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REVIEW

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Systematic Review: Uses, Applications and Therapeutic Trends of *Bauhinia forficata* Link

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ABSTRACT

This study aimed to perform a systematic review on the uses and therapeutic applications of *Bauhinia forficata* Link seeking for evidence-based information on their biological properties. Among the articles included in this study, 55% focused on the research and verification of various pharmacological actions promoted by *B. forficata* L., mainly from this plant's extracts. Some articles addressed only the isolation and purification of phytochemical constituents (30%), some others isolated constituents and tested their pharmacological action (6%). There were also found ethnopharmacological studies that have sought for popular knowledge on the use of this plant species. The glycemia reduction in experimental models of diabetes, the antioxidant action and the presence of flavonoids as major phytochemical constituents were scientifically proven by several studies demonstrating the high pharmacological potential of this plant species.

Keywords: *Bauhinia forficata*; Systematic review; Therapeutic applications

INTRODUCTION

The use of plants for therapeutic purposes is one of the oldest forms of medical practice, and it follows the historical evolution of pharmacy and medicines. The demand for the use of medicinal plants in curing or preventing diseases has driven the pharmaceutical industry in the search for plant species with potential for development of herbal medicines. Furthermore, according to the World Health Organization (WHO), 65-80% of the population of developing countries rely on medicinal plants as the only form of access to basic health care [1-3].

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Brazil is the country with the greatest biodiversity on the planet, with a rich ethnic and cultural diversity that holds a valuable traditional knowledge concerning the use of medicinal plants. This scenario led to the adoption, in July 22nd, 2006, of the National Policy on Medicinal Plants and Herbal Medicines by the federal government, in order to ensure access and correct use of medicinal plants and herbal medicines, sustainable use of Brazilian biodiversity and the development of the productive chain and national industry [4]. Later, with the intention of directing scientific research in the field, it was published the National List of Medicinal Plants of Interest to the National Health System (RENISUS) that includes 71 plant species with promising pharmacological potential for the development of therapeutic products [5]. Among the species reported in RENISUS, there are some representatives of the genus *Bauhinia*, being *Bauhinia forficata* Link one of the most studied species in Brazil and the one that presents more research on the hypoglycemic activity [6].

The *Bauhinia forficata* L. is characterized as a small-sized tree belonging to the family Fabaceae, which covers more than 300 species of Bauhiniae genus, and is distributed mainly in tropical regions and in countries like Argentina, Bolivia, Paraguay, Uruguay and Brazil. It is popularly known as pata de vaca (cow paw), due to the shape of its leaves, and its importance is related to its extensive popular use for various therapeutic purposes. The infusion of its leaves is used as a diuretic, tonic and cleanser agent, but it is highlighted by its use as a hypoglycemic, also being known as insulin plant [7-8].

Given the increased use of *B. forficata* L. for therapeutic purposes associated with the great interest in research with this plant species, this study aimed to perform a systematic review on *B. forficata* L. seeking for evidence-based information on their biological properties, using a secondary survey of conducted and published experimental studies with this plant species.

MATERIAL AND METHODS

The search strategy used aimed to achieve all the articles on experimental basis available in the literature that addressed the components research and pharmacological actions present in *Bauhinia forficata* L., as well as studies on their use and pharmaceutical applications. The articles were searched in Science Direct, Scielo (Scientific Electronic Library Online) databases and in the Virtual Health Library (VHL) which is coordinated by the Latin American and Caribbean Center of on Health Sciences Information (BIREME), using the word *Bauhinia forficata* as a descriptor. All this survey occurred between September 2nd and 6th, 2012.

Initially, the analysis of the titles and abstracts of the articles found was performed as a way of choosing studies of significant relevance to the research. The repeated and non relevant studies were excluded at this point. After this step, the articles chosen were fully analyzed and those that fit the following inclusion criteria established were selected: articles from experimental research related to the assessment of the components and pharmacological actions present in *Bauhinia forficata* L., as well as studies on its use and pharmaceutical applications. There was no restriction regarding the publication date or language, and review studies were excluded.

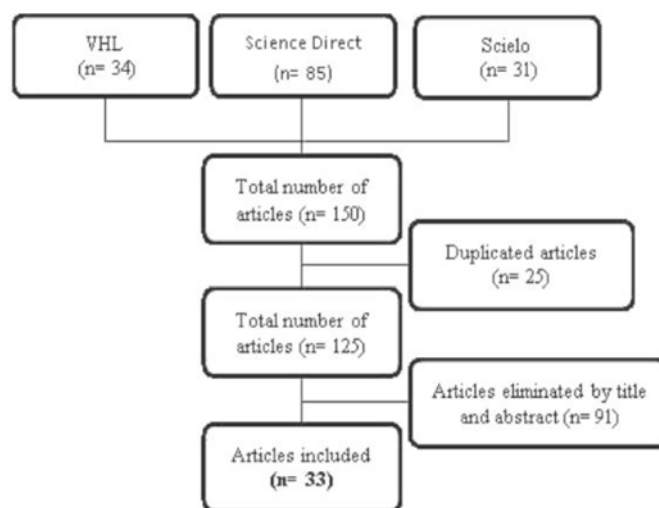
All analyzes were independently performed by two authors and the disagreements that occurred by chance were resolved by consensus among researchers or evaluation by a third author.

RESULTS AND DISCUSSION

A total of 150 articles were found in the search, and after exclusion of duplicate articles and application of inclusion criteria, only 33 were evaluated in detail. Figure 1 shows a schema on the choice of the articles studied.

Most of the studies found aimed to research and verify the various pharmacological actions promoted by *B. forficata* L, mainly from extracts from this plant. Some articles addressed

Figure 1: Number of articles found about the plant and choice of the articles studied: VHL - Virtual Health Library; Scielo - Scientific Electronic Library Online; n - number of articles.



only the isolation and purification of its phytochemicals constituents (30%), and others isolated its constituents and tested their pharmacological action (6%). Some ethnopharmacological studies that have sought popular knowledge on the use of this plant species were also found. The overall distribution of studies included is shown in figure 2.

Pharmacological aspects

Among the articles included, 55% studied the presence of pharmacological activities present in *B. forficata* L. The hypoglycemic action was the most researched, being present in 12 out of 20 studies found on pharmacological action.

The fact that most studies seek a proof of the hypoglycemic activity of this plant is related to its wide use by the population for this purpose. The evidence that the use of the plant does not cause toxicity or adverse effects when used in groups such as pregnant women is another factor that leads to its assessment. Most of the studies present in this systematic review showed positive results for the presence of hypoglycemic action in this species. Research was found in different normoglycemic and hyperglycemic animal models using different extractive solutions

Figure 2: Overall distribution of studies.

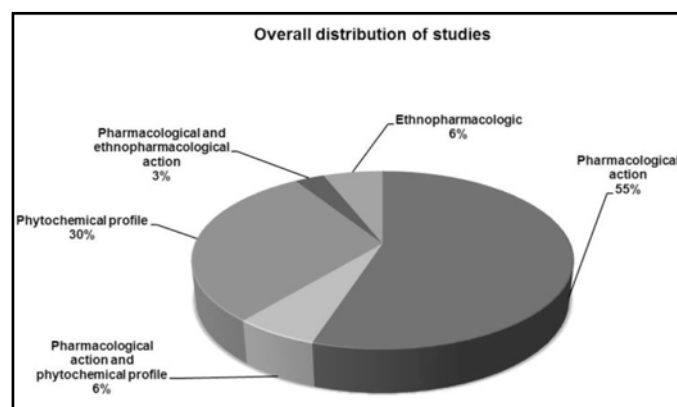


Table 1: Research on the evidences of *Bauhinia forficata* Link pharmacological activity.

HYPOGLYCEMIANT		
Author and Date	Method used	Conclusion
Silva et al. (2002) [9]	ES ^a : N-butanol fraction of the hydroalcoholic extract from the leaves; In vivo assay : Swiss diabetic male albino mice (induced by monohydrated alloxan) and normal mice had their blood glucose levels measured after administration of the extractive fraction. The doses used were 400, 500, 600 and 800 mg / kg	Hypoglycemic effect in normal mice (500 and 600mg/Kg) and induced at all doses, being 800mg/Kg the most potent.
Pepato et al. (2002) [10]	ES: aqueous extract from the leaves. In vivo assay : streptozotocin-induced diabetic wistar mice and nondiabetic mice received an average of 35.2 ± 7.8 mL/100g of body weight for approximately 30 days.	Hypoglycemic effect was observed in diabetic mice.
Pepato et al. (2004) [7]	ES: aqueous extract from the leaves. In vivo assay : normal mice and streptozotocin-diabetic received the ES for 33 days. Serum activity of toxicity was assessed using the markers lactate dehydrogenase, creatine kinase, amylase, angiotensin-converting enzyme and bilirubin.	Potential treatment for diabetes and produces no measurable toxic effects.
Jorge et al. (2004) [11]	ES: N-butanol fraction of the hydroethanolic extract from the leaves; In vivo assay on the effects of kaempferitrin isolated from the ES. Alloxan-induced diabetic wistar mice received 100mg/kg of kaempferitrin by gavage and were evaluated for 24h.	Proven hypoglycemic effect.
Lino et al. (2004) [12]	ES: Aqueous, ethanolic and hexane extract: In vivo assay : alloxan-induced diabetic mice were orally given doses of 200 and 400 mg/kg of extract for 7 days.	Confirmed hypoglycemic action.
Sousa et al. (2004) [13]	ES: Fraction of n-butanol from the leaves; In vivo assay on the effects of kaempferitrin isolated from the ES. Alloxan-induced diabetic mice and nondiabetic mice: Dose: 50, 100 and 200 mg/kg of Kaempferitrina. In vitro Assay : Myeloperoxidase and DPPH.	Hypoglycemic and antioxidant action observed.
Vasconcelos et al. (2004) [14]	ES: <i>Bauhinia forficata</i> L. aqueous extract against condition of hyperglycemia promoted by the Tityus serrulatus scorpion venom (TSV). In vivo assay : TSV (500 ug/kg, ip) for induction; ES (1 g/kg, po), 24, 12 and 1 hour before and immediately after TSV or saline and a single dose of insulin (1.5 IU / kg, sc) after TSV.	Reduces hyperglycemia induced by TSV. However, it does not neutralize other factors caused by poisoning, which makes it not suitable in this situation.
Damasceno et al. (2004) [15]	ES: Aqueous extract from the leaves; Assay in vivo : Virgin diabetic female wistar mice (streptozotocin-induced) were mated with nondiabetic wistar male mice and the gestational period was expected. Treatment was orally administered by gavage and the doses were 500, 600 and 1000 mg / kg consecutively.	There was no control of maternal hyperglycemia.
Menezes et al. (2007) [16]	ES: Aqueous extract from the leaves. In vivo assay : Normoglycemic mice received 0.1 mL of extract/10g of weight, and their blood glucose was measured 2, 4, 6 and 8 hours after administration of the extract. The control group received only distilled water.	Confirmed hypoglycemic action.
Volpato et al. (2008) [17]	ES: Aqueous extract from the leaves. In vivo assay : pregnant diabetic (streptozotocin-induced) and nondiabetic Wistar mice. Increasing doses were administered in 500, 600 and 1000 mg/kg of the extract.	There was no hypoglycemic action.
Moraes et al. (2010) [8]	ES: Aqueous extract from the leaves. In vivo assay : patients with Diabetes Mellitus type 2. It was performed biweekly, for 75 days, the assessment of fasting glucose.	Confirmed hypoglycemic action.
Cunha et al. (2010) [18]	ES: Hydroalcoholic extract from the leaves, then dried in an oven and in spray dryer and in the form of granules. In vivo assay : streptozotocin-induced diabetic mice.	The drying of the extract did not alter its hypoglycemic activity nor its content of flavonoids.

^aExtractive Solution, ^b2,2'-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid), ^cPhenazinemetosulfate, ^dNitrobluetetrazolium, ^eNicotinamide Adenine Dinucleotide, ^fTrolox equivalent antioxidant capacity, ^gOxygen radical antioxidant capacity using fluorescein as fluorescent probe, ^h Molecular Formula.

ANTIOXIDANT		
Author and Date	Method used	Conclusion
Sousa et al. (2004) [13]	ES: N-butanol fraction of forficata Bauhinia leaves; In vivo assay on the effects of kaempferitrin isolated from the ES. In alloxan-induced diabetic mice and nondiabetic mice: Dose: 50, 100 and 200 mg/kg of Kaempferitrin. In Vitro Assay: Myeloperoxidase and DPPH.	Hypoglycemic and antioxidant action observed.
Silva et al. (2007) [19]	ES: Consisting of methanol, ethanol, distilled water and hydrochloric acid (69: 20:10:1, v: v: v: v) into contact with leaves, bark and stems. In vitro assay: Total phenols - Folin-Ciocalteu's colorimetric method. The antioxidant activity was determined by TEAC ^f assay using the ABTS ^b radical cation and ORAC ^g Fluorescein ^g .	Connection between the presence of flavonoids and antioxidant potential.
Khalil et al. (2008) [20]	ES: Aqueous extract from the leaves and subsequent freeze-drying. In vitro assays: ABTS ^b ; PMS ^c /NBT ^d /NADH ^e ; MPO.	Antioxidant action detected.
Souza et al. (2009) [21]	ES: Hydroalcoholic extract from the leaves and subsequent drying by spray drying and spouted bed. In vitro assays: 2,2-diphenyl-1-picrylhydrazyl radical (DPPH) and inhibition of lipid peroxidation induced by Fe +2 (LPO).	Antioxidant action detected on both techniques.
ANTIMALARIAL, ANTICOAGULANT, ANTIBACTERIAL, ANTIFUNGAL, ANTIPROLIFERATIVE		
Author and Date	Method used	Conclusion
Deharo et al. (2001) [22]	ES: Extract from the bark; In vivo assay: swiss mice infected with parasitized cells were treated for 3 days at escalating doses from 100 to 500mg/kg. The suppression of malaria was analyzed using blood smears.	No antimalarial action detected.
Souza et al. (2004) [23]	ES: Methanolic extract from the aerial parts, In vitro assay: Disk diffusion test against <i>Staphylococcus aureus</i> , <i>Staphylococcus epidermidis</i> , <i>Micrococcus luteus</i> , <i>Bacillus subtilis</i> , <i>Escherichia coli</i> , <i>Candida albicans</i> and <i>Saccharomyces cerevisiae</i> .	No activity detected, the microorganisms tested were resistant to the extract.
Oliveira et al. (2005) [24]	ES: Aqueous extract from the aerial parts: In vitro assay: the serine protease enzyme was isolated from the venom and mixed with the extract. All mixtures were incubated for 30-60 min at 37°C and the aliquots were tested in different test systems. The clotting activity was assayed with 200µL of human plasma.	High anticoagulant potential, but not suitable for the venom neutralization.
LIM et al. (2006) [25]	The compound HY52 (MF ^h = C17H30O2N2) was isolated from the leaves' ethanol extract and tested for antiproliferative activity against HeLa cells (human cervical adenocarcinoma) - In vitro assay.	Inhibited cell proliferation, keeping them at the G1 phase.
Svetaz et al. (2010) [26]	ES: ethanol extract; In vitro assay: Microdilution Technique for <i>Candida albicans</i> , <i>Candida tropicalis</i> , <i>Saccharomyces cerevisiae</i> , <i>Cryptococcus neoformans</i> , <i>Aspergillus flavus</i> , <i>Aspergillus fumigatus</i> , <i>Aspergillus niger</i> , <i>Trichophyton rubrum</i> , <i>Trichophyton mentagrophytes</i> , <i>Microsporum gypseum</i> and <i>Epidermophyton floccosum</i> .	Antifungal activity against <i>Trichophyton rubrum</i> ; <i>Trichophyton mentagrophytes</i> ; <i>Epidermophyton floccosum</i> .
Silva et al. (2012) [27]	Elucidation of a new lecithin, called BFL, extracted and purified from seeds of <i>B. Forficata</i> , in vitro test of its anticoagulant action.	BFL showed anticoagulant activity.

^aExtractive Solution, ^b2,2'-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid), ^cPhenazinemethosulfate, ^dNitrobluetetrazolium, ^eNicotinamide Adenine Dinucleotide, ^fTrolox equivalent antioxidant capacity, ^gOxygen radical antioxidant capacity using fluorescein as fluorescent probe, ^h Molecular Formula.

Diabetes is a multifactorial pathological condition characterized by continued high levels of blood glucose, which causes disturbances in the metabolism of carbohydrates, lipids and proteins. The total or partial absence of insulin and/or the receptors functional deficiency on the uptake of glucose are factors that can promote this condition [28]. Many plants are used as treatment for this pathological condition, and ethnopharmacological studies demonstrate the use of *B. forficata* L. by the population [9,23].

The first assays on the hypoglycemic activity of this plant

species were performed by Juliani in 1929 and 1931, and showed positive effects in diabetic patients [29]. Since then, several studies have been conducted using different animal models and also different preparations from *B. forficata* L.

In a study by [9], using the n-butanol fraction of the hydroalcoholic extract from *B. forficata* L., it was evidenced the presence of hypoglycemic action in normal and alloxan-induced diabetic mice. The presence of this action in normal mice led to the assumption that the possible mechanism of action occurs through the insulin catabolism delay or by

inhibiting reabsorption of glucose by the kidney. A similar result was found by Sousa *et al.* (2004), whose study also showed hypoglycemic action in normal and induced diabetic mice, using as test a flavonoid compound, Kaempferitrin isolated from the n-butanol fraction of the hydroalcoholic extract from *B. forficata* L leaves [13].

Concerning the hypoglycemic action, Lino *et al.* (2004) demonstrated the reduction on lipid parameters in mice treated with ethanolic, aqueous and hexanic extracts from *B. forficata* L. leaves [12].

The fasting glucose level of diabetic patients who used an infusion of *B. forficata* L. leaves for 75 days was compared to that of a group of people with the disease who did not use the tea. It has been found significant glucose reduction in the infusion user group [8]. This result corroborates with several other studies, which also tested the action of aqueous and hydroalcoholic extracts from *B. forficata* L leaves in normoglycemic and induced diabetic animal models (mice), and obtained satisfactory results concerning the reduction of blood glucose [10,12,14,16]. However, when it comes to this action in pregnant female mice, Damasceno *et al.* (2004) and Volpato *et al.* (2008) showed that the aqueous extract showed no hypoglycemic action at the doses tested. However, the extract was found to be safe and acted by increasing the levels of reduced glutathione (GSH) in diabetic mice, which implies an improvement in the oxidative effects caused by the hyperglycemic condition [15, 17].

Flavonoids are the main phytochemical constituents of this plant species and to them are assigned the main reasons for *B. forficata* L. hypoglycemic action. However, there are still many controversies regarding the mechanism of action through which these compounds act [12,8]. Although most of the studies prove *B. forficata* L. extract's action in reducing blood glucose, some studies show conflicting results, which may be explained by several factors such as: the experimental protocol used, the methodology for obtaining extracts, the environmental, seasonal and plant collection conditions, and its cultivation and storage. All these factors can qualitatively and quantitatively influence the presence of the plant's typical metabolites that are important to the development of the pharmacological action [9, 30-31].

The search for compounds with potential to inhibit or reduce oxidative damage caused by free radicals in the human body is increasingly real since a large number of diseases may be related to this condition. Free radicals can cause oxidative damage by biomolecules oxidation, which result in cell death and thus tissue damage [32-33].

The *in vitro* determination of the antioxidant capacity of the extracts and of the Kaempferitrin isolated from leaves of *B. forficata* L. was pointed in several studies [13, 19-21]. The flavonoids are responsible for the antioxidant activity present in several plants, and this relationship has been studied and proven to extracts of *B. forficata* L. for it having many flavonoids in its constitution [19].

A very promising feature concerning the pharmacological studies with this plant was the proof of maintenance of flavonoids and antioxidant and hypoglycemic activity in extracts that went through drying processes. Drying of plant extracts is extremely important to the development of intermediate and final pharmaceutical forms as it increases their physical and chemical stability and reduces the rate of microbial contamination, which is easily found in fluid extracts. There was proven antioxidant action in the dry extract obtained by the *spray dryer* and *spouted bed* methods. The drying by *spray dryer* promoted a larger degradation of total flavonoids than the *spouted bed* drying did, however both dry extracts showed similar antioxidant activity. Despite the further loss of flavonoids by the *spray dryer* method, possibly by high temperatures, the dried extracts similar antioxidant capacity may be related to the alleged formation of Maillard reaction products that might have contributed individually or in synergy with natural antioxidants to improve the overall antioxidants characteristics of the product [21].

Hydroethanolic fluid extracts were also subjected to oven drying and *spray dryer* and it was observed that besides the preserved flavonoid content it was demonstrated hypoglycemic action in diabetic-induced animal model [18].

Other pharmacological activities were sought in experiments with this plant species proving the presence of anticoagulant and antifungal action for the aqueous and ethanolic extracts, respectively, from *B. forficata* L. leaves [24,26]. Yet the inhibition of cell cycle progression in HeLa cells, human cell line, by a compound isolated from the plant named by the authors HY52 ($C_{17}H_{30}O_2N_2$) [25].

Studies included in this survey that sought the presence of antimalarial and antibacterial activity did not show positive results for these actions [22-23]. However, only one study was found for each situation, which leads to the need for more studies in different experimental conditions, to confirm the presence or absence of this pharmacological action.

Phytochemical Profile

Studies related to the research and elucidation of the phytochemical constituents of *B. forficata* L. totaled 30% of the studies found. The first to qualitatively describe through colorimetric and precipitation reactions the constituents present in *B. forficata* L. leaves extract was Miyake *et al.* (1986). In this study, alkaloids, flavonoids, essential oil, mucilage and tannins were found and subsequently, several studies have been conducted with the aim of isolating and quantifying these various compounds [34]. Table 2 shows the studies that brought up the search and isolation of the main phytochemical compounds of *B. forficata* L.

The genus *Bauhinia* is characterized by the accumulation of free and glycosylated flavonoids, while the main compounds reported for *Bauhinia forficata* L. comprise kaempferol and quercetin glycosides isolated mainly from the leaves [35-36].

The kaempferitrin (Figure 3) flavonoid was found in many studies and is considered as a chemical marker for quality control in preparations with *Bauhinia forficata* L. leaves [37,16,38,36].

The presence of volatile oils in the leaves of several species of the genus *Bauhinia* was studied by [39]. This study demonstrated the presence of monoterpenes and sesquiterpenes in the *B.forficata* L. species. In this very study the author suggests that

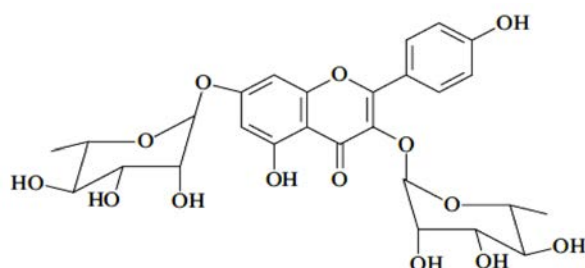
Table 2 - Phytochemical constituents present in *Bauhinia forficata* Link.

Author and Date	Part of the plant and method used	Constituents present
Miyake et al. (1986) [34]	Leaves/qualitative - colorimetric and precipitation reactions	Alkaloids, flavonoids, essential oil, mucilage and tannins.
Silva et al. (2000) [40]	Leaves/Isolation by column chromatography and identification by spectroscopy	β -sitosterol and Kaempferitrin
Pizzolatti et al. (2003) [35]	Leaves and Flowers/Isolation by column chromatography and identification by one- and two-dimensional NMR ^a techniques of ¹ H and ¹³ C.	Leaves: kaempferol, 3,7-di-O-a-L-rhamnopyranosylkaempferol, 3,7-di-O-a-L-rhamnopyranosylquercetin, 3-O-[β -D-glucopyranosyl-(1 6)-a-L-rhamnopyranosyl]-7-O-a-L-rhamnopyranosylkaempferol and 3-O-[β -D-glucopyranosyl-(16)-a-L-rhamnopyranosyl]-7-O-a-L-rhamnopyranosylquercetin Flowers: 7-O-a-L-rhamnopyranosylkaempferol.
Duarte-Almeida et al. (2004) [39]	Leaves/ Volatile oil extraction by steam distillation and analysis by GC / MS ^b	Monoterpenes (α -Pinene, Sabinene, β -Pinene, β -Ocimene); Sesquiterpenes (α -Copaene, β -Elemeno, β -Caryophyllene, γ -Elemeno, bicyclgermacrene, α -Humulene and copene isomers).
Faria et al. (2004) [41]	Seeds/ Isolation by successive extractions to obtain lipids and proteins.	Lipid fraction: linoleic acid, palmitic acid, stearic acid, oleic acid and gondoic acid; Protein Fraction: Globulins; basic glutelins, Prolamins, acid glutelin and albumins.
Pinheiro et al. (2006) [37]	Leaves/ Liquid chromatography	Kaempferitrin
Menezes et al. (2007) [16]	Leaves/ HPLC ^c and NMR ^a	Quercetin-3,7-O- dirhamnoside and kaempferol-3,7-O- dirhamnoside
Engel et al. (2008) [38]	Leaves/ TLC ^d and HPLC ^c	Kaempferitrin
Andrade et al. (2011) [42]	Leaves/ Isolation and purification from acetone precipitate, by chromatography on Sephadex G-25, canecystatin-sepharose, and Con A-Sephadex.	A new cysteine proteinase named Beaupain.
Marques et al. (2012) [31]	Leaves/ HPLC ^c	Kaempferitrin
Ferreres et al. (2012) [36]	Leaves/HPLC ^c	Flavonoids: Quercetin-3-O-(2-rhamnosyl)rutinoside-7-O-rhamnoside; Kaempferol-3-O-(2-rhamnosyl)glucoside-7-O-rhamnoside; Kaempferol-3-O-(2-rhamnosyl)rutinoside-7-O-rhamnoside; Quercetin-3-O-rutinoside-7-O-rhamnoside;Kaempferol-3-(2/3/4-di-rhamnosyl) glucoside;Kaempferol-3-O-(2-rhamnosyl) rutinoside; Kaempferol-3-O-rutinoside-7-O-rhamnoside;Quercetin-3,7-di-O-rhamnoside; Quercetin-3-O-rutinoside; Kaempferol-3-O-robinoside; Kaempferol-3,7-di-O-rhamnoside; Kaempferol-3-O-rutinoside; Kaempferol-3-O-rhamnoside
Silva et al. (2012) [27]	Seeds/ Ammonium sulfate fractionation, DEAE-Sephadex, Sepharose-4B and Superdex 75. Purification via HPLC ^c .	Isolation and purification of a new lecithin called BFL.

^aNuclear magnetic resonance, ^bGas Chromatography coupled to a mass spectrometer, ^cHigh Performance Liquid Chromatography, ^dThin Layer Chromatography.

Table 3 - Ethnopharmacological studies involving *Bauhinia forficata* Link.

Author and Date	Part used / Therapeutical Purpose
Di Stasi et al. (2002) [44]	Leaves / Hypoglycemic, Diuretic, High Blood Pressure
Souza et al. (2004) [23]	Leaves / Antimicrobial
Ferreira (2009) [45]	Leaves/Hypoglycemic, High Cholesterol, High Blood Pressure

Figure 3: Chemical structure of the 3,7-Di-O- α -rhamnopyranosylkaempferol (kaempferitrin).

the occurrence of sesquiterpenes as predominant constituents is a chemical characteristic of the genus *Bauhinia*.

Ethnopharmacological approach

Ethnopharmacology is the ethnobiology/ethnobotany branch dealing with medical practices, especially medicines used in traditional medicine systems. The most accepted definition for ethnopharmacology is "multidisciplinary scientific exploration of biologically active agents traditionally employed or observed by man" [43,24]. This knowledge leads the scientific community to investigate the constituents responsible for the pharmacological actions previously obtained by empirical and traditional use of medicinal plants. Subsequently, several experimental studies in different models are carried out for the establishment of scientific substantiation, which may be positive or not.

The *Bauhinia forficata* Link is widely used by local people for many different therapeutic purposes, being consecrated by its use as hypoglycemic. The ethnopharmacological studies found in this study showed its popular use for other therapeutic purposes such as reducing cholesterol and blood pressure, diuretic and antimicrobial [44, 23,45]. These data are shown in Table 3.

This systematic review showed that there already are experimental scientific evidences that proved *Bauhinia forficata* L. hypoglycemic and antioxidant action, besides other therapeutic actions previously mentioned. The evidence of antibacterial action, although cited by folk medicine, was not confirmed by Souza et al. (2004) in her studies with methanol extract from the aerial parts of this plant species, not promoting growth inhibition of some fungi and bacteria species [23]. Therefore, further studies should be performed in other conditions to assess this action.

CONCLUSION

Through this systematic review the great pharmacological potential of *Bauhinia forficata* Link was evidenced, especially as regards its auxiliary action in diabetes treatment, since many studies have shown positive results for this action. Evidences of its antioxidant action were also found, in addition to the isolation and elucidation of many important compounds for the development of these pharmacological actions, being the kaempferol and quercetin glycosides the main constituents responsible for these actions.

As prospects for the use of *B.forficata* Link, these results indicate the promising potential for the development of pharmaceutical dosage forms from this plant species.

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