ACIDIFIED WATER AS A GREEN SOLVENT FOR ULTRASOUND-ASSISTED EXTRACTION OF ANTHOCYANINS FROM GRAPE POMACE

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ABSTRACT

This study presented the ultrasound-assisted extraction (UAE) of anthocyanins from grape pomace with acidified water as the solvent. The pomace was oven-dried (OD) and freeze-dried (FD) before the extraction. The effects of ultrasound parameters - power density (8.3 - 16.7 W/mL), pulse interval (0 – 2 s), and extraction time (1 - 5 min) - on the dependent variables total phenolics and total anthocyanins. The results showed that UAE improved the amount of extracted anthocyanins, and the acidified water can be used as a green solvent, replacing organic solvents usually employed in extracting bioactive compounds from food industry waste.

Keywords: acidified water, green solvents, food waste management.

1 INTRODUCTION

Anthocyanins are a group of water-soluble pigments that impart blue, purple, and red color to many flowers, fruits, and vegetables [1]. Beyond their function as colorants, the pigment also presents many health-promoting benefits, including antioxidant and anti-inflammatory effects and prevention of chronic diseases such as diabetes, obesity, and cancer [2,3]. The properties associated with anthocyanins have garnered attention in recent years, leading several studies to focus on the extraction of these bioactive compounds for further applications as substitutes for synthetic additives for both colorant and pharmacological purposes [4,5].

Grape pomace stands out as a great source of anthocyanins, as it has a high content of phenolic compounds resulting from incomplete extraction during winemaking. Additionally, its use promotes the valorization of industrial waste from wineries [6,7]. The grape variety *Vitis labrusca,* widely cultivated in Brazil and used for juice and wine production, presents high antioxidant potential compared to other grape varieties due to its high content of bioactive compounds [8].

The extraction of anthocyanins from grape pomace has some challenges that must be overcome, mainly due to the low stability of the pigment, which depends on several parameters, such as extraction technology, solvent type, and pH of the media [9]. Anthocyanins are a group of water-soluble pigments that impart blue, purple, and red color to many flowers, fruits, and vegetables [1]. Beyond their function as colorants, the pigment also presents many health-promoting benefits, including antioxidant and anti-inflammatory effects and prevention of chronic diseases such as diabetes, obesity, and cancer [2,3]. The properties associated with anthocyanins have garnered attention in recent years, leading several studies to focus on the extraction of these bioactive compounds for further applications as substitutes for synthetic additives for both colorant and pharmacological purposes [4,5].

2 MATERIAL & METHODS

Grano D'oro (*Vitis labrusca*) grape pomace was kindly provided from wineries (Nova Trento, Santa Catarina, Brazil). The seeds and peels were manually separated, and only the peel was used for the extraction. The pomace was dried before the extraction using oven-drying and freeze-drying technologies to improve the stability of the bioactive compounds. 100g of the pomace was dried in a convective air oven (TE-394/1, Tecnal, Brazil) for 5 hours at 60 ºC. Another 100g of the pomace was freeze-dried (X10, LioTop, Brazil) for 24 hours. Then, the dried pomaces were ground in a laboratory mill (A10, IKA, Brazil), vacuum-packed in polyethylene bags, and frozen at –20 ºC until the extraction day. Before the experiments, the grape pomace was thawed at 4 °C.

Extraction was done using 1.5 g of grape pomace mixed with 30 mL of acidified water (pH = 1.5), prepared with hydrochloric acid. The suspension was placed in a jacked glass reactor (internal dimensions: diameter = 45 mm; height = 110 mm) coupled to a thermostatic water bath to maintain the temperature at 25 °C. The extractions were carried out in an ultrasound processor (Eco-sonics®, Brazil), working at a nominal power of 500 W and a maximum effective power density of 0.223 ± 0.014 W/mL, with a 4 mm diameter probe microtip submerged to a 15 mm depth in the sample. The effective power density was measured using the calorimetric method [10]After the extraction, the suspension was centrifuged at 10,000 g for 10 minutes and filtered through Whatman n° 01 filter paper. The extract, free of solids, was stored at –20 °C before analysis.

Total phenolic content was determined using the Folin Ciocalteu method [11] modified by [12]. Monomeric anthocyanin content was assayed by the differential pH method [13].

3 RESULTS & DISCUSSION

UAE was optimized using a CCDR experimental design (data not shown). The total phenolic content in the extracts reached values up to 2.38 (OD) and 4.36 mg/g (FD), which is 59% (OD) and 94% (FD) higher than the maximum content obtained after the static extraction (2.38 and 2.24 mg/g for OD and FD samples, respectively). Regarding monomeric anthocyanin, UAE increased by 32.6% (2.56 mg/g, OD) and 22.3% (2.79 mg/g, FD) the pigment content, compared to the maximum contents reached by static extraction (1.93 and 2.28 mg/g for OD and FD samples, respectively). In 2021, Romanini et al. conducted a study that yielded comparable results. Their research demonstrated that the anthocyanin content in *Vitis vinifera* grapes increased by 21%, from 2.79 to 3.78 mg/g, when subjected to UAE with water for 10 minutes at 25 ºC and using amplitudes of 20 and 40%. This enhancement was observed compared to static extraction methods that did not involve sonication.

4 CONCLUSION

Comparing the drying technologies, in general, FD samples presented slightly higher recovery yields of both total phenolics and anthocyanins ($p < 0.10$) compared to OD samples in the same condition of UAE. The highest content of total phenolics obtained from FD samples was 14.9% higher than that obtained from OD samples (3.79 and 4.36 mg/g for OD and FD samples, respectively). When evaluating anthocyanin content, the highest content obtained from FD samples was only 8.9% greater than that found in OD samples. The effect of ultrasound power on the extraction of this pigment depends on the initial state of the matrix [14].

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ACKNOWLEDGEMENTS

The authors thank the financial support of the Brazilian funding agency CNPq, the National Institute of Science and Technology of Tropical Fruit, and FUNCAP. This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Finance code 001 Brasil (CAPES).