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BAGAÇO DE CANA-DE-AÇÚCAR: ANÁLISE DE POLIFENÓIS, COMPOSTOS COM ATIVIDADE ANTIOXIDANTE E ANTIMICROBIANA

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RESUMO

O bagaço de cana-de-açúcar é um resíduo sólido amplamente produzido no Brasil e representa uma ótima oportunidade para explorá-lo como fonte de compostos funcionais. Assim, o objetivo do presente trabalho é avaliar a concentração de polifenóis totais, compostos com atividade antioxidante e antibacteriana. Os resultados mostraram que o extrato aquoso do bagaço de cana não foi capaz de inibir o crescimento de importantes bactérias de origem alimentar. O conteúdo total de polifenóis foi de 728.201±58,21 mg de ácido gálico equivalente por 100g e flavonóis de 325.143 ± 19,03 mg de equivalente de rutina por 100 gramas de bagaço seco. A capacidade antioxidante foi capaz de sequestrar 5,05%±0,003% dos radicais DPPH e apresentou capacidade de sequestro de ABTS de 67.535 ± 10,44 mmol de equivalente de Trolox por 100 gramas de bagaço seco. Assim, o presente trabalho pode contribuir para futuros estudos para avaliar o resíduo a ser utilizado como componente funcional em aplicações industriais.

Palavras-chave: Bagaço de cana-de-açúcar. Resíduos de alimentos. Aproveitamento de resíduos. Compostos bioativos.

1 Introduction

Data from Companhia Nacional de Abastecimento estimates that, for the 2016/17 harvest, Brazilian sugarcane production was 694.54 million tons, which makes Brazil the world largest producer of sugarcane [1-2]. The solid residue from sugarcane processing represents about 40.11% of dry matter [3], rendering a great opportunity for the waste valorization with the aim of managing waste in the most sustainable way.

In this scenario, Machado et al. [2] observed that sugarcane bagasse has high potential for use as feedstock in biorefineries. Silveira et al. [4] utilized the residue as substrate for *Monascus purpureus* for red pigment production in submerged cultivations. Amin [5] used activated carbons prepared from sugarcane bagasse for removal of reactive dye from aqueous solutions by adsorption. The crop residue can also be used for many other ecofriendly biotechnological applications such as production of enzymes, carotenoids, amino acids, xylitol, citric acid, among others, as can be seen elsewhere [6-7]. Additionally, food waste and residues may also constitute to a large development of valuable end products, which remains under-exploited and represents a huge opportunity for further studies [8].

For industrial applications and commercialization, the utilization of dried sugarcane bagasse may be an important alternative due to microbiological and biochemical stability, reduced costs of packaging, transport and storing. Thus, the characterization of the crop residue and the study of compounds with important activities, such as antimicrobial and antioxidant activities, is important for the promotion of sustainable food waste valorization practices. In this context, the objective of the present work wasto evaluate the total polyphenol, compounds with antioxidant and antibacterial activity of dried sugarcane bagasse.

2 Material and Methods

2.1 Plant material

Sugarcane bagasse was gently donated by Agroindústria Brandão (Muçum, RS, Brazil), after juice production, and immediately conducted to oven-drying (SPPLabor, SP 102/27 model, Brazil) at 60ºC for 24h. Dried residue was crushed in an industrial blender (RI1764, Walita, Brazil) for 1 min and passed through a 0.811 mm sieve, previously sterilized with ethanol 70ºGL.

2.2 Analysis of polyphenols and compounds with antioxidant activity

Total polypehnols and compounds with antioxidant activity were extracted by maintaining 1g of the dried samples in 50 mL of ethanol:water (50:50, v/v) for 30min at 60ºC [9].

Total phenolic content was determined by the reaction of the alcoholic extract with Folin-Ciocalteau (Vetec, Duque de Caxias, RJ, Brazil) reagent and saturated solution of sodium carbonate. The reaction absorbance was measured at 765 nm by UV-1600 spectrophotometer (Pró-Análise, Brazil) and the results expressed as mg gallic acid equivalent per 100 gram of dry bagasse weight (mg GAE/100g db) [10].

The total flavonols was determined by following the procedure as described by Mazza et al. [11]. Briefly, the sample (0,25 mL) was diluted in a test tube and 0.25mL 0,1% HCl in 95% ethanol (v/v) and 4.55mL 2% HCl (v/v) were added. The solution was thoroughly mixed and allowed to stand for approximately 15 min before the reading of the absorbance at 360nm with a spectrophotometer. Results were expressed as mg of rutin equivalent per 100 grams of dried bagasse (mg RE/100g db).

Antioxidant analysis were performed by the determination of 2,2-azino-bis-(3-ethylbenzothiazoline)-6-sulfonic acid (ABTS) radical scavenging activity [12]. The ABTS radical cation was produced by an overnight reaction, in the dark, of ABTS stock solution with potassium persulfate, and further dilution in ethanol to an absorbance of 0.7 at 734 nm. The sugarcane extract was then mixed with the ABTS•+ solution and an absorbance (734 nm) measured after 6 min. Trolox was used as standard antioxidant compound and results were expressed as mm of Trolox equivalent per 100 grams of dried bagasse (mmol TE/100g db).

The DPPH antioxidant activity was evaluated according to Brand-Willians et al. [13]. In the dark, aliquots of 0,1 mL sample were transferred to test tubes with 3,9 mL radical DPPH (60 μmol/L DPPH solution, diluted in methyl alcohol). After 45 min, the scavenging activity was measured spectrophotometrically by the decrease in absorbance at 517 nm. Likewise, the same proportions (0,1 mL distilled water and 3,9 mL DPPH radical) were used as a control, using methyl alcohol as blank. The results were expressed as scavenging activity (%) = $[1-(A/A0)]\times100$, where A is the absorbance of the test and A0 is the absorbance of the blank.

2.3 Antibacterial activity

The extraction of antimicrobial substances was performed by maintaining 10 g of dried sugarcane bagasse with 1 L of boiling distilled water for 10 min under constant stirring (model 754A, Fisatom, Brazil), and then filtered through Whatman filter paper nº1 and immediately used [14]. Suspensions of 10^7 CFU/mL of *Staphylococcus aureus* ATCC25923, *Listeria monocytogenes* ATCC7644, *Listeria innocua*, *Salmonella* Enteritidis ATCC13076 and *Escherichia coli* ATCC25922 were spread onto Plate Count Agar (PCA) with a sterile swab and aliquots of 0,02 mL of the extract were applied. Plates were incubated at 37°C for 24 h, when the presence of inhibition halos were verified [15].

3 Results and Discussion

The results for total polyphenol, flavonols and compounds with the capacity to scavenge DPPH and ABTS radicals in the sugarcane bagasse are presented in Table 1. The food residue presented total polyphenolic content of 728,201±58,21 mg GAE per 100 grams of dried bagasse, meanwhile the flavonol content was 325,143±19,03 mg of rutin equivalent per 100 grams of dried bagasse.

The antioxidant capacity of the alcoholic extract from the sugarcane residue was able to scavenge 5,05%±0,003% of DPPH radicals and presented ABTS scavenge capacity of 67,535± 10,44 mmol of trolox equivalent per 100 grams of dried bagasse. Souza-Sartori et al. [16] observed total flavonoids content in sugarcane tops of 24,6 mg of quercitin equivalent per ml of ethanolic extract, meanwhile total antioxidant capacity was 22.008,3%, measured by the phosphomolibidenium complexation tests. Duarte-Almeida et al. [3] observed the predominance of flavones (apigenin, luteolin and tricin derivatives), among flavonoids, and of hydroxycinnamic, caffeic and sinapic acids, among phenolic acids, representing a total content of around 160 mg/L in sugarcane juice. Vila et al. [17] suggested that sugarcane may be considered a functional food since interesting contents of flavonoids were observed (orientin-o-rhamnoside in sugarcane leaves and schaftoside, isoschaftoside, diosmetin-8-c-glycosie, orientin and 4'-5'-dimethyl-luteolin-8-c-glycoside in the sugarcane juice), although the author suggests more studies to claim this. Additionally, polyphenols may be strongly linked to the vegetable matrix and are not extractable by organic solvents, being available only in human intestine, an important characteristic for a functional ingredient [9,18-19].

The evaluation of sugarcane bagasse as a source of compounds with antibacterial activity showed that the aqueous extract tested was not capable to inhibit the growth of *S.aureus*, *L.monocytogenes*, *L.innocua*, *S.* Enteritidis and *E.coli*. It has been reported that pure polyphenols present antimicrobial activity against Gram-positive and Gram-negative bacteria. Their mechanisms of action are related to oxidation of microbial cell membranes, complexation of essential metal ions, or inhibition of extracellular enzymes [20-21].

Similar results were observed previously by Sant'Anna et al. [22] when spent coffee ground was evaluated. The disability of sugarcane extract to show antimicrobial activity in the present work may be related to a reduced concentration of compounds with antibacterial activity due to the extraction methodology, although Caxambú et al. [14], using the same methodology found antibacterial capacity of aqueous extract from pecan nutshell. Also, different phenolic compounds may have different

susceptibility to be extracted to the liquid system [9], and, in the present work, possibly not present in the extract to act as an antimicrobial agent.

Table 1. Mean values for total polyphenols, flavonols and compounds with ABTS and DPPH scavenging capacity in sugarcane bagasse.

Total polyphenols (mg GAE/100g db)	**Flavonols (mg RE/100g db)**	**ABTS scavenging activity (mmol TE/100g db)**	**DPPH scavenging activity (%)**
728,201±58,21	25,143±19,03	67,535± 10,44	5,05%±0,003%

4 Conclusion

Sugarcane solid residues remain under-exploited in the field of food science and technology, although they represent a great opportunity for exploration as source of functional compounds. The results showed that aqueous extract from the sugarcane bagasse was not capable to inhibit the growth of important foodborne bacteria. However, the results of the present work showed that sugarcane bagasse presents important concentration of total polyphenolics and flavonols. Additionally, it was observed that these compounds present the capability to scavenge synthetic radical, which shows that there is great potential of the residue to have antioxidant activity on its vegetable matrix. In conclusion, the present work may contribute to further studies to evaluate the residue to be used as functional component in industrial applications.

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SUGARCANE BAGASSE: ANALYSIS OF POLYPHENOLS, COMPOUNDS WITH ANTIOXIDANT AND ANTIMICROBIAL ACTIVITIES

ABSTRACT: Sugarcane bagasse is a solid residue widely produced in Brazil and represents a great opportunity for exploration as source of functional compounds. Thus, the objective of the present work is to evaluate of total polyphenol, compounds with antioxidant and antibacterial activity. The results showed that aqueous extract from the sugarcane bagasse was not capable to inhibit the growth of important foodborne bacteria. Total polyphenolic content measured was 728,201±58,21 mg of gallic acid equivalent per 100g and flavonol content of 325,143±19,03 mg of rutin equivalent per 100 grams of dried bagasse. The antioxidant capacity was able to scavenge 5,05%±0,003% of DPPH radicals and presented ABTS scavenge capacity of 67,535± 10,44 mmol of trolox equivalent per 100 grams of dried bagasse. Thus, the present work may contribute to further studies to evaluate the residue to be used as functional component in industrial applications.

Keywords: Sugarcane bagasse. Food residues. Waste management. Bioactive compounds.

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