Assessing the potential of a sustainable bean leaf extract with abscisic acid in pear ripening restoration

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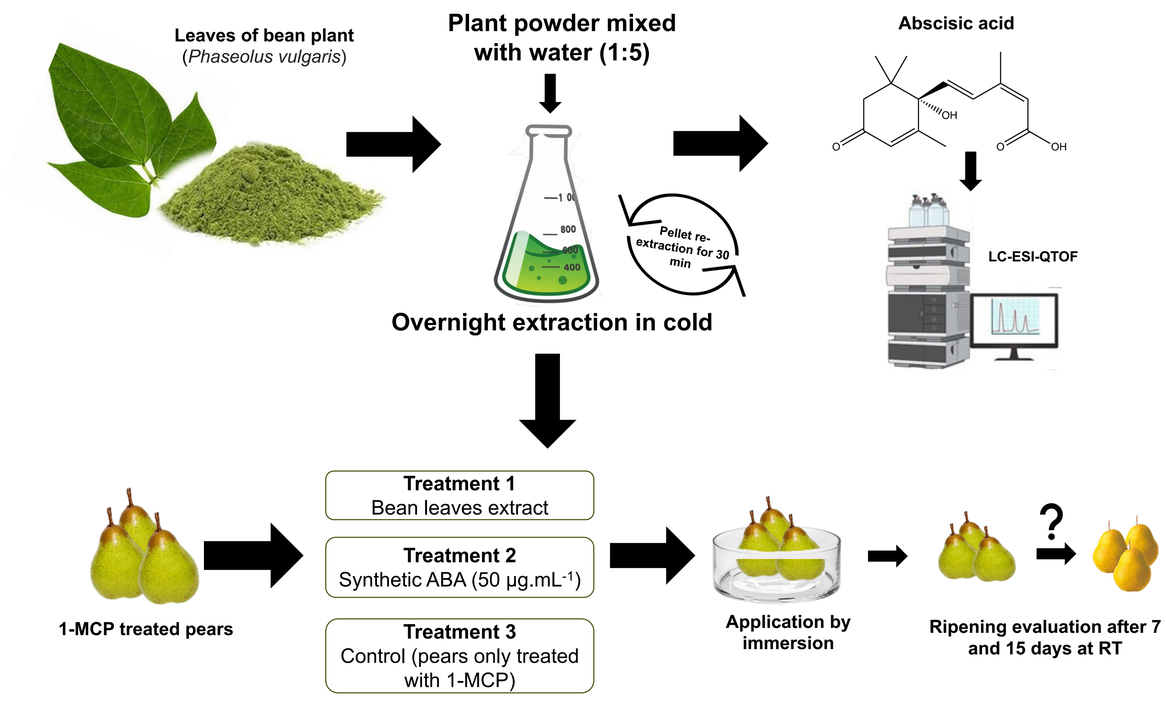
INTRODUCTION

Rocha pear (*Pyrus communis L*. cv Rocha) is a **Portuguese cultivar** stored with **1-MCP in controlled atmosphere** to **extend storage life and prevent postharvest issues[1].** However, **1-MCP obstructs the normal ripening**, impacting pear quality for consumers. Several strategies have been applied to **reboot the ripening** of pear under 1-MCP effect, such as the application of **higher temperatures, exogenous ethylene** or a combination of both[2,3]. However, these treatments demand high energy consumption. Some **phytohormones,** like **abscisic acid (ABA),** have been shown to accelerate **ripening** by stimulating ethylene production, firmness loss, coloring, among other ripening markers [4,5].

OBJECTIVE

In this study, **leaves from bean plants** derived from agri-food wastes were explored to **extract phytohormones** with focus on **ABA**, using a sustainable approach. Further the study aimed to investigate the **potential of this green extract** as a **ripening inducer for pears** under the 1-MCP effect. Time course physiological and biochemical analysis comparison with 'Rocha' pear treated with synthetic ABA was performed.

MATERIALS AND METHODS



RESULTS

Identification and quantification of ABA

Identification

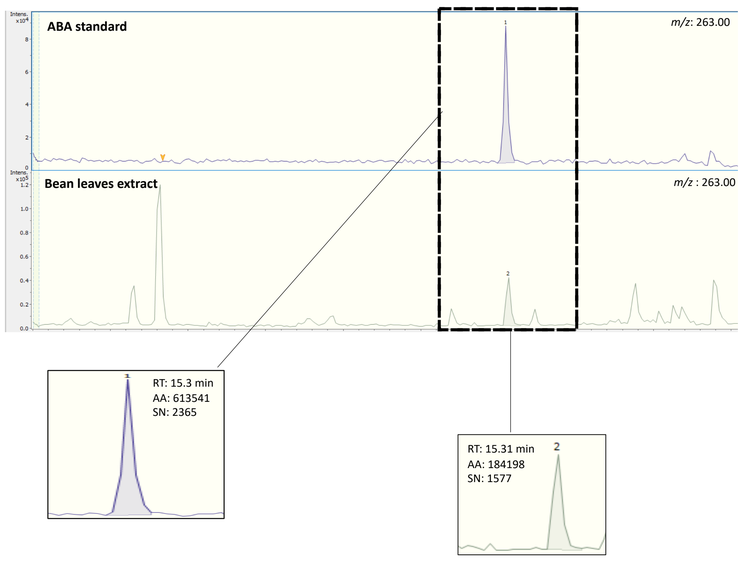


Figure 1. LC-ESI-MS/MS chromatograms of a standard solution of ABA (100 ng.mL^{-1}) (upper chromatogram) and bean leaves extract (lower chromatogram).

Quantification

Table 1. Calibration curve and other quantitative data for ABA quantification.

Calibration curve[a]	Range (ng.mL^{-1})	Correlation coefficient
y=0.005x + 0.0211	50-500	0.9932

[a] y: peak area ratio of standard and internal standard (ABA d_6 was used as internal standard)

Table 2. Analytical results of ABA in bean leaves extract samples. Values are mean ± standard deviation of 3 replicates.

Retention time (min)	Concentration (ng.g_{FW})	Recovery (%)
15.31 ± 0.01	8.01 ± 0.1	77

Biochemical data

Respiration

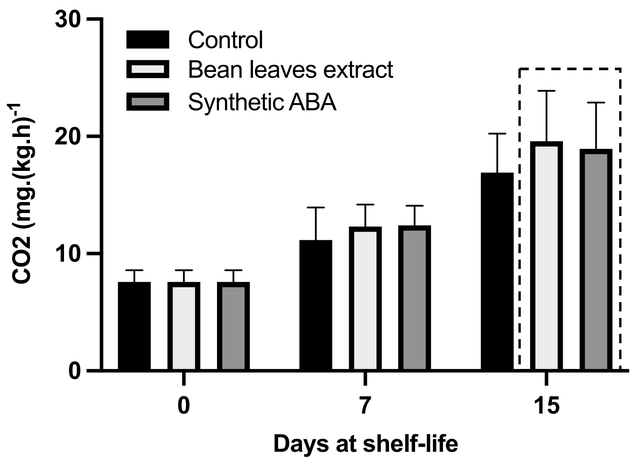


Figure 2. Respiration rate variation of 'Rocha' pear after treatments during shelf-life at 20 °C. Values are means ± standard deviation of 6 biological replicates.

Ethylene

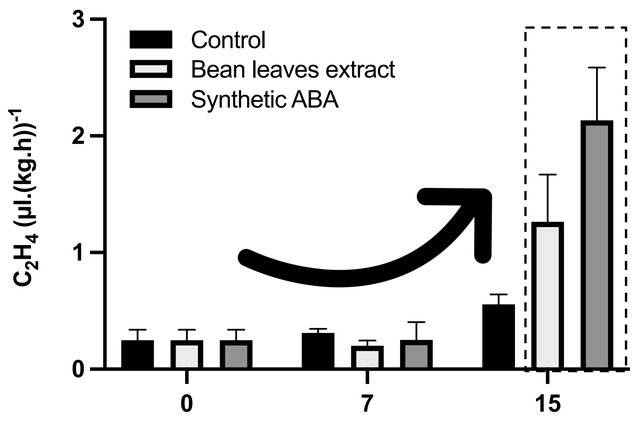


Figure 3. Ethylene production variation of 'Rocha' pear after treatments during shelf-life at 20 °C. Values are means ± standard deviation of 6 biological replicates.

Physiological data

Table 3. Soluble solids content (SSC) (%) variation of 'Rocha' pear after treatments during shelf-life at 20 °C. Values are means ± standard deviation of 6 biological replicates

Days at shelf-life	Control	Bean leaves extract	Synthetic ABA
0	13.92 ± 0.42	13.92 ± 0.42	13.92 ± 0.42
7	14.52 ± 1.39	13.70 ± 0.88	14.17 ± 1.22
15	15.04 ± 1.40	15.32 ± 1.27	14.2 ± 1.11

Table 4. Hue angle variation of 'Rocha' pear after treatments during shelf-life at 20 °C. Values are means ± standard deviation of 6 biological replicates

Days at shelf-life	Control	Bean leaves extract	Synthetic ABA
0	100.36 ± 21.85	100.36 ± 21.85	100.36 ± 21.85
7	95.23 ± 5.52	94.14 ± 6.93	95.04 ± 4.87
15	85.18 ± 6.87	79.41 ± 6.45	81.80 ± 5.33

Firmness

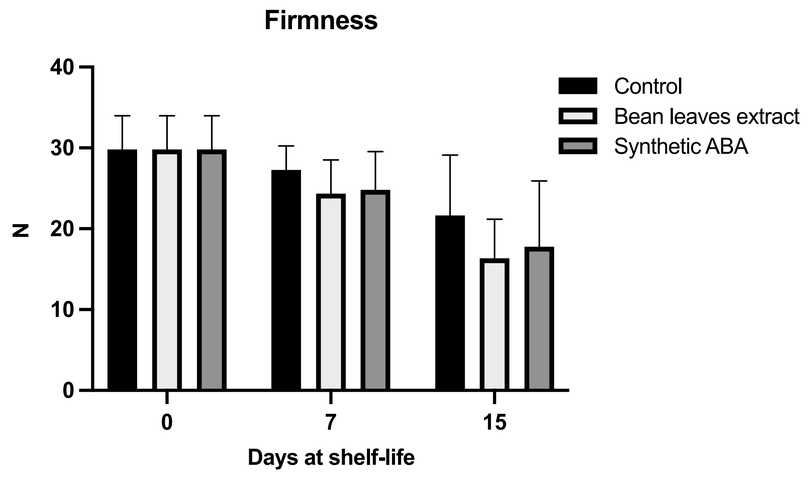


Figure 4. Firmness variation of 'Rocha' pear after treatments during shelf-life at 20 °C. Values are means ± standard deviation of 6 biological replicates.

CONCLUSIONS

- The extraction approach developed in this study **extracted ABA from bean leaves** using **only water under cold conditions**. This suggests a **sustainable approach** by repurposing agricultural by-products;
- **Bean leaves extract and synthetic ABA treatment** of pears, under the influence of 1-MCP, resulted in **increased respiration** and **ethylene production** after 15 days. This was accompanied by **higher SSC**, **color and firmness loss** suggesting that ABA may be inducing the ripening process;
- Evaluating natural and synthetic ABA on pear ripening is essential to determine the effectiveness of the natural source relative to the conventional synthetic version. Despite lower ABA concentration in the natural extract, **similar responses to synthetic ABA** suggest the **involvement of not only ABA but other bioactive compounds**;
- The results of this study could have implications for the development of **eco-friendly and sustainable practices in agri-food waste utilization and fruit post-harvest management**.

References

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