The effect of temperature and exogenous ethylene on the ripening of ‘Rocha’ pear pretreated with 1-MCP

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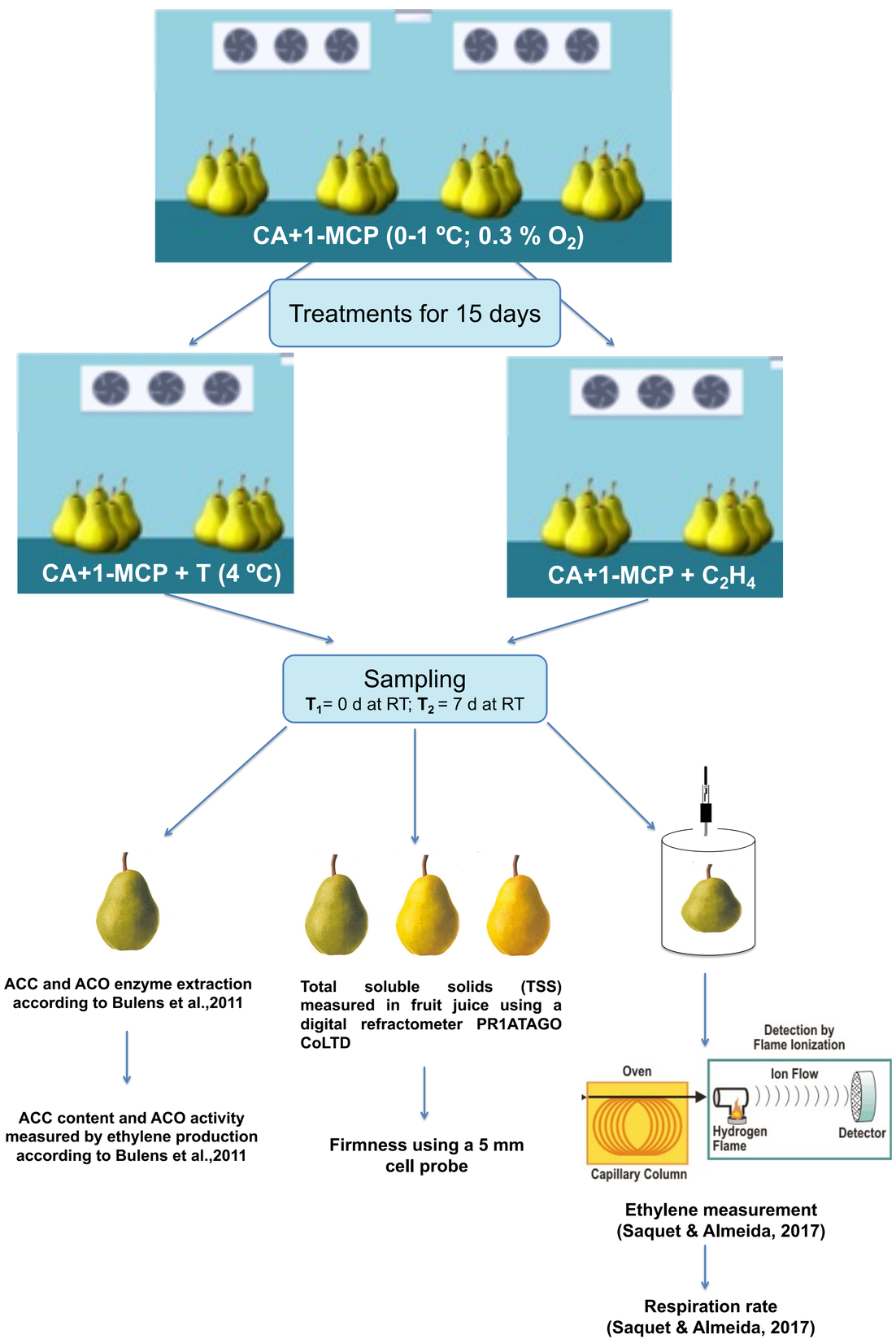
Introduction

Fruit are vulnerable to several postharvest losses due to their production seasonality, growing conditions, perishability, unpredictable ripening, and postharvest disorders [1]. For about forty years, the postharvest application of diphenylamine was an efficient strategy to protect fruit from postharvest problems. However, in 2011 its use was no longer allowed in the European Union. Currently, in combination with cold storage, 1-methylcyclopropene (1-MCP) is used as an alternative to prolong the self-life of fruit [2]. However, the pear fruit (*Pyrus communis* L.) industry sector is facing a problem resulting from 1-MCP´s application which compromises producers’ sustainability, because 1-MCP causes problems in the normal ripening, affecting the eating quality and increasing postharvest losses [3,4].
‘Rocha’ pear (*Pyrus communis* L. cv. Rocha) is a DOP cultivar, from West region of Portugal quite appreciated worldwide due to its exceptional organoleptic and nutritional quality. It´s high exportation has raised the need to develop adequate conditions for long-term cold storage and due to 1-MCP application sector is facing some significant losses.
This study was designed to assess whether a storage temperature (T) of 4 ºC (higher than the current recommendations of -1 to 0 ºC) or the application of exogenous ethylene (C_2H_4), could restore the post-storage ripening of ‘Rocha’ pear treated with 1-MCP, while preserving the fruits from physiological disorders.

Methods



Results

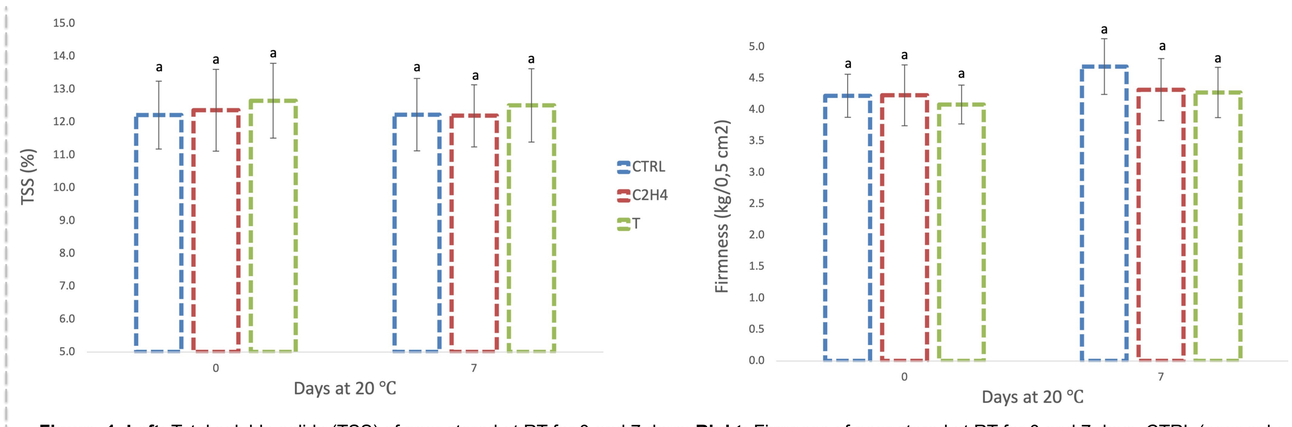


Figure. 1. **Left:** Total soluble solids (TSS) of pear stored at RT for 0 and 7 days; **Right:** Firmness of pear stored at RT for 0 and 7 days. CTRL (pear only treated with 1-MCP); C_2H_4 (pears treated with ethylene after 1-MCP application); T (pears treated with temperature after 1-MCP application). Values are means ± standard deviation of 20 determinations. Different small letters indicate significant differences at p<0.05 calculated by LSD test at each time-point.

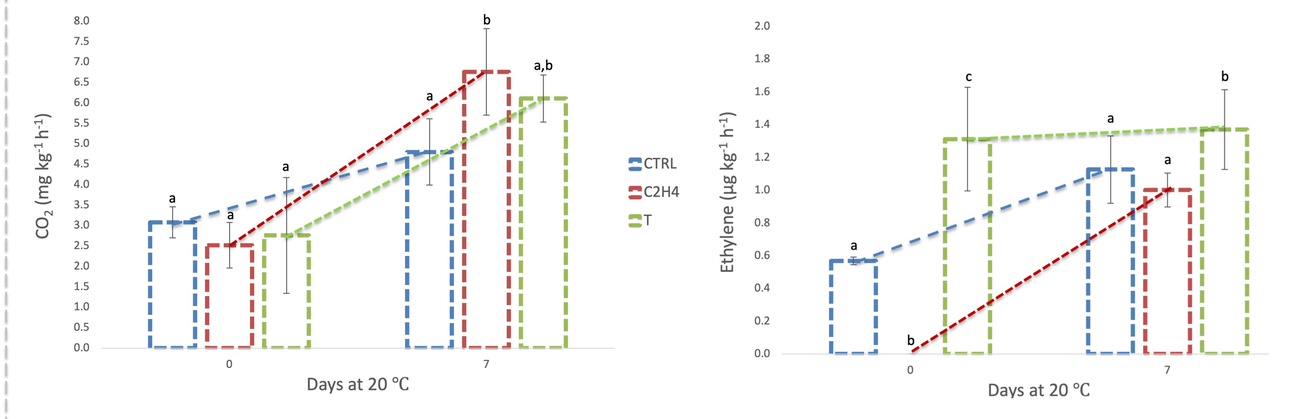


Figure. 2. **Left:** Respiration rate of pear stored at RT for 0 and 7 days. **Right:** Ethylene production of pear stored at RT for 0 and 7 days. CTRL (pear only treated with 1-MCP); C_2H_4 (pears treated with ethylene after 1-MCP application); T (pears treated with temperature after 1-MCP application). Values are means ± standard deviation of 6 determinations. Different small letters indicate significant differences at p<0.05 calculated by LSD test at each time-point.

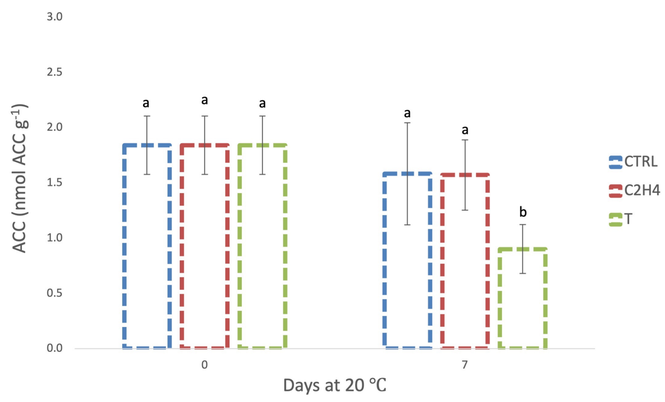


Figure. 3. ACC level of pear stored at RT for 0 and 7 days. CTRL (pear only treated with 1-MCP); C_2H_4 (pears treated with ethylene after 1-MCP application); T (pears treated with temperature after 1-MCP application). Values are means ± standard deviation of 4 determinations. Different small letters indicate significant differences at p<0.05 calculated by LSD test at each time-point.

Conclusions

- An overall impact on ripening promoted by C_2H_4 and T is observed, especially on respiration rate and ethylene production. Comparing to CTRL it can be concluded the ripening blockage prompted by 1-MCP, since a higher increase of CO_2 and ethylene production due to C_2H_4 and T treatments post-1-MCP is observed.
- Exogenous treatment with C_2H_4 effectively prompted the production of ethylene and respiration. However, the higher metabolic activity is not reflected on firmness loss and increase of TSS, since no significant changes were observed.
- Increasing storage temperature to 4 ºC also induced the respiration of pear compared to control, but it did not promote an increase on ethylene production.
- The results obtained regarding ACC content are in accordance with the ethylene production in each condition, since this amino acid is the substrate for ACC oxidase to produce ethylene. The lower ACC level observed after 7 days at room temperature in CTRL and C_2H_4 can be related with the higher ethylene production. On the other hand, the significant decrease of ACC observed in pear treated with T could also explain the non increase on ethylene production. ACC oxidase activity was measured and detected, but it was under the limit of quantification.
- The results provide information regarding how blockage caused by 1-MCP may be overcome and ethylene sensitivity can be regulated, thus opening avenues for consistent ripening of ‘Rocha’ pear and other cultivars, therefore reducing postharvest losses.

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Acknowledgements
This work was co-supported by the European Fund for the Regional Development (FEDER), through the Internationalization and Competitiveness Operational Program (POCI), within the project: RE-EAT ROCHA PEAR (POCI-01-0247-FEDER-040016). We would also like to thank the scientific collaboration under the FCT project UIDB/50016/202 and FCT individual PhD grant (SFRH/BD/143560/2019)