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Plants used as antidiabetics in popular medicine in Rio Grande do Sul, southern Brazil

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ABSTRACT

Ethnopharmacological relevance: Plants are widely as antidiabetics. The study of these plants is essential because many of them may have undesirable effects, such as acute or chronic toxicity; or their use may even delay or discourage the adoption of the proper and effective treatment.

Materials and methods: The present study surveyed the plant species that are popularly used to treat *diabetes mellitus* in the state of Rio Grande do Sul in southern Brazil. Sixteen ethnobotanical surveys performed in the state were consulted, and the species used to treat diabetes were listed. For species cited in at least two of the studies, scientific data related to antidiabetic activity were searched in the *ISI Knowledge* database. The scientific binomial of each species was used as keywords, and data found in review papers were also included.

Results: A total of 81 species in 42 families were mentioned; the most important families were Asteraceae and Myrtaceae. Twenty eight species were cited at least twice as being used to treat diabetes in the state. For 11 of these, no scientific data regarding antidiabetic activity could be located. The species most frequently mentioned for use with diabetes were *Syzygium cumini* (Myrtaceae) and *Bauhinia forficata* (Fabaceae), in 12 studies each, followed by *Sphagneticola trilobata* (Asteraceae), in six studies; and *Baccharis trimera* (Asteraceae), *Bidens pilosa* (Asteraceae), *Cynara scolymus* (Asteraceae), and *Leandra australis* (Melastomataceae) in four studies each. *Bauhinia forficata* and *Syzygium cumini* have been studied in more detail for antidiabetic activity.

Conclusions: A considerable number of plant species are traditionally used for the treatment of diabetes melitus in the Rio Grande do Sul State. The majority of those plants that have been studied for antidiabetic activity showed promising results, mainly for *Bauhinia forficata* and *Syzygium cumini*. However, for most of the plants mentioned, the studies are not sufficient to guarantee the efficacy and safety in the use of these plants in the treatment against diabetes.

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1. Introduction

Diabetes mellitus is a metabolic disease that currently affects 250 million people around the world. Each year another 7 million people develop the disease (International Diabetes Federation, 2011), resulting in a chronic state of hyperglycemia. The condition is characterized by the body's inability to transform sugar into energy, causing hyperglycemia. Hyperglycemia can cause retinopathy, nephropathy, and cardiovascular damage (American Diabetes Association, 2007; Malviya et al., 2010).

WHO estimates that 30 million people had diabetes in 1985, and this number increased to 171 million people in 2000. In that year, an estimated 2.9 million people died of diabetes, representing 5.2% of all deaths, probably the fifth largest cause of mortality in the world (Roglic et al., 2005). It is estimated that in 2030, people with diabetes will number 366 million, most of them from developing countries, especially the among people from 45 to 64 years of age (Roglic, 2004).

Marles and Farnsworth (1995) listed 1200 species of plants that have been used to treat diabetes worldwide. They mostly belong to the families Fabaceae, Asteraceae, and Lamiaceae.

Among the main natural hypoglycemic products are carbohydrates, alkaloids, glycopeptides, terpenoids, flavonoids, and coumarins (Marles and Farnsworth, 1995; Negri, 2005; Cazarolli et al., 2008).

In Brazil, the use of plants as antidiabetics is very common, as reported by Volpato et al. (2002), Barbosa-Filho et al. (2005), Negri

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(2005), and Borges et al. (2008). In Rio Grande do Sul, several ethnobotanical studies established that the use of plants for metabolic disorders such as diabetes is common (Simões et al., 1986; Ceolin, 2009).

According to Witters (2001), in the Middle Ages, *Galega officinalis* L. (Fabaceae) was prescribed for polyuria, one of the most common symptoms of diabetes. The active principle in *Galega officinalis* is known as guanidine. Although guanidine this and some of its derivatives are overly toxic to treat diabetes, dimeric forms known as biguanides have been considered useful to treat the disease since the 1950s.

About 66% of the Brazilian population has no access to commercial medicines, which means that the use of plants is their only alternative for the treatment of their ills (Di Stasi, 2007). In this context, ethnobotanical studies that have the main objective to catalogue knowledge about medicinal plants and cultural aspects of communities can serve as the basis to list species to be studied as medicinal in order to validate the use, encourage the production of phytotherapeutics from these plants, or even the isolation and/or semi-synthesis of bioactive molecules (Elisabetsky and Coelho de Souza, 2007). The development of medicines by the production of synthetic or semi-synthetic bioactive molecules is based on the chemical diversity of plants (Phillipson, 2007).

This study surveyed the plant species mentioned for the treatment of diabetes in ethnobotanical surveys performed in Rio Grande do Sul, and evaluated the current status of scientific knowledge related to the antidiabetic activity of these plants.

2. Materials and methods

Sixteen ethnobotanical studies performed in Rio Grande do Sul were consulted: Simões et al. (1986); Kubo (1997); Garlet (2000); Marodin (2000); Possamai (2000); Garlet and Irgang (2001); Ritter et al. (2002); Hass (2003); Leitzke (2003); Martha (2003); Sebold (2003); Löwe (2004); Soares et al. (2004); Vendruscolo (2004); Barbosa (2005); Vendruscolo and Mentz (2006); Barros et al. (2007), and Ceolin (2009). The papers consist of articles, master's dissertations, and monographs contributed by researchers in the state, and were found in databases or in university libraries.

The plants used for the treatment of diabetes mentioned in these studies were selected by searching for terms such as "*diabete*", "*diabetes*" and "*lower the blood sugar*".

The popular names mentioned for these species, as they are given in the studies consulted, were compiled. For better understanding, the information concerning the plant parts used in preparations has been standardized. Terms related to preparation form such as infusion and decoction have been standardized as "tea", since these methods just differ in the extraction time and the temperature reached. The plants that were identified only to genus are listed separately, and were not considered in further analyses. The valid names of the species and the authors were confirmed using the databases Tropicos (2011) and The Plant List (2011). However, it was decided to retain the names given to the species as *Baccharis crispa*, *Baccharis trimera*, *Cynara scolymus* and *Eruca sativa* because the new combinations are not widely recognized currently yet. The botanical families were updated based on the APG III classification system (Stevens, 2011).

For species listed in two or more ethnobotanical studies, chemical data and data related to antidiabetic activity, found in studies in the database ISI Web of Knowledge (2010) were searched. In the search for these data, the scientific binomial of the plant was used as the descriptor.

3. Results and discussion

The ethnobotanical studies consulted mentioned 568 taxa with some medicinal usage, 84 of them used to treat diabetes. Among these, only three were not identified to species level, and were not counted in the final list. They are: *Eucalyptus* sp., Myrtaceae (Marodin, 2000); *Mentha* sp., Lamiaceae (Marodin, 2000); and *Origanum* aff. *vulgare*, Lamiaceae (Soares et al., 2004). The species of these genera are admittedly difficult to delimit, in addition to the occurrence of many hybrids.

The 81 species used for diabetes in the state of Rio Grande do Sul (Table 1) are members of 42 botanical families. Species of the families Asteraceae and Myrtaceae were most often mentioned, comprising, respectively 29% and 15% of the occurrences. The relatively high number of species of the families Asteraceae and Fabaceae agrees with the findings of Marles and Farnsworth (1995).

These two families include species of great abundance and biodiversity in Brazil (Giulietti et al., 2005) and plants of these families also have a highly developed secondary metabolism. A considerable fraction of antidiabetic compounds belonging to species of these families have been described and tested for diabetes and its complications (Marles and Farnsworth, 1995; Negri, 2005; Jung et al., 2006). There is a predominance of species belonging to the "tanniferous diagonal" which is a chemical group of families characterized by the production of large amounts of tannins (commonly gallic acid derivatives) and comprises the Cronquist's subclasses: Hammamelidade, Dillenidae and Rosidae (Dahlgren, 1980; Kubitzki and Gottlieb, 1984a). The species placed in this chemical group are often woody and tend to contain shikimate derivatives (Kubitzki and Gottlieb, 1984b). These compounds are also of great importance regarding antidiabetic activity known so far, because of their antioxidant properties (Negri, 2005). Several species of the family Myrtaceae are rich in tannins, flavonoids, and other phenolic derivatives. Among these classes, some compounds with antioxidant activity have been isolated.

The family Lamiaceae occupies a significant place in many ethnobotanical surveys, because of its aromatic characteristics and high phytochemical diversity, but did not have great significance in this study. Importantly, hypoglycemic activities attributed to flavonoids in the leaves of *Origanum majorana* L. and phenolic compounds from the leaves of *Hyssopus officinalis* L. have been found (Jung et al., 2006).

The species most frequently mentioned for use with diabetes were *Syzygium cumini* (Myrtaceae) and *Bauhinia forficata* (Fabaceae), in 12 studies each, followed by *Sphagneticola trilobata* (Asteraceae), in six studies; and *Baccharis trimera* (Asteraceae), *Bidens pilosa* (Asteraceae), *Cynara scolymus* (Asteraceae), and *Leandra australis* (Melastomataceae) in four studies each.

The monocots, although their metabolism has fewer secondary metabolites, contain many polysaccharides, which also show hypoglycemic activity (Von Poser, 2007). In *Saccharum officinarum*, e.g., the activity was found in the stems, where usually occurs the accumulation of polysaccharides (Takahashi et al., 1985).

The predominance of the use of teas agrees with the findings of surveys for medical use in general. The use of tea has a strong cultural appeal (Santayana et al., 2005). In the case of plants used for diabetes, this is particularly important because the antioxidants are commonly soluble in water. Furthermore, some reports described a combination of plants such as compound teas, elixirs, and also the use of the plant together with "chimarrão", a drink made with leaves of *Ilex paraguariensis* A. St. Hil., which is widely consumed in southern Brazil.

Popular names such as "insulin" and "vegetal insulin" were repeatedly mentioned, for four species of two different families: *Aspilia montevidensis* and *Sphagneticola trilobata* (Asteraceae); and

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