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### Review

## Biological activities and chemical constituents of *Araucaria angustifolia*: An effort to recover a species threatened by extinction



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### ABSTRACT

**Background:** *Araucaria angustifolia* (Bert.) O. Kuntze (*Araucaria brasiliensis*), known as Paraná pine, is the sole native gymnosperm of the Atlantic forest in Brazil and has great economic, cultural and social importance. Its seed, known as *pinhão*, has been consumed since prehistoric times. Besides the nutritional aspects, different parts of *A. angustifolia* are also used in the Brazilian folk medicine for the treatment of rheumatism, respiratory infections, fatigue, anemia, among other disorders. Timber exploration has dramatically reduced the species population, and currently, *A. angustifolia* is classified as vulnerable regarding the risk of extinction.

**Scope and approach:** This review presents the most recently uncovered details about the chemical composition of the various parts of the plant. Emphasis is given to the main isolated and identified compounds or fractions and their corresponding bioactivities.

**Key findings and conclusions:** Apart from the nutritional properties of the *pinhão*, particularly as a starch source, this review reveals that a number of biological activities have been found in different parts of *A. angustifolia* (leaves, bark and *pinhão* coat), such as protection against DNA UV-induced damage, antioxidant, antiinflammatory, antiviral and digestive enzyme inhibiting activities. Further investigations should include parts of *A. angustifolia* that are currently discarded, such as the bark, bracts and the *pinhão* coat, with potential for use in pharmaceutical and cosmetic industries. Studies on *A. angustifolia* must combine two important elements: the need for preservation of a typical ecosystem and the implementation of the *A. angustifolia* forests as a true economic alternative for local residents.

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### 1. Introduction

*Araucaria* is a genus of evergreen coniferous trees in the family Araucariaceae. The genus *Araucaria* includes approximately nineteen species, all confined to the Southern Hemisphere (Kershaw & Wagstaff, 2001). Two species grow in South America, *Araucaria*

*angustifolia* and *Araucaria araucana*. *A. angustifolia* covers areas of the South and South East of Brazil and North East of Argentine (Kock & Correa, 2010) whereas *A. araucana* is restricted to the high mountains in the South of Argentine and Chile (Cardemil & Riquelme, 1991).

*Araucaria angustifolia* (Bert.) O. Kuntze (*Araucaria brasiliense*), popularly known as Paraná pine, Brazilian pine or simply "Araucaria", is the sole native gymnosperm of the Atlantic forest in Brazil and has great economic, cultural and social importance (Auler, Reis, Guerra, & Nodari, 2002). Originally, the natural forests of Araucaria covered 185,000 km<sup>2</sup> in Brazil (Carvalho, 1994; Astarita, Floh, & Handro, 2003). Timber exploration has dramatically reduced the species population and nowadays only 2–4% of the original

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population still exists (Mantovani, Morellato, & dos Reis, 2004; Santos, Linares, Lisi, & Tomazello, 2015). Most of the populations of *A. angustifolia* are concentrated in the Southern Brazilian States (Paraná, Santa Catarina and Rio Grande do Sul), with some representative forests in the Southeastern Brazilian States (São Paulo, Minas Gerais and Rio de Janeiro) (Fig. 1).

Currently, *A. angustifolia* is classified as vulnerable regarding the risk of extinction (Brazilian Decree 42,099, 2002). Due to this situation the cultivation of the species has received strong encouragement from governmental agencies related to environment and agriculture, and many efforts have been carried out in order to propagate and conserve the species (Balbuena et al., 2011).

The edible part of the seed, known as *pinhão*, is consumed by different species of animals, especially rodents, as well as by humans and has a high nutritional value. Indians of Southern Brazil (Caingang and Guarani) are used to eat *pinhão* since prehistoric times. Especially during winter, cooked or in the form of flour, the *A. angustifolia* seed often becomes the most important food for survival (Cordenunsi et al., 2004). Besides the nutritional aspects, different parts of *A. angustifolia* are also used in the Brazilian folk medicine (Aslam, Choudhary, Uzair, & Ijaz, 2013). Tinctures extracted from the nodes are traditionally used orally or topically for the treatment of rheumatism and infusions of the nodes are used orally for the treatment of kidney



Fig. 1. *Araucaria angustifolia*. (A): mature tree; (B): female cones or pine cones; (C): mature seeds; (D): cooked seed (edible part).

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