The role of *Opuntia ficus-indica* in mitigating climate change impacts on vineyards: a physiological and molecular approach

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Introduction

Grapevine (*Vitis vinifera* L.) is one of the most widely cultivated plant species due to its role in wine industry. Production loss in vineyards is partly due to the high radiation levels associated with extreme temperatures. To mitigate this problem, various approaches have been adopted to enhance plant resilience, such as the application of natural substances. These substances, which may be compounds, microorganisms, or a combination of both, improve plant tolerance to environmental stresses, enhance nutrient uptake, and promote growth, without being classified as pesticides or fertilizers.

In particular, the use of natural substances derived from cactus species has shown promising results in increasing crop tolerance to both biotic and abiotic stresses.

The main objective of this study is to explore the potential of *Opuntia ficus-indica* extract to protect grapevine plants against high temperatures by investigating plant response at physiological and biochemical levels.

Methodology

Preparation of *O.ficus-indica* cladodes extract.

Extract application by foliar spraying and acclimatization of grapevine plants (cv. 'Aragonês') in a growth chamber, with a gradual increase in temperature up to 42°C.

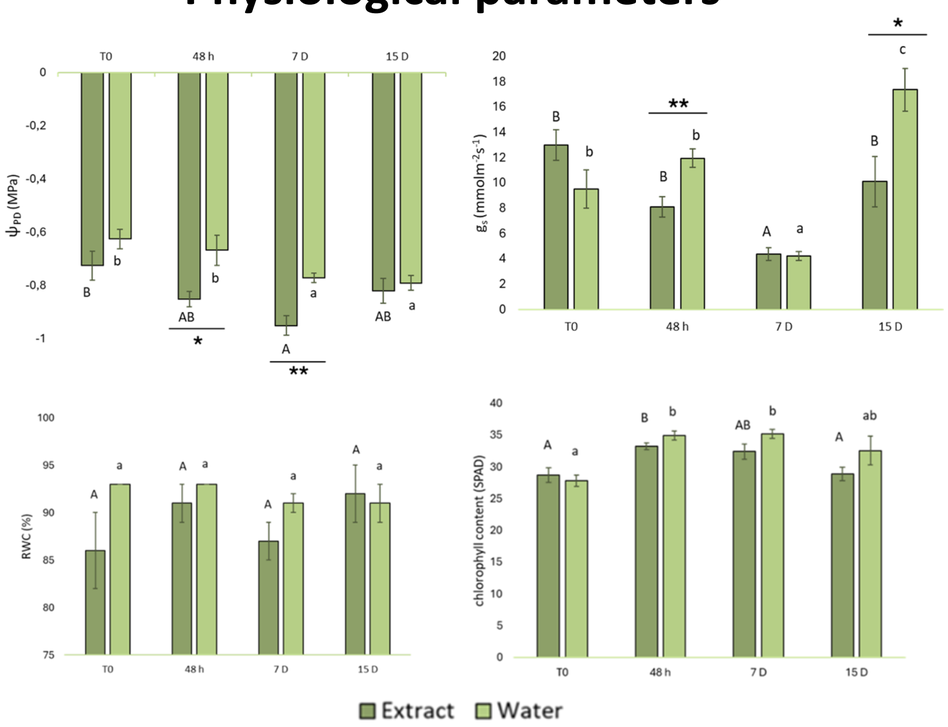
Measurement of physiological parameters before extract application and 48 hours, 7 days, and 15 days after the treatments.

Analysis of the whole proteome in grapevine leaves through **two-dimensional electrophoresis (2-DE)**.

Protein spots identified by Mass Spectrometry.

Results

Physiological parameters



- Different capital letters means significant differences among time points for plants sprayed with *O. ficus-indica* extract;
- Different small letters indicate significant differences among time points for plants sprayed with water.
- * Indicate significant differences among plants sprayed with extract and water for $p < 0.05$ or $p < 0.01$ (**).

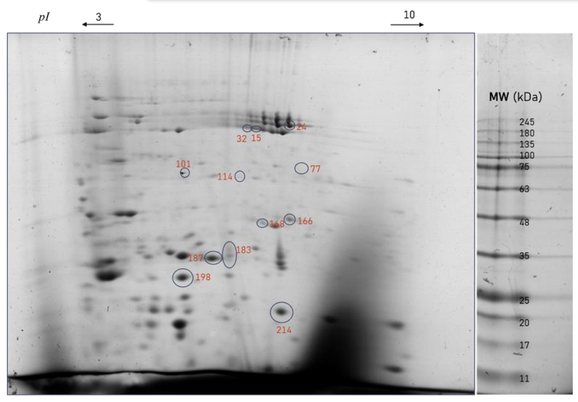
A significant decrease in water potential (ψ_{PD}) and stomatal conductance (g_s) was observed in plants sprayed with *O.ficus-indica* extract, compared to plants sprayed with water.

The *O. ficus-indica* extract is rich in bioactive compounds, such as antioxidants, phenolic compounds, and mucilage, which can provide protection against oxidative stress while promoting water retention.

- **Extract of *O. ficus-indica* impacted vines physiological preformence**
- **This study could uncover innovative solutions for protecting grapevines while supporting sustainable agricultural practices.**

Protein profile

144 protein spots were considered for analysis.



Representative 2-DE profile of *V. vinifera* leaf.

Circles represent the spots differentially expressed among plants sprayed with *O. ficus-indica* extract and water.

12 spots were identified as differentially expressed between plants sprayed with *O. ficus-indica* extract and water.

MW – molecular weight (kDa);
pI – isoelectric point.

Protein spots identified by MALDI-TOF/TOF MS

Spot	Protein	Theoretical MW (kDa)	Theoretical pI	*O. ficus-indica* extract pulverization	water pulverization
24	α-Amy 1A	58.4	9.25	↓	↑
166	RBC (large chain)	22.3	8.33	↓	↑
168	RBC small subunit, chloroplastic	20.7	9.11	↓	↑
187	RBC (large chain)	29.5	9.18	↑	↓
198	RBC (large chain)	21.2	6.23	↓	↑
214	HSP18.1	18.1	6.78	↑	↓

RBC - Ribulose bisphosphate carboxylase
HSP - Heat Shock Protein

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