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Chemical Characterization and Antioxidant Activity from *Bromelia macambira* Seeds

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Abstract

The *Bromeliaceae* family includes 3140 species grouped in 58 genera. This family stands out mainly for its ornamentals characteristics, besides presenting some fruit species, like the pineapple. The *Bromelia laciniosa*, known as “macambira”, is present in the dry areas of Brazilian Northeast, covering the states of Bahia to Piauí, being used in large scale for garden's ornamentation. The aim of this work was evaluated the chemical composition of *B. laciniosa* seeds. The seeds showed average lengths of 0.28 mm and 0.45 mm and average widths of 0.24 mm and 0.39 mm, and are formed in a fruit with three locus having 4±1 cm in length and 15±5 cm in diameter, and yellow berries with purples axes when reach the maturation stage. The protein levels was 4.34%, the acidity present 3.13%, the pH showed a medium value of 5.24 and the vitamin C present in seeds reached the level of 920 mg/100 g. The *Bromelia laciniosa* seeds showed a great potential as source of vitamin C and antioxidant compounds, and also can be used in human feeding.

Keywords: antioxidant activity, bromeliad, *Bromelia laciniosa*, vitamin C

1. Introduction

The Bromeliaceae family includes 3140 terrestrial, epiphytic and saxicola species, that are grouped into 58 genera; its distribution is neotropical and occurs in moist forest habitats and xerophytic environments (Givnish et al., 2011). The family Bromeliaceae is notable primarily for its ornamental characteristics, but it also consists of fruit species, such as *banana-do-mato* (*Bromelia antiacantha* Bertol.) and pineapple (*Ananas comosus*) that has a great economic importance (Krumreich et al., 2015).

The *macambira*, a common species name for *Bromelia laciniosa*, is a bromeliad species of Bromelia genus. It is present in dry areas from Brazilian Northeast, from Bahia to Piauí State. This specie has thin roots, a stalk of cylindrical shape and leaves (made up of two distinct parts: a dilated base and a limbo) distributed around the stem. The plant size varies and its fruit is a berry which has a length of three to five centimeters and a diameter ranging from 10 to 20 mm. When the fruit is ripe, the berries are yellow, resembling a bunch of small bananas (Angelim et al., 2007).

The *macambira* develops beneath other trees or in clearings, it is used in animal and human feeding and during the long drought periods. Accordingly, to Angelim et al. (2007), from the base of the leaves is extracted a mass, from which is made a type of bread. The *macambira* is also known as saw *macambira*, stone *macambira* or arrow *macambira*. Its seeds do not germinate in the absence of light, and therefore it behaves as a positive photoblastic plant (Dutra et al., 2011).

There are just a few references about *B. laciniosa* species, despite it, is considered as one of the alternatives offered by Caatinga, for the smallholders in the Brazilian Northeast as a complementary feeding for his farm animals (goats, sheep and pigs), and, thus, during the dry season reduce the costs through an appropriate and sustainable management (Angelim et al., 2007).

Scientific information about the nutritional composition and biological activity for this species are still restricted, therefore, the objective of the present work was to evaluate the chemical composition of *B. laciniosa*'s seeds.

2. Material and Methods

For the realization of this work were used *Bromelia laciniosa*'s seeds (Figure 1). First, the fruits were peeled, cutted lengthwise and the seeds were removed, these ones were stored in a freezer at -30 °C until the analyses were completed. The work was developed in a laboratory at State University of Londrina. All analyses were tripled performed.

Figure 1. Flor de *Bromelia laciniosa*, left detail of the flower. Fonte: Hortipedia (2017)

The moisture content was obtained in a heating chamber at 105±3 °C according to specifications rules for seed Analysis (Brasil, 2009), were weighed 3 samples containing 3 g each and placed in porcelain capsule and take into the heating chamber for 24 hours. After cooled the samples in a desiccator containing silica, they were weighed and the moisture value was obtained through the difference between the initial weight and final weight.

In order to determine the ash content, 5 g of each sample were taken to the muffle for incineration at a temperature of 550 °C for 2 h, after 12:00 am the muffle was opened and the capsules were removed to measure in the precision scale to obtain the value of ash through the difference between the initial and the final weight.

The determination of the crude protein was measured by the Kjeldahl method (FAO, 1973).

The titratable acidity, was measured weighing 1 g of the sample and by adding 50 mL of water and 4 drops of phenolphthalein solution and subsequently performed the titration with sodium hydroxide solution 0.01 M, up to rosy coloring, to the determination of pH was weighted 1 g of crunched seeds and diluted it in 50 mL of water (Instituto Adolfo Lutz, 1985).

The quantification of Ascorbic acid (vitamin C) was performed by the methodology of Tillmans (Instituto Adolfo Lutz, 2008). It was pipetted 10 mL from the sample volume that was added to a 250 mL conical flask containing 50 mL of oxalic acid solution 1%; later it was titrated with a 2.6 dichlorophenol indofenol solution up to 15 seconds until the persistent rosy coloring.

For the determination of total phenols, was used the methodology described by Swaint and Hillis (1959), which consist in use the Gallic acid as standard model. It was added 0.1 grams of the sample in a test tube, 5 ml of methanol (80%) and it was left in turmoil for 30 min, then was centrifuged at 2500 rpm for 5 min, 0.5 ml of the supernatant was collected and was added 0.5 ml of folin (0.9 N) and 0.5 ml of Na_2CO_3 (10%). The solution rested for 30 min in the dark, then read proceeded at 760 nm.

The determination of flavonoids was carried out according to the methodology proposed by Woisky & Salatino (1998), 10 g of sample and 10 mL of ethanol was used and were kept under constant stirring for 30 min agitator table at 2500 rpm (Orbital-New organic. After that the supernatant was collected and sent to centrifugation for 5 min at 2500 rpm. It was collected 2 mL from the supernatant solution and 1 ml of aluminum chloride 10% (m/v) and 2 mL of methanol were added. Then it was let for 30 min in the dark and the read proceeded in a spectrophotometer (Coleman 33D) 425 nm. It was used as default the quercetin.

3. Results and Discussion

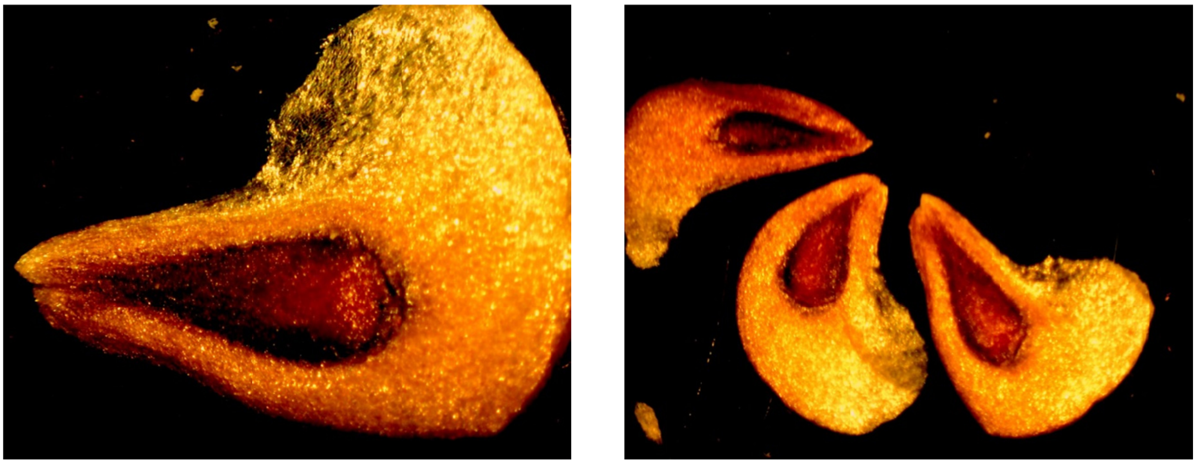

Figure 2. Seeds of *Bromelia laciniosa* used in the experiment, photos made in stereoscopic magnifying glass, with an increase of 2000 times

The Bromelia lacioniosa showed average lengths of 0.28 and 0.45 mm and average widths of 0.24 and 0.39 mm for big and small seeds, respectively, therefore, these seeds showed a medium length of per lot of 0.315±0.075. The seeds can be three times bigger than the *Nidularium innocentii* (Lem.) seeds, and according to Morokawa (2005) presents a medium size of 1.00 mm, being smallest than the seeds of Dykia goehringiique, which showed a 3.28 mm (medium length) and 4.69 (medium width) (Ferreira Duarte et al., 2010).

The seeds classification by size must to occur, due the fact that this variable can influence the seed quality, and allow to estimate a ideal size lot for species propagation. The seed size can influence in a directly way in their physiological quality, and according to Frazão et al. (1983) when bigger the size, higher the seed quality.

The plants belonging to the Bromeliaceae family was evolved over the centuries, adapting to the environmental conditions of their native region. This evolution can be noted by several morphological characteristics of plants, highlighting the evolution of seeds, who improve itself for better dispersion in the environment. Each species has a different morphological pattern, like the Bromelia laciniosa, who has a lanceolate format, being hard and with brown color (Figure 2). According to Dutra et al. (2010), these seeds are formed in a three locus fruit, with the follows characteristics: 4±1 cm of length, 15±5 cm of diameter and yellow color with purple axe when the berries reach the stage of maturation.

In the same lot of seeds can occur a variation in their morphological pattern, due the fact that the seeds are developed inside the berries locus, changing according the conditions that the mother-plant growth up during the seed formation (Mayer & Poljakoff-Mayber, 1963).

The moisture content of the seed was 7.16%, this value was considered suitable for preservation of orthodox seeds because when they are dehydrated, its metabolism is reduced to minimum levels, what allows them survive to environmental stresses (Castro et al., 2004). Marcos Filho (2005) reports that, for species of orthodox seeds, water levels between 10% and 12% allow the maintenance of germination, for a period of six to eight months. Already Bewley and Black (1994) recommend levels between 8% and 9%, for the restriction of insect's activity. In *B. laciniosa* was found gray levels of 5.09%.

The protein levels in Macambira seeds were 4.34%, this content can be considered high when compared to other Bromeliads as the pineapple (*Ananas comosus*). Gondim et al. (2005), about the centesimal composition and minerals in fruit peels, observed a 1.45% content of a fresh sample of pineapple peel. However, Costa et al. (2007) in your experiment obtained a quantity of 3.27% for peel and 3.18% to bagasse.

The acidity is an important parameter in assessing the conservation status of a product. The results observed for this parameter were of 3.13%. The results observed for this parameter in fruits Ananas comosus were 2.53% for powder obtained from pineapple peelings and 2.98% for the food powder obtained of untreated (Costa et al., 2007).

Through the results observed for pH parameter with a value of 5.24 the authors can affirm that seed of B. laciniosa presents a slight acidity in its composition and therefore makes it a difficult material to microbial attack because one of the main intrinsic factors able to determine growth, survival or destruction of microorganisms on it is the pH. Micro-organisms have great and maximum pH values for their multiplication. It turns out that around the neutral pH (6.5-7.5) is the most favorable for most microorganisms (Hoffmann, 2001).

Chemical analysis of raw materials showed a high content of vitamin C present in the seed, 920 mg/100 g seed, pineapple offers a low value of vitamin C, 20.9 mg of Ascorbic acid per 100 g of juice (Akira et al., 2002). However, if its compared to the ACE which is a fruit rich in vitamin C, ascorbic acid levels with many variables (the 300 mg/100 g of pulp 4,676) (Freire et al., 2013; Matsuura, 1994), macambira presents itself as a great source for obtaining this vitamin C.

The seeds of *B*. laciniosa presented in its composition 738.36 Gallic acid/g phenolic compounds including the flavonoids quercitina/94.23 g. The occurrence of flavonoids Bromeliaceae's family allows you to highlight the chemistry importance from them as possible pharmacologic agents and, also, to consider them as potential chemotaxonomy markers. It has been identified so far, 2 different flavanols, 3 flavanones, 26 flovones, 25 flovonols and 20 anthocyanins in 83 Bromeliaceae species evaluated, being 30 from the subfamily Bromelioideae, 26 from Pitcairnioideae subfamily and 27 from Tillandsioideae subfamily (Manetti et al., 2009)

4. Conclusion

The seeds *Bromelia laciniosa* are rich in Ascorbic acid and antioxidant compounds, and high levels of vitamin C.

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