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Aqueous solutions of alkanediols as alternative solvents for emergent extraction processes: a case study using Juçara fruit (Euterpe edulis Martius)

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PURPOSE OF THE ABSTRACT

Juçara (Euterpe edulis Martius) is a tropical palm tree of the Atlantic Forest that produces a spherical purple fruit popularly known as juçara, which has been the focus of scientific research. It is a by-product of the extraction of palm-heart from juçara tree, and is considered a ?superfruit? with a high nutritional value, rich in phenolic compounds such as anthocyanins and phenolic acids [1]. Emergent extraction techniques such as Ultrasound-Assisted Extraction (UAE) combined with biobased solvents have been adopted to overcome limitations such as processing time, temperature levels, and the environmental impact of the solvents employed in conventional extraction techniques. Although alkanediols are well-known industrial biosolvents and have been adopted for many applications [2] they have been so far poorly explored as extractive solvents. In this scenario, this work aimed to study the effect of the alkanediols as extraction biosolvents for the recovery of phenolic compounds from Juçara fruit by Ultrasound-Assisted Extraction (UAE).

Experimentally, Juçara fruit (Euterpe Edulis Martius) pulps were freeze-dried for 48 h to reduce the moisture content from approximately 96% to 4-6%. After UAE was carried out using aqueous solutions of alkanediols, namely 1,2-propanediol, 1,3-butanediol, and 1,6-hexanediol (4, 16, 32% w/w) to perform the extractions. Ethanol/water solvent was used as control. The assays were accomplished in UAE equipment (Branson 450 Digital Sonifier) at 252 W, 50 ºC, for 10 min, in a solid-liquid ratio of 1:20 (w/v). For comparison, the maceration technique was carried out using ethanol/water solvents and pure ethanol and water as control, in the same solid-liquid ratio, in a shaker, at 50ºC, 200 rpm for 24 h in the absence of light. The quality of the extracts was evaluated in terms of monomeric anthocyanin concentration (MAC) and total phenolic compounds (TPC), while the antioxidant activity was found by FRAP and ABTS assays.

The results in terms of MAC, TPC, and antioxidant activity by FRAP and ABTS are summarized in Figure 1. Alkanediols aqueous solutions demonstrated to be as efficient as hydroethanolic ones since alkanediols juçara extracts achieved similar or even higher MAC, TPC, FRAP, and ABTS responses compared to ethanol/water extracts.

Extractions using pure ethanol in UAE reached the lowest anthocyanin and phenolics concentration as well as antioxidant activity. The enhanced performance of the ethanol/aqueous solutions results from a better balance between polarity and the presence of apolar moieties in the organic solvent. Globally, extractions using pure water as solvent showed similar values when compared to aqueous solutions of ethanol, 1,2-propanediol, and 1,3-butanediol, as can be perceived by the dashed blue lines of Figure 1 which is possibly a consequence of the high affinity of anthocyanins with water. Aqueous solutions of 1,6-hexanediol were shown to be the best solvent to produce extracts with high antioxidant activity, extracting a high amount of anthocyanins but presenting the lower

total phenolic content. On the other hand, the juçara's extracts using the aqueous 1,2-propanediol or 1,3-butanediol showed the higher concentration of phenolics and similar antioxidant activity to ethanol/water extracts. The main differences for the balance TPC/MAC and FRAP/ABTS are due to the extraction of other compounds from the juçara matrix, that also exhibit antioxidant capacity. Comparing the results obtained with UAE and maceration, the latter presents TPC values comparable to the UAE extracts. Still, the antioxidant activity, either by FRAP or ABTS, and the anthocyanin concentration were higher for all extracts obtained applying UAE. It is remarkable that even small concentrations of alkanediols (4-16% w/w) are sufficient to obtain extracts by UAE with high concentration of the target compounds and with high antioxidant capacity.

FIGURES

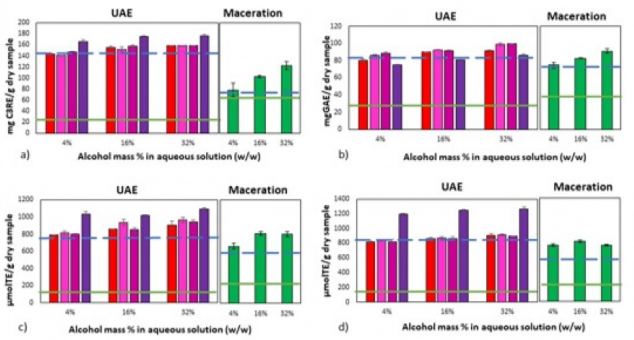

Figure 1. UAE obtained data by a) MAC, b) TPC, c) FRAP and d) ABTS assays for different concentrations of ethanol/water (■), 1,2-propanediol/water (■), 1,3-butanediol/water (■) and 1,6-hexanediol/water (■) mixtures, pure ethanol (—) and pure water (- - -) for control. Equivalent information using maceration method in ethanol/water (■) mixtures, pure ethanol (—) and pure water (- - -) are also included for comparison. Lines are guide for the eyes.

FIGURE 1

Figure 1

FIGURE 2

KEYWORDS

#alkanediols | # juçara'sfruit | #ultrasound-assistedextraction | #biobasedsolvents

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