microstructural differences between pepper samples from the distinct preparation procedures ($p=0.001$) and time after cutting under refrigerated storage ($p=0.001$); however, the interaction between these two factors was not statistically significant ($p=0.051$). Frozen samples presented higher cellular destruction than via the other two procedures, and no statistical significant differences were observed between these two. Red bell pepper samples stored for 4 and 7 d presented (as expected) higher degree of cellular destruction than their initial sample counterpart.

Conclusions

- SEM was successfully applied in the microstructural study of fresh-cut red bell pepper; it provided a clear viewing of microstructural changes over time after cutting, under refrigerated storage. Red bell pepper samples stored for 4 and 7 d presented (as expected) higher degree of cellular destruction than samples at 0 d. Samples for SEM prepared via freeze-drying produced better quality images than frozen samples.
- The methodology applied, which was based on panel evaluation of SEM images, proved a valuable tool to obtain quantitative parameters.
- This work allowed optimization of preparation procedures of sample, and development of successful methodology for quantitative image analysis – which will eventually permit application to related work in other food matrices.

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