# RED RASPBERRY WASTE AS A SOURCE OF ANTHOCYANIN-RICH FOOD COLORANTS: EXTRACTION PROCESS OPTIMIZATION AND FUNCTIONALITY ASSESSMENT

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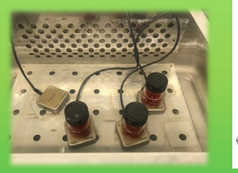
## INTRODUCTION

Food colorants are increasingly used in the food industry to preserve, improve or change the food color. While the quite controversial artificial colorants are widely used in this sector, the natural counterparts have been less selected in part due to the limited availability of options and stability issues [1]. Within this class, anthocyanins are naturally occurring colorants that can be found in different plant matrices, including berries such as red raspberry (*Rubus idaeus* L.). These water-soluble pigments show attractive colors ranging from red to purple and present health-promoting effects [2,3]. Therefore, this work aimed to develop a novel anthocyanin-rich food colorant from red raspberry waste through the optimization of a sustainable extraction methodology and to characterize this ingredient for its functionality.

## METHODOLOGY

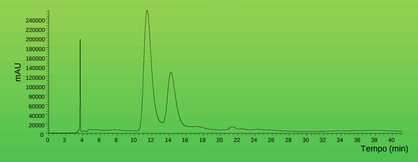
Heat (HAE)- and ultrasound (UAE)-assisted extraction methods were implemented to recover the anthocyanins from red raspberry. Processing time, ethanol concentration, and temperature or ultrasonic power were the independent variables analyzed in a central composite design (CCD) coupled with response surface methodology (RSM) for processes optimization. The extraction yield and levels of anthocyanins (cyanidin-3-*O*-sophoroside and cyanidin-3-*O*-glucoside) were monitored gravimetrically and by HPLC-DAD-ESI/$MS^n$, respectively, and used as response criteria. The constructed theoretical models were successfully fitted to the experimental data and used to determine the optimal extraction conditions. Extracts obtained in optimal conditions were used to evaluate antioxidant and antimicrobial activities.



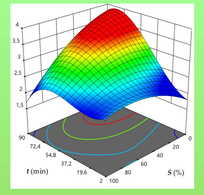
HAE

UAE

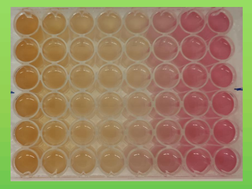
Obtention of anthocyanin-rich extracts under the 20 runs of the five-level CCD design




Quantification of anthocyanins by HPLC-DAD-ESI/$MS^n$ as response criteria




Obtention of optimal conditions by RSM

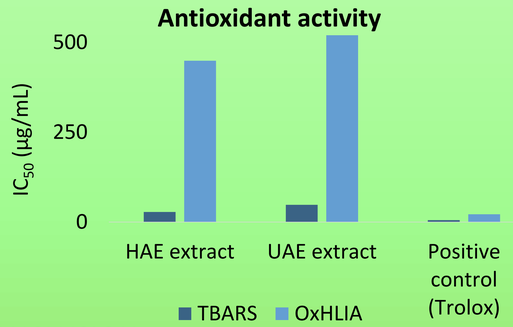


Bioactivity evaluation of the optimal extracts

## RESULTS and DISCUSSION

Overall, HAE originated slightly higher response values (61% extract weight and 8.7 mg anthocyanins/g extract) but needed 76 min processing at 38 °C, with 21% ethanol, while the UAE process required 16 min sonication at 466 W, using 38% ethanol, to obtain 58% extract weight and 8.3 mg anthocyanins/g extract. Then, the predictive models were experimentally validated and the purple-red extracts obtained under optimal condition showed antioxidant activity through lipid peroxidation (TBARS) and oxidative hemolysis inhibition (OxHLIA), and antibacterial effects against food-related bacteria, such as *Escherichia coli* and *Enterococcus faecalis* [4]

| | Optimal conditions | | | | | |
|---|---|---|---|---|---|---|
| | Independent variables | | | | Responses | |
| | Time (min) | Ethanol (%) | Temperature (°C) | Power (W) | Extraction yeld (%) | Anthocyanin content (mg/g) |
| **HAE** | 76 | 21 | 38 | - | 61 | 8.7 |
| **UAE** | 16 | 38 | - | 466 | 58 | 8.3 |




**Antibacterial ctivity against:**

*E. coli*
*E. faecalis*

## CONCLUSION

These results could be exploited by industries interested in the production of anthocyanin-based ingredients with coloring and bioactive capacity. In future studies, it will be interesting to investigate the stability of the developed anthocyanin-rich extracts when exposed to different factors and in real food matrices. The production of spray-dried red raspberry coloring powders will also be interesting to explore.

## REFERENCES

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[3] J. He, M.M. Giusti, M.M. Annu. Rev. Food Sci. Technol. 1 (2010) 163.
[4] R. Rocha, J. Pinela, R. Abreu, et al., Processes, 8 (2020) 1447.

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