Assessment of calcium content in pear fruits under storage after $CaCl_2$ applications during pre and post-harvest phases

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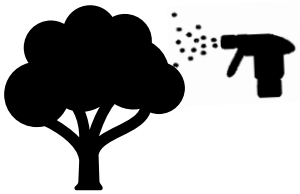

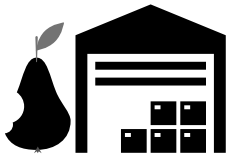

Food sector

- Feed a growing population
- Limitations: climate change, and land and hydric resources
- Perishabel fruits

Pre-Harvest

Foliar sprays

T1 = 4 kg.ha^{-1} $CaCl_2$;

T2 = 4 -8 kg.ha^{-1} $CaCl_2$;

Post-Harvest

Immersion

1.3% $CaCl_2$, during 10 minutes at room temperature

Analysis

- Ca content in fruits
- Total soluble solids
- Acidity
- Hardness
- Colorimetric parameters of pulp

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Abstract: Post-harvest systems are crucial for fruit conservation since it minimizes the waste of such perishable food and allows its marketability to consumers during the year. This study thus aims to assess calcium values in stored fruits, previously sprayed and/or immersed in $CaCl_2$, and possible implications on quality. Fruits previously sprayed with different concentrations of calcium chloride (0 – 8 $kg.ha^{-1}$ $CaCl_2$) during the productive cycle (pre-harvest phase) were separated into two groups at harvest. One was immediately stored in conservation chambers, while the second group was immersed in 1.3% $CaCl_2$ (for 10 minutes at room temperature) in the post-harvest stage. After 4 months of storage, calcium content was evaluated with X-Ray fluorescence analysis and quality parameters, such as total soluble solids, malic acid, hardness, and colorimetric parameters of pulp were also monitored. Overall, calcium content in stored fruits with post-harvest bath were superior, but fruits with the exclusive application of $CaCl_2$ during the pre-harvest phase were superior to the respective control. Furthermore, treatment T2 (corresponding to the highest concentration of $CaCl_2$ during pre-harvest, up to 8 $kg.ha^{-1}$) presented the lowest total soluble solids values. The highest value of malic acid prevailed in fruits with no application of $CaCl_2$ while it also presented the lowest value of hardness. No significant differences were observed for colorimetric parameters of pulps. In conclusion, the pre-harvest workflow used for this study in-creased calcium content in fruits at harvest, but post-harvest immersion can be used in complementation to pre-harvest treatments to avoid fruit quality decay. Calcium applications did not compromise its marketability to consumers.

Keywords: Calcium; Pear storage; Pre-harvest and post-harvest calcium treatments; Quality parameters

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Introduction

In meads of hydric and land resource limitations, and climate changes, minimizing food loss and waste could decrease the demand for production increases (FAO, 2016; FAO, 2017).

Due to its perishability, fruit preservation methods become important to avoid the loss of quality characteristics (Shewfelt et al., 2014). In plants, calcium acts as an intracellular messenger or performs structural roles, making it an important nutrient for fruit quality (Thor, 2019; Bonomelli et al., 2020). Rocha pear (*Pyrus communis*) is the main pear variety grown in Portugal (ANP, 2021).

For this study, Ca content in Rocha pear fruits sprayed with $CaCl_2$ in the pre-harvest phase, and/or immersed in $CaCl_2$ at post-harvest was assessed after 4 months of storage under controlled atmosphere. Monitorization of quality parameters such as total soluble solids, acidity, hardness, and color of pulp, was also performed.

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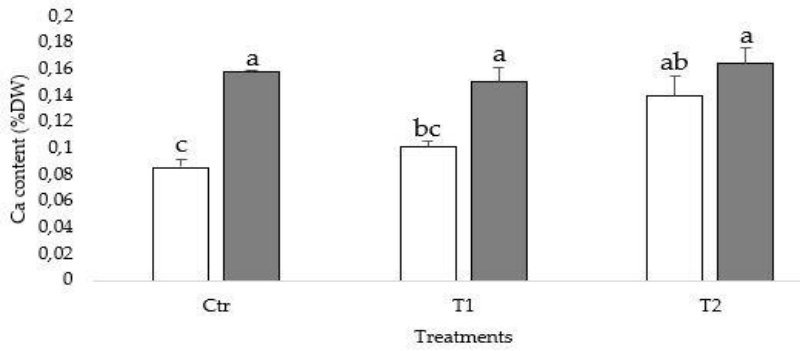
Results and Discussion

- Calcium content in fruits immersed in $CaCl_2$, were superior to the ones of fruits with pre-harvest applications. Furthermore, when considering only fruits without post-harvest applications, T2 was significantly different from the control.
- Fruits flavor is related to TSS and acidity (Soares, 2015). TSS is classified has a fingerprint marker for this variety (stored for 5 months under controlled atmosphere), with values ranging between 10.0 – 13.8 °Brix (Pedro et al., 2020), in which our values are comprehended. For acidity, even though there was a slight decrease in values in comparison to Ctr, the general absence of significant differences suggests that Ca does not influence this parameter. These results confirm that Ca applications during pre or post-harvest phases influence hardness of Rocha pear fruits, due to its structural role in cell wall properties (Hocking et al., 2016).
- The absence of differences in colorimetric parameters indicates that Ca treatments did not affect the color of pulps, confirming the absence of damages in pulp.



Treatments	Total Soluble Solids (°Brix)	Malic Acid (g/L)	Hardness (kg)
Ctr	11.3 ± 0.2 a	1.09 ± 0.09 a	5.44 ± 0.06 c
T1	10.3 ± 0.2 bc	0.80 ± 0.03 b	5.77 ± 0.06 ab
T2	10.1 ± 0.1 c	0.90 ± 0.04 ab	5.51 ± 0.04 bc
I-Ctr	11.1 ± 0.3 ab	0.92 ± 0.02 ab	5.60 ± 0.06 abc
I-T1	11.3 ± 0.1a	0.92 ± 0.03 ab	5.81 ± 0.08 a
I-T2	10.7 ± 0.2 abc	0.89 ± 0.03 ab	5.54 ± 0.06 bc

Treatments	L	a*	b*
Ctr	76.3 ± 2.1 a	-5.4 ± 0.6 a	20.1 ± 1.5 a
T1	78.0 ± 0.6 a	-5.9 ± 0.4 a	20.6 ± 1.5 a
T2	79.8 ± 1.1 a	-6.8 ± 0.1 a	18.8 ± 0.4 a
I-Ctr	79.5 ± 0.3 a	-6.4 ± 0.3 a	19.8 ± 1.0 a
I-T1	78.2 ± 0.4 a	-6.1 ± 0.1 a	19.8 ± 0.5 a
I-T2	79.3 ± 0.2 a	-6.0 ± 0.1 a	18.8 ± 0.3 a

Conclusions

The application of $CaCl_2$ during pre-harvest led to Ca content increases in fruits, further enhanced by immersion in $CaCl_2$. Quality parameters of fruits were not negatively impacted by $CaCl_2$ concentrations and storage conditions were adequate, preserving their marketability to consumers or further processing into different food products. Calcium structural role was also confirmed with hardness values of Rocha pear fruits increasing with $CaCl_2$ applications during pre and post-harvest phases.

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