

RESPONSE SURFACE METHODOLOGY FOR NATURAL ANTIOXIDANTS RECOVERY FROM *PYROPIA COLUMBINA* SEAWEED USING PRESSURIZED LIQUID EXTRACTION

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INTRODUCTION

Pyropia columbina is a red seaweed prominent in the Patagonia region in Argentina. It contains proteins, fiber, vitamins, minerals, and relatively low lipid content. Sea weeds have been studied due to their content of phenolic compounds, which can be harnessed as antioxidants. Different extraction methods can be used for this purpose, among which pressurized liquid extraction (PLE) stands out as a greener option.



Figure 1. Dried *Pyropia columbina*.

OBJECTIVE

The aim of this study was to determine the optimal extraction conditions through PLE using ethanol–water mixtures for seaweed *Pyropia columbina*, with a focus on its antioxidant activity.

METHODOLOGY

Extraction was performed at varying ethanol concentrations (50–100%) and temperatures (100–140°C). Extraction yield (%/g), total phenolic content (TPC) using the Folin–Ciocalteu method (mg GAE/g) and radical scavenging activity via the ABTS assay ($\mu\text{Mol TE/g}$) were determined. Optimal conditions were assessed through the application of Response Surface Methodology (RSM) using the software Design Expert (DE) v12.

RESULTS

Extraction yield varied across conditions, ranging from 4.3% (100% EtOH, 100°C) to 70.9% (50% EtOH, 140°C). The extraction yield was maximized at higher temperatures and with the lowest ethanol content (50%) in the solvent mixture.

Regarding **TPC** and **ABTS**, 100% Ethanol at 140°C was the sample with the highest values (20.25 ± 1.33 mg GAE/g and 151.55 ± 5.24 $\mu\text{Mol TE/g}$) ($\alpha=0.05$).

Optimal conditions were 94% Ethanol at 140°C for TPC (0.98 desirability) and 73% at 140°C for TE (0.94 desirability). To optimize both parameters, final conditions were set at 83.5% EtOH and 140°C. A new extract with 41.8% yield, 18.24 ± 1.79 mg GAE/g, and 141.21 ± 6.97 $\mu\text{Mol TE/g}$ was obtained.

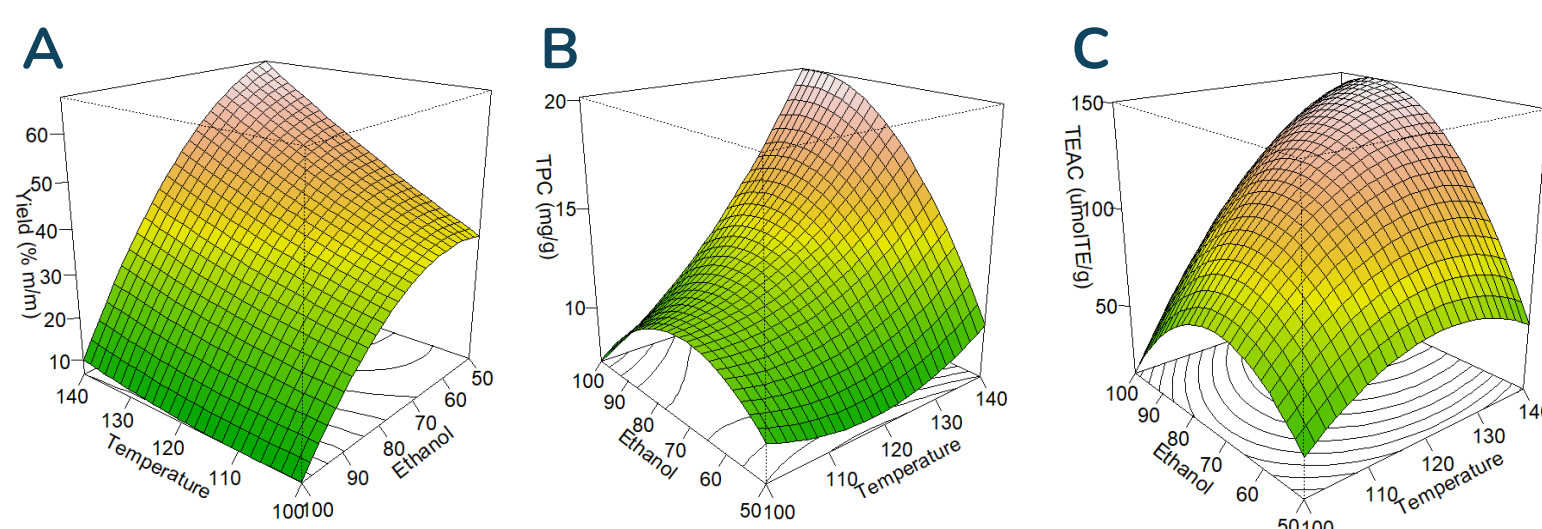


Figure 2. Response surface for yield (A), TPC (B) and TEAC (C), according to temperature and ethanol values.

CONCLUSION

Model validation confirmed the predicted values supporting **optimal conditions at 83,5% EtOH and 140°C** for antioxidant extraction from *Pyropia columbina* via PLE, with satisfactory yield.

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