BIOACTIVE EXTRACTS OBTAINED BY SOLID-STATE FERMENTATION OF AGROINDUSTRIAL RESIDUE FROM MANGABA

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ABSTRACT

The mangaba is widely produced and consumed fruit in the northeast of Brazil that shows high levels of bioactive compounds. Fruit pulp processing industries daily generate large amounts of waste that could be applied in various sectors, such as pharmaceuticals, food and cosmetic industries. In the present work, polyphenolic compounds were extracted from mangaba agroindustrial residue using solid-state fermentation associated with maceration or ultrasound-assisted technique. Fermentations were performed with *Aspergillus carbonarius* fungus and mangaba seed flour at 25°C for 168 hours. After that, the extracts were obtained by maceration with agitation using distilled water or 80% aqueous ethanol solution and by ultrasound assisted using both solvents. The extracts were evaluated for total phenolic compounds, total flavonoids, and antioxidant activity by ABTS, FRAP, and DPPH assays. The higher extraction of total phenolic and total flavonoid was obtained when the ultrasound-assisted technique with 80% ethanol was used. These result meant an increase of 594.28% and 2,659.70% in phenolic and flavonoid content on the flour, respectively, in relation to unfermented flour. The solid-state fermentation associated with ultrasound-assisted showed efficiency to improve the extraction of bioactive compounds from mangaba seed.

Keywords: Fermentation. Extraction. Polyphenolic Compounds. Antioxidant.

1 INTRODUCTION

The mangaba (*Hancornia speciosa Gomes*) is a tropical fruit recognized for the high nutritional value, rich in B-complex vitamins, vitamin C, and high iron content. The fruit's seeds, which constitute 12% of its volume[1], present considerable levels of proteins, lipids, moisture, and total acidity, with potential for use as substrate in fermentation[2].

Mangaba has high content of bioactive compounds, as phenolic compounds that have various biological activities reported *in vitro* and *in vivo*, such as antioxidant, ant-proliferative and antimicrobial activity. However, there are still few studies about the extraction of these compounds in mangaba seeds[3]. Due to the elevated production and consumption of mangaba in Sergipe state[4], a large amount of waste is generated, mainly in fruit pulp industries. Considering the potential the fruit residues as bioactive compounds source, this work aimed evaluated the solid-state fermentation associated with maceration or ultrasound-assisted techniques to extraction polyphenolic compounds from mangaba residue obtained of a pulp fruit industry.

2 MATERIAL & METHODS

The mangaba seed was obtained from fruit pulp processing industry in the city of Aracaju, Sergipe. The seeds were washed with water and immersed in a 200-ppm chlorine solution for 15 min. Subsequently, the seeds were dried in a forced-air oven at 50ºC for 24 h, ground in industrial blender and sieved to obtain the flour. The mangaba seed flour (MSF) was sterilized at 121ºC for 15 min. The fungus *A. carbonarius* (IOC 4612) was acquired from the Oswaldo Cruz Foundation. The strain was activated in YM broth, transferred to potato dextrose agar, and incubated at 30º C for 7 days. The fermentations were performed in Erlemeyers containing 10 g of flour and spore suspension with 10^7 spores/g of flour at 30ºC for 168 h. Every 24 h, the fermented flour was removed to extraction of bioactive compounds. The extractions were as follows: 1) maceration with distilled water; 2) maceration with 80% ethanol solution; 3) ultrasound-assisted with distilled water and 4) ultrasound-assisted with 80% ethanol solution. All extracts were evaluated for total phenolic, total flavonoid and antioxidant activity.

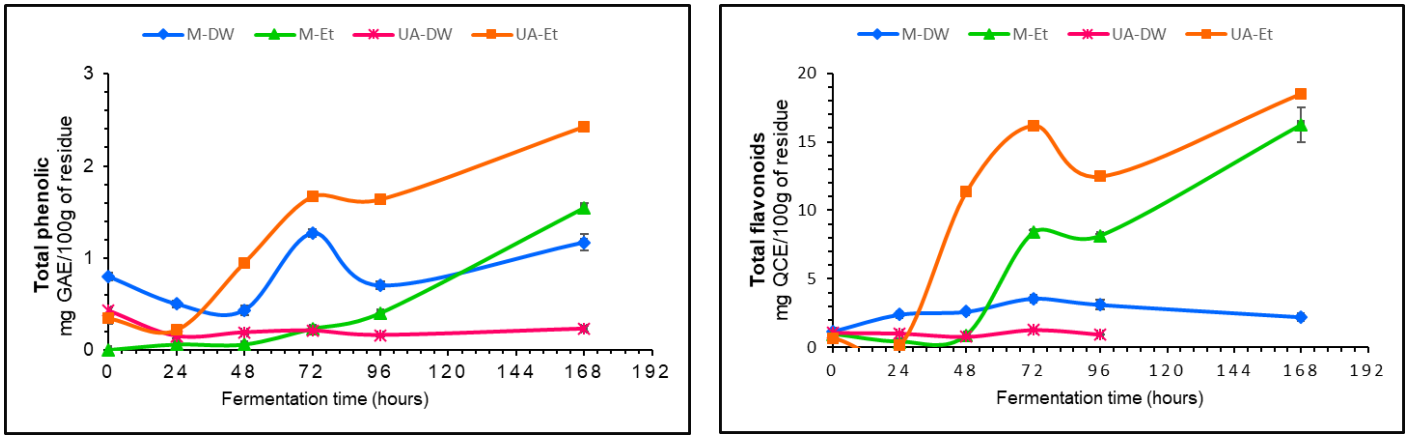
The determination of total phenolic compounds was based on the Folin-Ciocalteau method[5,6]. The results were expressed in terms of milligrams of gallic acid equivalent (GAE) per 100 g of flour (mg GAE/100 g). The total flavonoid content was determined with aluminum chloride[7]. The results were expressed in milligrams of quercetin per 100 g of flour (mg QCE/100 g). The antioxidant activity of the extracts was determined by ABTS (2,2´- azinobis(3-etilbenzotiazolina-6-ácido sulfônico)[8], DPPH (1,1-difenil-2-picrilhidrazil)[9] and FRAP (Ferric Reducing Antioxidant Power)[10] assays. The results were expressed in µmol Trolox/g.

3 RESULTS & DISCUSSION

Higher extraction of total phenolic (2.43 mg GAE/100 g) and total flavonoid (18.49 mg QCE/100 g) were both obtained by ultrasound-assisted with 80% ethanol (Figures 1 and 2). This result meant an increase of 594.28% and 2,659.70% of total phenolic and total flavonoid, respectively when compared with unfermented flour (0.35 mg GAE/100 g of residue and 0.67 mg QCE/100 g of residue, respectively). Considering that 80% ethanol is less polar than water these results indicate the presence of compounds with greater affinity for ethanol. Also, it was verified higher extraction by ultrasound-assisted (UA) than maceration technique. In

UA there is a cavitation process generated by acoustic waves (>20kHZ), which interact with the solvent and dissolved gas by creating free bubbles that can expand to a maximum size and violently collapse, generating locally extreme heat and pressures. As consequence of this phenomenon, the cell walls can be ruptured, providing channels for solvent access, and mass transfer is improved, facilitating the removal of bioactive compounds[11].

The extract obtained in the present work showed higher total flavonoids content (18.49 mg QCE/100 g) than the obtained by Franco et al.[12], which obtained approximately 0.51 mg QCE/100 g of mangaba residue from from fruit pulp processing. Probably the solid-state fermentation as a pretreatment, facilitated the release of compounds promoting greater extraction of flavonoids[13].



(A) (B)

Figure 1. Total phenolic (A) and total flavonoid (B) content in mangaba seed extracts obtained after fermentation with *A. carbonarius* using the following extraction methods: maceration and distilled water (M-DW); maceration and 80% ethanol (M-Et), ultrasound-assisted and distilled water (UA-DW); ultrasound-assisted and 80% ethanol (UA-Et).

The extract with higher polyphenolic compounds content (obtained after 168 h of SSF with 80% ethanol by ultrasound-assisted) was evaluated for antioxidant activity (AA) by ABTS, FRAP and DPPH methods. The higher AA was obtained by ABTS (6.13 µmol of Trolox/g) than DPPH (4.30 µmol of Trolox/g) and FRAP (1.28 µmol of Trolox/g). This result meant that the polyphenolic compounds in the mangaba seed have greater capacity to capture the radical ABTS.

In general, extracts of mangaba seeds have showed AA ranging from 1.33 to 7.88 µmol of trolox/g, 1.24 to 13.06 µmol of trolox/g and 1.79 to 18.48 µmol of trolox/g in DPPH, ABTS, FRAP assays respectively[14]. Therefore, the results obtained in the present study are in accordance with the literature.

4 CONCLUSION

In the present work the solid-state fermentation associated with ultrasound-assisted technique was effective to increase the antioxidant polyphenolic compounds content on mangaba seeds flour. The future studies are necessary to optimize the extraction process.

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