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European Naturalists and Medicinal Plants of Brazil

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1. Introduction

Plants have been used as a food and medicinal source in the Americas for a long time. Historical registers demonstrate that Amerindians used avocado (*Persea americana* L.), sweet potatoes (*Ipomoea batatas* (L.) Lam.), mate (*Ilex paraguariensis* A. St.-Hil.) and cacao (*Theobroma cacao* L.) 10,000 years ago (Wolters, 1992). The Portuguese and Spanish brought several of these species to Europe at the beginning of the 16th century. There, they began to investigate the native beliefs about disease and the plants that cured them. The use of Brazilian plant remedies, such as copaiba (*Copaifera* spp.), jaborandi (*Pilocarpus* spp.), ipecacuanha (*Psychotria ipecacuanha* (Brot.) Stokes) and curares (*Chondodendron* spp.), have expanded to several parts of the world. In addition to the dissemination of knowledge, the plant remedies themselves were transported in great quantity (Ferrão, 2004). Medicinal plants are widely used in both rural and urban areas of Brazil. However, the intense miscegenation of cultures over the last centuries has popularized the use of exotic and imported plants in medicine. Most plants are used according to folk tradition, which was brought to the country by Europeans and Africans, popularizing European than indigenous medicine. Moreover, the growth of the pharmaceutical industry in Brazil during the second half of the 20th century markedly changed traditional Brazilian medicine.

Brazil's native vegetation is continuously suffering destruction in consequence of different economic cycles (Machado & Figuerôa, 2001). The first economic cycle in Brazil was due to the exploitation of redwood ("pau-brasil") along the coast by the Portuguese since the discovery of the country, lasting over 50 years. The wood of this species provides a deep red color, which was much used at the time to dye cloth, and more recently the only true wood for violins bows. In the second half of the 16th century the sugarcane plantations started, indicating that Portugal was really motivated to settle Brazil. For a period exceeding 150 years, sugar production accounted for almost the sole basis of the Brazilian economy. Actually, in the middle of the 17th century Brazil was the world's largest sugar producer, and at that time the first competitors started their production in Central America and the Caribbean. The third economic cycle is more or less simultaneous with the sugarcane cycle

and is due to cattle grazing, occupying vast territories in Brazil, initiating the march towards the west. Then gold gave rise to the fourth economic cycle at the end of the 17th century, after the discovery of rich alluvial deposits in Minas Gerais. For some authors, diamonds is responsible for the fifth economic cycle, starting in 1729 and lasting 140 years, until South Africa emerged as the major producer. It is considered that in the 17th and 18th centuries, Brazil contributed ca. 50% of the world production of gold and diamonds, promoting the prosperity and luxury of the Portuguese crown. At that time, baroque art flourished in Minas Gerais, with Ouro Preto the most outstanding monument of this glorious past. Coffee gives its name to the sixth economic cycle, and the first large-scale plantations began in 1835, after the independence of Brazil from Portugal (Dean, 1996) . Finally, in the last years of the 19th century rubber production started in the Amazon, giving rise to the seventh economic cycle. After this cycle, our economy became so diversified through industrialization that it would not be adequate to define more specific cycles as such. Currently, however, several projects, including the expansion of ethanol production, mining and Soyabean cultivation, threaten what remains of the native vegetation (Martinelli et al., 2010; Sawyer, 2008). With the exception of rubber, all of these processes have brought serious consequences to the native vegetation in Southeastern Brazil.

In a recent study, we evaluated the knowledge of the population in the mining region of Minas Gerais (Royal Road) on several species of native medicinal plants described by the work of naturalists. We interviewed 152 men and 54 women, between 65 and 90 years of age, recognized as experts on the native medicinal plants. These people were born before the 1940s, i.e., prior to the urbanization and industrialization of Minas Gerais and to the introduction of large-scale drug manufacturing, which has been occurring in Brazil since the 1950s. Each informant was asked whether he knew and/or has used any of the 20 species of native plants registered in the 19th century, and if so, where they were collected. The survey demonstrated that the population knew little to nothing about most of the surveyed species or their current applications. Almost all of the respondents learned about medicinal plants from their families, but their descendants were not interested in pursuing this knowledge. A small percentage of younger respondents (5%) revealed that knowledge about these plants was not being passed to new generations. Our study showed that some of the plants of the Royal Road remain unknown today, as is the case with *Zanthoxylum tingoassuiba* A. St-Hil. (Rutaceae, tinguaciba), which went unrecognized by all informants. In contrast, some species that were described by the naturalists are currently known and used. However, their uses differ from past applications (Santos et al., 2011). This survey reveals the urgent need to recover the information describing the utility of the native plant species and to promote further studies on their ecology and conservation (Giulietti et al., 2005; Michalski et al., 2008).

Historical research can be vital for recovering valuable ethnopharmacological data regarding the use of plants (Medeiros, 2008). Much of the available information about the use of native medicinal plants in Brazil has been compiled by European naturalists that traveled throughout the country in the 19th century. The data recorded in their books served as an important source of information about the use of plants. At that time, the native flora was conserved, and Brazilian species were predominantly used. The contributions to the understanding of Brazilian flora made by these naturalists are incalculable. Hundreds of new plants were discovered, and innumerable new genera were described based on the material that they collected. Several naturalists have traveled widely in the southwest

province of Minas Gerais and have recorded both the biological and mineral richness of the region (Brandão et al., 2008b). The main objective of our research group is to retrieve and disseminate information and images of useful native species (www.dataplamt.org.br). In this script, we discuss the important work undertaken by European naturalists, who traveled through Brazil in the nineteenth century recording plant knowledge and their uses.

2. A brief history

Brazil was a Portuguese colony between 1500 and 1822. Most of the information about the uses of native plants was collected by the Jesuits during Brazil's colonization. They were the first to have direct contact with the Amerindians since the beginning of colonization. The Jesuits attracted the attention of the Portuguese repeatedly in their reports on the potential and utility of Brazilian medicinal plants. For example, the Theriacs, electuaries prepared by mixing the extracts of many plants, originated from ancient Rome and have been used as remedies for all kinds of envenomation. The Jesuits have incorporated Native American species in this remedy, termed "Triaga Brasilica", which was used to treat fevers and venom from snakes and other animals (Pereira et al., 1996). In the seventeenth century, Northeast Brazil was invaded by the Dutch. The doctor William Piso lived in this region for eight years, and in his book "Historiae Naturalis & Medicae", published in 1648 in Holland, he described the uses of various native plants by the Amerindians (Pisonis, 1648). The data contained in this work remains a major source of information on the biodiversity in Brazil throughout the late 18th century.

Brazil remained under the rigid control of the Portuguese until the early nineteenth century. This policy was intended to hide the potential of the natural resources from other nations. The German naturalist Alexander von Humboldt, who extensively explored northern South America from 1799 to 1804 (Humboldt, 1993), was banned from entering Brazil, indicative of this strict policy. Instead, Portugal sent Brazilian Alexandre Rodrigues Ferreira, who had traveled the Brazilian Amazon and the Pantanal for ten years to collect information and native plant and animal specimens (França, 1922). In 1808, Bonaparte's invasion of Portugal drove the Portuguese royal family to re-settle in Rio de Janeiro. There was remarkable progress in the economy and in culture and science during the thirteen years that they lived in Rio de Janeiro, wherein foreigners gained permission to enter the country. Several European naturalists, artists and scientists traveled the vast Brazilian territories, registering the mineral, animal and vegetal resources as well as the customs of the inhabitants. Thus, a cycle of scientific expedition sponsored by different nations began the systematic production of works in Brazil. The information gathered by naturalists contributes greatly to the growing knowledge of South American biodiversity and has led to significant advances in understanding the continent's natural history.

The naturalists were supported by the governments of their countries. Furthermore, the liberalism of the Portuguese court in Rio de Janeiro promoted incentives to attract scientific missions. The lack of skilled personnel in Brazil, due to centuries of colonial dependency and exclusivity imposed by Portugal, developed the need for the services offered by foreigners. Different interests attracted European naturalists to Brazil. Some came following the European court, such as Pohl and von Martius, whereas others were invited to come to work, such as Mawe, Saint-Hilaire and Burton. The large numbers of travelers, scientists and artists that arrived at the port of Rio de Janeiro, the main port of arrival, prohibit us from knowing precisely how many came to Brazil during at that time. Once having explored

Rio de Janeiro, travelers were interested in penetrating into the interior of the country, primarily into the mining zone in Minas Gerais (Leite, 1996).

Twenty-four foreign naturalists are known to have traveled through Minas Gerais during the 19th century, which is particularly interesting due to its status as the world's largest gold producing region at that time. Production strongly declined when new areas became available for mining in California, Australia, South Africa and Alaska. Consequently, new economic activities prevailed, such as agricultural development, described by naturalists Saint-Hilaire and Mawe, and included a greater substitution of native vegetation by sugar cane, coffee and cattle grazing. Despite the exhaustion of gold, incentives to create innovate techniques for exploring deeper auriferous and iron veins persisted.

Thus, the province of Minas Gerais was heavily visited by European naturalists throughout the nineteenth century. Their bibliographies document their observations about the various aspects of Brazilian life, including the use of medicinal plants. Today, the State of Minas Gerais, whose area is approximately that of France, is the second most industrialized in Brazil and was the most populated until 1940, when São Paulo's industrial growth began to polarize national migration flows. Minas Gerais exhibited a remarkable ecological diversity. Four of Brazil's six main biomes occur in Minas Gerais, viz. the Atlantic Forest in the East, savannas in the West, Caatinga in the North, and *Araucaria* Forests in the South. Consequently, hundreds of medicinal plant species were available, a situation different from that observed today because most of the medicinal plants used by the population are exotic (Brandão et al., 2006a; Rodrigues & Carvalho, 2007; Schmeda-Hirschmann & Arias, 1990; Stehmann & Brandão, 1995). Prior to the 19th century, 45% of the territory was covered by forests and extensive unexplored savannas, and a strong interaction between the native Amerindians and the more recently arrived inhabitants of the agricultural areas remained. This interaction was vital for the success of the expeditions conducted by visiting naturalists. The locals assisted with locating and identifying plants by sharing the popular nomenclature and indicating the best regions for research (Moreira, 2002). The native knowledge of the plants and their uses was mentioned by several naturalists. For example, Saint-Hilaire discussed the necessity of creating commissions to document how the plants were used by the native people (Saint-Hilaire, 1824a, 1824b).

These naturalists' diaries demonstrated the extensive use of Amerindian medicinal plants by the population. According to some authors, the knowledge about the Amerindian medicinal plants held by the natives was the only aspect of their culture that was respected by the Portuguese. Undoubtedly, one of the biggest naturalistic interests of that period was to learn from the Brazilian population the medicinal utilities of their plants, as Saint-Hilaire states:

"*in all part that I stopped, I had always the care to ask which were the plants most used in the region*"

Viagem pelos distritos dos diamantes e litoral do Brasil
(Journey through the diamond district and the coast of Brazil)
Saint-Hilaire, 1975a

However, the intense mining, extensive cattle ranching and coffee plantation development during the 18th century through the 20th century culminated in the substitution of much of the state's native vegetation by pastures, agriculture and eucalyptus monoculture reforestation. Today, almost 600 plant species are approaching extinction in Minas Gerais (http://www.ibama.gov.br).

3. The European naturalists that traveled throughout Minas Gerais

Most European naturalists that described the use of medicinal plants, who traveled in the state of Minas Gerais in nineteenth century, were Austrian, German, English and French. They arrived in Brazil interested in studying the natural resources of Brazil and assessing their potential utility. Arriving at Rio de Janeiro, after several excursions through the coastal area, naturalists traveled to other sites, including large tracts of the vast Brazilian territory.

In 1817, the marriage of the daughter of the King of Austria (Leopoldina) to the heir of Portugal (Pedro I) promoted a visit by a delegation of Austrian and German naturalists, including Johann Emanuel Pohl (1782–1834) and K. F. von Martius (1794–1868). Pohl was a botanist who resided in Brazil from 1817 to 1821. He left in September 1818, beginning a long journey through the provinces of Minas Gerais, Goias, Mato Grosso and Para, which was one of the greatest journeys made in Minas Gerais in the nineteenth century (Pohl, 1976). He documented his observations on the Brazilian flora in "Plantarum Brasiliae Icones et Descriptions" in 1827 (Pohl, 1827). Karl Friedrich Philipp von Martius journeyed with Johann Baptist von Spix throughout much of the country, traveling over 10,000 kilometers from 1817–1820. They travelled from Rio de Janeiro toward São Paulo, Minas Gerais, Bahia, Pernambuco, Piaui, Maranhão, Para and Amazonas. Spix was a zoologist and the curator of a museum in Munich. They published several books in the fields of botany and zoology. Before he died, six years after returning to Europe, he documented almost all of their travels, along with Martius. The "Flora Brasiliensis", organized by von Martius, describes twenty thousand species, six thousand of which were unknown at that time (Spix & Martius, 1981; www.florabrasiliensis.cria.org.br).

The German physician G.H. von Langsdorff's (1774–1852) expedition was integrated by the illustrator Rugendas and the botanical Riedel, who was in charge of the collection and registers of the American plants. The Amerindian use of plants was infrequently documented in his travel diaries (Silva, 1997a, 1997b, 1998). He was the Consul General of Russia and lived on the outskirts of Rio de Janeiro from 1813. He enthusiastically supported and promoted scientific explorations and traveled from São Paulo to Pará, passing through Mato Grosso. In 1815, Maximilan von Wied-Neuwied arrived in Rio de Janeiro to explore the Brazilian coast with funding from European museums (Neuwied, 1989). He was accompanied by the zoologist Freireyss (1789–1825). Georg Wilhelm Freireyss was an organizer of zoological and botanical collections of the Museum of Stockholm. In 1814, he journeyed to Minas, passing through Villa Rica and the tribes of the Coroados and Puris (Freireyss, 1982). The zoologist Hermann Burmeister (1807–1898) arrived in Brazil in late 1850. He stayed for five months as a monitor of Danish Peter W. Lund, who had explored paleontological traces in Lagoa Santa since 1834 (Burmeister, 1958).

Several English naturalists who visited Brazil in the nineteenth century and recorded the use of medicinal plants, including John Mawe, Charles Fox Bunbury, George Gardner and Richard Burton. John Mawe (1764–1829) was the first to obtain permission to travel to Minas Gerais. He arrived in 1807 with extensive experience in working and traveling in the mines of England and Scotland in search of specimens for a mineralogical collection of the King of Spain. He was in Brazil between 1807 and 1811, and although he was not a specialist in botany, his book extensively describes the use of medicinal plants (Mawe, 1978). Charles James Fox Bunbury arrived in Rio de Janeiro in July 1833 and stayed there until December, when he embarked for the River Plate, visiting Montevideo and Buenos Aires. He returned to Brazil in 1834, where he began preparations for his trip, and left for the interior to explore the British gold mines. He

returned to Europe in January 1835 (Bunbury, 1981). The botanist George Gardner (1812–1849) arrived in Rio de Janeiro in 1838, where he resided for five years, traveling the provinces of Bahia, Alagoas, Pernambuco, Ceará, Piauí, Goiás and northern Minas Gerais (Gardner, 1975). Richard Francis Burton (1821–1890) was an anthropologist, traveler and writer who belonged to the Royal Geographical Society and is best known for his travels in Africa. He frequently journeyed around the country, particularly from Rio de Janeiro to Minas Gerais. Part of the route was made by canoe, from Sabará to the Atlantic Ocean, the Rio das Velhas and São Francisco rivers. He was generally interested in the nature of Brazil and its potential, including the use of medicinal plants (Burton, 1977).

The French botanist Auguste de Saint-Hilaire, born in Orleans in 1779 and died in the Turpinière in 1853, had the opportunity to come to Brazil in the company of the Duke of Luxembourg and was appointed to ambassador in Rio de Janeiro. He arrived in 1816 and returned to Europe in 1822. During this period, he explored the province of Minas Gerais and then headed south, crossing the provinces of Rio de Janeiro, Sao Paulo, Santa Catarina, Rio Grande do Sul and Uruguay. In addition to observing the collection of botanical material, he never failed to record the habits and customs of the habitants. He was very concerned about the deforestation leading to grazing and other activities occurring at that time. He returned to France carrying 7,000 plants, 2,500 birds, 16,000 insects, 129 quadrupeds, 35 reptiles, 58 fish and shellfish and various minerals to contribute to the Museum of Paris. Saint-Hilaire dedicated the rest of his life to the study of the material collected during these trips and to teaching as a professor of botany at the School of Sciences in Paris. Francis de la Porte Castelnau was born in 1812 in London, but his family belongs to the aristocracy of Central and Southern France. His studies in Brazil primarily included geology and zoology, but he also collected ethnographic information on the tribes and cultures that he visited. He explored the provinces of Minas Gerais, Goias and Mato Grosso. Alcide Dessalines d'Orbigny was born on the outskirts of Nantes, France in 1802 and died in Seine-Saint-Denis on 1875. He was the son of a physician and an amateur naturalist, becoming interested in natural sciences early in life. In 1820, his family moved to the seaside town La Rochelle, where he began his studies with microscopic marine fauna. Between 1831 and 1834, the 24-year-old D'Orbigny formed part of an integrated mission from the Museum of Natural History in Paris to South America, where he visited Brazil, Argentina, Paraguay, Chile, Bolivia and Peru, when he was twenty-four years old. He returned to France with a collection of over 10,000 objects of natural history (D'Orbgni, 1976).

4. Naturalist interest in medicinal plants

During colonial times, most drugs and medicines circulating in Minas Gerais were obtained directly from Portugal. The long distance between Rio and Minas posed several problems, but drugs continued to arrive from Portugal to Rio de Janeiro and Bahia and were transported on mules to the countryside. The process was lengthy, and the difficult transport conditions endangered the quality of the medicines. Throughout the eighteenth century, the medical literature reported the widespread use of native Brazilian drugs, whose virtues had been advocated since the beginning of colonization. Gradually, the apothecaries and surgeons, particularly in Minas Gerais, started to incorporate the herbs into their recipes. Luis Ferreira Gomes, author of Erario Mineral (2002), warned that the "herbs, roots, minerals and animal things have bad conditions and that the pharmacies should develop local drugs that incorporate them. Inhabitants that were practicing medicines in the Province began to describe

and better understand the local flora and fauna to incorporate them into the medical field. Naturalists traveling to Brazil aimed to examine the local biome using more precise methods, including the Linnaean system of classification (Furtado, 2005). The contribution of these naturalists to the knowledge of the Brazilian flora is incalculable. Hundreds of new plants were discovered, and innumerable new genera were described. Much of the information on the use of the native species of Minas Gerais is described in their bibliographies.

Independent of the work in the field, the European naturalists were interested in recording different aspects of native vegetation, including the use of Brazilian medicinal plants. They recorded more than 300 useful species, especially Burton, Saint-Hilaire and von Martius (www.dataplamt.org.br). Burton and Saint-Hilaire suggested several improved ways to use the natural resources, criticizing the destructive manner used by the Portuguese, and followed by the Brazilians. The use of several medicinal species is described in their traveler books. Von Martius and Saint-Hilaire also documented their thoughts about the use of medicinal plants in "Systema Materiae Medicae Vegetabilis Brasiliensis" (1843) and "Plantes Usuelles des Brasiliens" (1824a), respectively. Thus, von Martius and Saint-Hilaire have significantly contributed to the knowledge of the utility of native Brazilian plants. Besides describing new species, they made comparisons between the Brazilian plants and those commonly used in Europe.

Table 1 presents medicinal species registered by three or more naturalists in Minas Gerais. Data were obtained from the diaries of A. Saint-Hilaire (Saint-Hilaire, 1975a, 1975b, 1975c, 1975d), J. Spix & K. Martius (1981), R. Burton (1977), G. Gardner (1975), J.E. Pohl (1976), G.H. von Langsdorff (Silva, 1997a, 1997b, 1998), H. Burmeister (1958), A D´Orbigny (1976), C.J.F. Bunbury (1981), J. Mawe (Mawe, 1978), G.W. Freireyss (1982), M.W. Neuwied (1989) and Castelnau (1949). The books that specifically expounded on the use of medicinal plants, "Plantes Usuelles des Brasiliens" (Saint-Hilaire, 1824a) and "Systema Materiae Medicae Vegetabilis Brasiliensis" (Martius, 1854), were also used in the study.

The names of certain species mentioned by J.E. Pohl and A. Saint-Hilaire were confirmed by consulting the original collections in the Natural History Museums in Vienna and Paris, respectively. The names of plants cited by von Martius were verified at the website www.florabrasiliensis.cria.org.br. English names for each species and their family placement were updated using the data from the Missouri Botanical Garden's website Tropicos database at www.mobot.org. The species cited by von Martius and Saint-Hilaire in their books on medicinal plants are marked with an "*".

FAMILY AND SCIENTIFIC/ POPULAR NAMES	SH	MT	BR	GA	PO	LG	BU	DO	BN	MW	FR	MX	CA
Rubiaceae													
Psychotria ipecacuanha (Brot.) Stockes./ Ipecacuanha, poaia	x*	x	x		x	x	x	x		x	x		
Amaranthaceae													
Gomphrena officinalis Mart./ Paratudo	x*	x		x			x		x				
Aristolochiaceae													
Aristolochia cymbifera Mart. & Zucc./ Jarrinha, Cassaú	x	x	x			x		x					

FAMILY AND SCIENTIFIC/ POPULAR NAMES	SH	MT	BR	GA	PO	LG	BU	DO	BN	MW	FR	MX	CA
Leguminosae *Anadenanthera colubrina* (Vell.) Brenan.; *A. rigida* Benth./ Angico			x			x	x	x		x			
Leguminosae *Senna occidentalis* L./ Fedegoso	x	x	x		x	x							
Leguminosae *Stryphnodendron adstringens* (Mart.) Coville./ Barbatimão	x	x	x		x	x							
Aquifoliaceae *Ilex paraguariensis* A. St.-Hil./ Mate	x	x	x	x									
Asteraceae *Lychnophora pinaster* Mart., *L. affinis* Gardner/ Arnica		x	x	x	x								
Myrtaceae *Eugenia dysenterica* DC./ Cagaiteira	x	x	x	x									
Rubiaceae *Remijia ferruginea* (A.St-Hil.) DC / Quina mineira, quina da serra	x*	x*	x		x								
Vochysiaceae *Qualea grandiflora* Mart./ Pau Terra	x	x		x	x								
Anacardiaceae *Schinus terebinthifolius* Raddi / Aroeira	x	x*	x										
Annonaceae *Annona crassiflora* Mart./ Araticum	x	x		x									
Asteraceae *Baccharis trimera* (Less.) DC./ Carqueja amarga	x	x*							x				
Bignoniaceae *Tabebuia impetiginosa* (Mart. ex DC.) Standl./ Ipê-Roxo	x		x		x								
Capparaceae *Colicodendron yco* Mart/ icó		x*	x		x								

FAMILY AND SCIENTIFIC/ POPULAR NAMES	SH	MT	BR	GA	PO	LG	BU	DO	BN	MW	FR	MX	CA
Euphorbiaceae *Croton fulvus* Mart., *C. campestris* A. St.-Hil./ Velame-do-campo	x	x	x										
Euphorbiaceae *Croton perdicipes* A. St.-Hil./ Pé de perdiz, alcanfora	x*	x*	x										
Lamiaceae *Hyptis fruticosa* Salzm. ex Benth., *H. spicata* Poit., *H. fasciculata* Benth./ Hortelã do campo	x	x*		x									
Lecythidaceae *Lecythis ollaria* Loefl./ Sucupira, sapucaia			x				x	x					
Leguminosae *Bauhinia forficata* Link/ Unha de vaca, unha-de-boi	x		x	x									
Leguminosae *Copaifera* spp. / copaíba	x	x	x										
Malpighiaceae *Byrsonima verbascifolia* (L.) DC./ Murici, guiné	x	x			x								
Simaroubaceae *Simarouba versicolor* St. Hil./ Paraíba	x*	x*		x									
Solanaceae *Solanum lycocarpum* A. St.-Hil./ Lobeira	x		x				x						
Verbenaceae *Lantana pseudo-thea* Schauer / Chá de pedestre	x		x			x							
Total of plants	22	20	19	09	09	06	05	04	02	02	01	01	01

SH= Saint-Hilaire, MT= Martius, BR=Burton, GA= Gardner, PO= Pohl, LG= Langsdorff, BU=Burmeister, DO= D'Orbigny, BN=Bunbury, MW= Mawe, FR= Freireyss, MX= Maximilian Neuwied, CA=Castelnau

* Books specific about medicinal plants: Plantes usuelles des Brasiliens and Systema Materiae Medicae Vegetabilis Brasiliensis

Table 1. The native medicinal species registered by three or more European naturalists along the Royal Road, Minas Gerais, Brazil.

The naturalists A. de Saint-Hilaire (22 species), K. von Martius (20) and R. Burton (19) cited a larger number of plants along the Royal Road, Minas Gerais. Their travel books described the species *Psychotria ipecacuanha* (Rubiaceae), *Aristolochia cymbefera* (Aristolochiaceae), *Senna occidentalis* (Leguminosae), *Stryphnodendron adstringens* (Leguminosae), *Ilex paraguariensis* (Aquifoliaceae), *Eugenia dysenterica* (Myrtaceae), *Remijia ferruginea* (Rubiaceae), *Schinus terebinthifolius* (Anacardiaceae), *Croton fulvus* and *C. campestris* (Euphorbiaceae) and *Copaifera* spp. (Leguminosae). The most cited species included *Psychotria ipecacuanha* (Rubiaceae), *Gomphrena officinalis* (Amaranthaceae) and *Remijia ferruginea* (Rubiaceae), which were described by Saint-Hilaire in his book on the use of medicinal plants, "Plantes Usuelles des Brasiliens" (Usual Plants from Brazilians; Saint-Hilaire, 1824a). Similarly, the species *Schinus terebinthifolius* (Anacardiaceae), *Baccharis trimera* (Asteraceae), *Colicodendron yco* (Capparaceae), *Croton perdicipes* (Euphorbiaceae) and *Hyptis* spp. (Lamiaceae) were described by von Martius in his book "Systema Materiae Medicae Vegetabilis Brasiliensis" (1843). The utility of *Remijia ferruginea* (Rubiaceae), *Croton perdicipes* (Euphorbiaceae) and *Simaruba versicolor* (Simarubaceae) was included in both books, which indicates the medicinal importance of these species at that time.

Naturalists cited the species Rubiaceae *Psychotria ipecacuanha* (Brot.) Stokes, then called *Cephaelis ipecacuanha* (Brot.) A. Rich. (ipecacuanha or poaya), most frequently. Its use was described by Saint-Hilaire, von Martius, Burton, Pohl, Langsdorff, Burmeister, D'Orbgni, Mawe and Freyress. This species originated in the Atlantic Forest and has been used for centuries by Native Americans as an anti-diarrheal and emetic. The roots of this species were extremely valued by Brazilians at that time, when approximately four tons were transported annually from Rio de Janeiro to Portugal. The use of this plant and its exploration have been widely observed by Saint-Hilaire, von Martius, Burton, Pohl, Langsdorff, Burmeister, D'Orbgni, Mawe and Freireyss. All of the naturalists were concerned about the possible extinction of this species. The extensive exploitation of this plant since the eighteenth century has led to its rarity and endangered status, as declared by the Environment Agency of Brazil (Oliveira & Martins, 2002). Traditional uses of *P. ipecacuanha* as an emetic and anti-diarrheal have been confirmed by several pharmacological studies, which illustrated that their medicinal actions are due to the presence of the alkaloids emetine and cephaeline in the plant. These substances act specifically on *Entamoeba*, parasites that cause diarrhea, which were prevalent and often fatal at that time. Because of its importance in medicine, this species is included in the official lists of the pharmacopoeia of many countries and of the World Health Organization (WHO, 2007).

Table 1 presents the other frequently mentioned species that were registered by five naturalists in Minas Gerais: *Gomphrena officinalis* Mart. (Amaranthaceae, paratudo), *Aristolochia cymbifera* Mart. & Zucc. (Aristolochiaceae, jarrinha, cassaú) and the Leguminosae *Anadenanthera colubrina* (Vell) Benth (Angico), *Senna occidentalis* L. (fedegoso) and *Stryphnodendron adstringens* (Mart.) Coville (barbatimão). From these, *G. officinalis* was registered by Saint-Hilaire in his book "Plantes Usuelles des Brasiliens" (Saint-Hilaire, 1824a). *Senna officinalis* and *Stryphnodendron adstringens* were recorded by the same naturalists (Saint-Hilaire, von Martius, Burton, Pohl and Langsdorff), indicating a consistent cataloging of the use of these plants.

The species *G. officinalis*, *Aristolochia* spp., *R. ferruginea*, *B. trimera*, *B. forficata* and *S. versicolor* were used to treat fever and malaria. At that time, several plants were used by the population of Brazil to treat fevers, which were a common health problem. The intermittent fevers were the most dreaded and exhibited symptoms typical of malaria, a disease caused by the *Plasmodium* parasite, which can lead to death. The search for the malaria cure began

in the seventeenth century, when the Spaniards identified the bark of the *Cinchona* genus, especially the Peruvian native *C. succiruba*, which was used by Native Americans to treat fevers. These plants were known as the popular "quina". They produce quinine, a potent drug against malaria that is still used to treat cases of chemotherapy-resistant parasites. *Cinchona* species are not found in Brazil, but the name of quina is ascribed to many other medicinal plants. Naturalists, particularly Saint-Hilaire, mentioned several of these plants. He regarded the bark of Quina-mineira or Quina-da-serra (*Remijia ferruginea* (A. St.-Hil.) DC., Rubiaceae) to be a very effective treatment for fevers, similar to the uses of Carqueja (*Baccharis trimera* (Less.) DC., Asteraceae) and the Unha de vaca ou Pata-de-vaca (*Bauhinia forficata* Link, Fabaceae). Today, only *R.ferruginea* has been evaluated for its anti-malarial potential, which has displayed some activity, demonstrating the importance of traditional information. Indeed, malaria remains one of the most devastating diseases in the world that affects millions of people annually in the tropics and subtropics. The other species mentioned by St. Hilaire should be tested, especially those belonging to the family Rubiaceae, the same botanical family as *Cinchona* spp.

Saint-Hilaire described a plant originating in South America, the mate, *Ilex paraguariensis* A. St.-Hil. The infusion of the plant was already used by American Indians before the arrival of the Europeans, and its use was found in Minas Gerais. This plant is currently used in Argentina, Paraguay, Uruguay and southern Brazil and is one of Southern Brazil's major exports. The *I. paraguariensis* is promising due to the high caffeine content and its use as a digestive. Studies have illustrated the beneficial action of the tea plant as a choleretic, thus confirming its traditional use.

The remedies of the plants described by the naturalists were rapidly incorporated into medical practice. By 1854, the book "Systema Materiae Medicae Vegetabilis Brasiliensis " had been translated into Portuguese (Martius, 1954). The Danish Doctor Theodore Langgaard (1813-1883) came to Brazil in 1842, and in 1846, he published the "Dictionary of Domestic and Popular Medicine" (Langgaard, 1865). This book came in two editions, with nearly 1,500 pages, and described many native Brazilian medicinal plants. Chernoviz (1812-1881) was born in Poland (Lukov) and was forced to emigrate as a young medical student at Warsaw University. He continued his studies in France, and in 1837, he obtained his doctorate in medicine from the University of Montpellier. In December of that year, his diploma was recognized by the medical school of Rio de Janeiro, and he was accepted into the Imperial Academy of Medicine. He wrote several seminal books, including "Dicionário e Guia Médico" and "Manual de Medicina Popular", that were widely used by doctors and pharmacists until the publication of the Brazilian Official Pharmacopoeia in 1929. Recipes, that included several species are registered in this book as *Gomphrena officinalis* Mart, employed as digestive promoters, anti-diarrheal agents, fever reducers, *Simarouba versicolor* A. St.-Hil., used to kill lice in humans and in animals, and *Croton* spp., used as a sudorific and a stimulant, as shown in Table 2 (Chernoviz, 1996; Guimarães, 2005).

5. The contributions of European naturalists in valuing Brazilian biodiversity

The use of medicinal plants and herbal medicine is expanding worldwide. The current demand for complementary and alternative medicine may be in part due to the dissatisfaction with conventional medicine or the high cost of manufactured drugs. Their popularity has prompted pharmaceutical companies to invest in research and patenting of new bioactive compounds or extracts standardized for the preparation of new products. Brazil has

enormous potential for the discovery of new bioactive substances, home to one of the most diverse floras on the planet and to traditional medicine practiced by the Amerindians, which has been superficially studied. The World Health Organization, while recognizing the traditional use of plants for therapy, stresses the need for their validation. These studies would include the validation of the efficacy and safety of the plant, which are essential requirements for the employment of any medicine. These products, referred to as herbal medicine, must be well manufactured and be widely available at a low cost. In Europe, herbal medicines have been used for many decades, and most of them are standardized and prescribed by doctors. China and India have considerable experience in using plants as medicine, despite the fact that their efficacy has not been tested by pharmacological assays.

Family/Scientific name	Vernacular name	Popular uses / Indications	Studies related to the popular use
Anacardiaceae			
Schinus mucronulatus Mart.	Aroeira, Corneiba	ulcers	Lucena et al., 2006
Apiaceae			
Eryngium lingua tucani Mart.	Língua de Tucano	diuretic, inflammations	none
Apocynaceae			
Plumeria drastica Mart.	Tiborna	intermittent fevers, jaundice	none
Asteraceae			
Mikania officinalis Mart.	Coração de Jesus	tonic, stimulant, fevers	none
Bignoniaceae			
Zeyheria montana Mart.	Bolsa de pastor	against diseases of the skin	none
Clusiaceae			
Kielmeyera speciosa A. St. Hil.	Malva do campo	bath emollients	none
Combretaceae			
Terminalia argentea Mart.	Caxaporra do gentio	purgative	none
Convolvulaceae			none
Piptostegia pisonis Mart.	Ipú	purgative	
Cucurbitaceae			
Trianosperma ficifolia Mart	Abóbora do mato, Tayuyá,	hidropsy, amenorrhea, ulcers	none
Cayaponia cabocla (Vell.) Martius	Purga de gentio, caboclo	purgative, depurative	none
Dilleniaceae			
Davilla elliptica A. St. Hil.	Sambaibinha	astringent, inflammations	Azevedo et al., 2007; Kushima et al., 2009
Curatella cambaiba St. Hil.	Sambaiba	astringent, ulcers	Hiruma-Lima et al., 2009

Family/Scientific name	Vernacular name	Popular uses / Indications	Studies related to the popular use
Euphorbiaceae			
Croton perdicipes A. St. Hil.	Pé de perdiz	sudorific, wound healing	none
Croton campestris A. St. Hil.	Velame do campo	purgative	none
Fabaceae			
Cassia cathartica Mart.	Sene do campo	diuretics, tonic, purgative	none
Acacia jurema Mart.	Jurema	ulcers	none
Gentianaceae			
Lisianthus amplissimus Mart.	Genciana brasileira	febrifuge	Carvalho et al., 1991
Loganiaceae			
Strychnos pseudoquina St. Hil.	Quina do campo	intermittent fevers	Andrade-Neto et al., 2003
Malvaceae			
Helicteres sacarolha A. St. Hil.	Sacarolha	emollient, inflammations	none
Pavonia diuretica A. St. Hil.	Malva diurética	emollient, diuretics	none
Meliaceae			
Moschoxylon catharticum Mart.	Marinheiro de folha miúda	intermittent fevers	none
Moraceae			
Dorstenia opifera Mart.	Caapiá, Contraherva,	fevers, emmenagogue	none
Rubiaceae			
Cinchona ferruginea A. St. Hil.	Quina da serra	intermittent fevers	Andrade-Neto et al., 2003
Rutaceae			
Ticorea febrifuga St. Hil.	Três folhas brancas	intermittent fevers	none
Simaroubaceae			
Simaba ferruginea A. St. Hil.	Calunga	dispepsy, intermittent fevers	none
Simaroruba versicolor St. Hil.	Parahyba	kills lice	Coelho et al., 2006
Verbenaceae			
Lantana pseudothea St. Hil.	Chá de pedestre	stimulant	none
Violaceae			
Anchietea salutaris A. St. Hil.	Piragaia	purgative	none

Table 2. The medicinal uses of the species discovered and described by A. de Saint-Hilaire and von Martius and published by Chernovicz in 1869 (Chernovicz, 1996).

Very few plants mentioned by the naturalists have been subjected to pharmacological analysis, but all of the species that have been evaluated have shown promising results. Activities have been confirmed for the çambaibinha (*Davilla elliptica* A.St.-Hil.) as anti-inflammatory, pinhão de purga (*Jatropha curcas* L.) as a purgative, the quina (*Strychnos pseudoquina* A.St.- Hil., *Remijia ferruginea* DC.) as anti-malarial, capeba (*Piper umbellatum* L.) and the casca d'anta (*Drimys winteri* JRForst.) as analgesic. These results confirm the importance of traditional information obtained from the naturalists for developing new products.

In Brazil, many medicinal plants have become important in conventional medicine, as indicated by their inclusion in the 1st edition of the Brazilian Pharmacopoeia (Brandão et al., 2006b; Brandão et al., 2008a). The Brazilian Pharmacopoeia (FBRAS) has five editions, published in 1926, 1959, 1977, 1996 and 2010. Each drug is described in the pharmacopoeia in monographic form. Nine species described by Saint-Hilaire were included in an edition of FBRAS, attesting not only to their importance in traditional medicine practiced by the population but also to the doctors and pharmacists of the time. Saint-Hilaire also described the species Mate (*Ilex paraguariensis* A. St.-Hil.), quina-de-mendanha ou quina-do-campo (*Strychnos pseudoquina* A. St.- Hil.), paineira (*Chorisia speciosa* St-Hil.), the douradinha (*Waltheria communis* A.St.-Hil.), butua (*Chondrodendron platyphylum* (A. St.- Hil.) Miers), the quina-de-remijio (*Remijia ferruginea* (A.St.-Hil.) DC. (*Cinchona ferruginea* A.St.-Hil.), tinguaciba (*Zanthoxylum tingoassuiba* A. St.- Hil.), capitão-do-mato ou chá-de-pedestre (*Lantana* or *Lippia pseudothea* Schauer A. St-Hil.) and cipo suma or piraguaia (*Anchietea pyrifolia* (A. St-Hil.), which were published in the 1st edition of FBRAS. The number of monographs allotted to the native species of Brazil in the 2nd edition of FBRAS, published in 1959, was reduced dramatically. While only four monographs, describing the species *Paullinia cupana*, Sapindaceae, guaraná; *Passiflora alata*, Passifloraceae, maracujá; *Psycothria ipecacuanha*, Rubiaceae, ipeca; *Pilocarpus jaborandi*, Rutaceae, jaborandi, remained in the third edition, that number is increased in the 4th and 5th editions. The reduction in the number of monographs for native products of FBRAS was indicative of the transformations in Brazilian society from 1950 to 1970. During this time, the Brazilian industry reorganized, and "consumer society" underwent a major cultural realignment. In the 1970s, for example, the pharmacy business had already lost the importance it once held previously because the pharmaceutical industry came to completely dominate the drug market. This period was also characterized by intense fighting and a repression of mysticism, including the traditional use of plants. All of these processes have contributed to a lack of interest in medicinal plants, a situation that was reversed from the 1980s by the influence of the WHO (Manhã et al., 2008).

For decades, several native medicinal species have been used by pharmaceutical companies in Brazil to create commercial products. These companies are represented by small laboratories that evaluate their products on the basis of traditional formulas. Species described by von Martius and in FBRAS were used in manufacturing medicines, such as Velame (*Croton* spp.), the Quina-de-mendanha (*S. pseudoquina*), Douradinha (*W. douradinha*), Butua (*C. platyphyllum*) and Cipó-suma (*A. pyrifolia*). However, these preparations often did not meet the minimal standards of the WHO recommendations for products for traditional use (Brandão et al., 2010). Since 1995, the Governmental Health Agencies of Brazil, following the recommendations of the WHO (WHO, 2002), established a series of regulations to improve the quality of commercial herbal products (Carvalho et al., 2008). Companies have made some efforts to develop standardized phyto-medicines from native species while also assessing their quality, safety and efficacy. Acheflan® is a rare example. It is produced with essential oils obtained from *Cordia verbenaceae*, a native species used in Brazilian traditional

medicine to treat inflammations (Calixto, 2005). More exotic and imported species, rather than native species, are implemented in the pharmaceutical industry. These species, including *Foeniculum vulgaris*, *Panax ginseng*, *Matricharia recutita*, *Ginkgo biloba*, *Hypericum perforatum*, *Melissa officinalis*, *Aloe barbadensis*, *Valeriana officinalis* and *Zingiber officinalis*, are used in the preparation of several products by industries in Minas Gerais, whereas no products incorporate native Brazilian species. In fact, there is a paucity of knowledge, among both the population and within the scientific community, regarding the pharmacological properties of native Brazilian plants. Table 3 presents ten medicinal species described by von Martius in 19th century and in the 1st edition of Brazilian Official Pharmacopoeia. Despite their importance as traditional Brazilian therapies, only the Leguminosae *Erythrina mulungu* has been incorporated into medicine by national industries (Brandão et al., 2010).

Family/ Species	**Vernacular name**	**part**	**Current commercial uses**
Arecaceae/ *Copernicia cerifera* (Arruda) Mart	Carnaubeira / Carnauba / Caranda	Roots	Wax in the automobile industry
Aristolochiaceae / *Aristolochia cymbifera* Mart. & Zucc.	Cassau / Jarrinha / Cipo mil homens / Papo de peru/ Angelicó	Roots	none
Bignoniaceae/ *Anemopaegma mirandum* (Cham.) Mart. ex DC	Catuaba / Catuiba	Roots	none
Commelinaceae/ *Tradescantia diuretica* Mart.	Trapoeraba	Leaves	none
Fabaceae/ *Copaifera oblongifolia* (Mart.) Kuntze	Balsamo de copaiba	Balsam	none
Leguminosae/ *Erythrina mulungu* Mart.ex Benth	Mulungu / Murungu/ Sapatinho de judeu/Bico de papagaio	Wood	medicine
Fabaceae/ *Stryphnodendron adstringens* (Mart.)Coville	Barbatimao / Barba de timan / Uabatimo	Rind	none
Krameriaceae/ *Krameria argentea* Mart. ex Spreng.	Ratania / Ratania do Para	Roots	none
Monimiaceae/ *Siparuna apiosyce* (Mart. Ex Tul.) A. DC	Limoeiro bravo / Limoeiro do mato / Negra mina	Leaves	none
Sapotaceae/ *Chrysophyllum gonocarpum* (Mart.& Eichler ex Miq.) Engler	Monesia / Buranhem / Guaranhem / Casca doce	Wood	none

Table 3. The current commercial uses of the species described by von Martius and the 1st edition of the Brazilian Official Pharmacopoeia (1926).

The development of commercial products from biodiverse plants is considered to be one of the most important strategies for conserving native vegetation biomes, particularly in developing countries (Li & Vederas, 2009; Nepstadt et al., 2009; Nogueira et al., 2010). Given this situation, investment in the research and development of products from the Brazilian

native flora is imperative. Despite the complexity and richness of the flora, Brazil merely supplies raw botanical material to the international pharmaceutical market. The alpha-bisabolol taken from Candeia wood (*Eremanthus erytropappa*), the rutine obtained from Favela fruits (*Dimorphandra mollis*), the ipê-roxo bark (*Tabebuia avellanedae*) and the Copaíba balsam (*Copaifera* spp.) are natural products obtained from Brazilian native species that are almost exclusively used by international pharmaceutical corporations. The records kept by the visiting naturalists illustrate valuable tools for the development of new commercial products derived from native plant resources. They describe the primary uses of plants because the information was collected at a time when the vegetation was preserved, and traditional medicines incorporated native species almost exclusively. In contrast, Brazilian native plants, particularly the Amerindian, have been forgotten and are used infrequently. Efforts must be taken to protect them and promote a better use for them. The data recorded by the European naturalists are a rich source of information for these efforts.

6. Conclusion

The Englishman Richard Burton expressed his admiration for the richness and potential of biodiversity in the region of the São Francisco River in Minas Gerais as follows:

"The hope, and to a certain extent the vines, will flourish. Among the cereals it produces a wealth of maize and rice whilst barley, rye, and probably wheat will succeed in the Geraes. Most of the fruits and vegetables that belong to the subtropical and temperate regions may be introduced. A sugar plantation last three years, although the cane most inefficient treated. Coffee grows admirably; tea, congonha (or mate) and guarana (Paullinia sorbillis) much appreciated in northwestern Brazil, will succeeded in low, hot and humid spots. The tobacco is one of the best in the Empire: sarsaparilla and the cochineal cactus, aloes and vanilla grow wild. Lumber trade is susceptible of a vast development; the Aroeira, the Braúna, the Candea, The Peroba, the Canella, and the fine hard-woods of the Brazil generally, await exploration. Oil- plants and tannins bark, bast and fibers, drugs and gums, as the Jatahy-copal, the Balsam of Peru, The Copaiba and the Asafoetida, are yielded in abundance, and the same way be said of beeswax and the Carnaúba wax, which is converted into candles in Rio de Janeiro. The dyes are abundant, from índigo to the Pau Amarello, and of cabinets woods a long list is headed by the Jacarandá and the Brazilian cedar. In the presence of such vast and unexploited wealth awaiting the distressed classes of Europe we way exclaim with Goethe: "Who says there is nothing for the poor and the vile save poverty and crime?"

Richard Francis Burton
The Highlands of Brazil, 1869

Naturalists often discuss their admiration for the greatness and richness of Brazilian biodiversity and its potential. The conservation of biodiversity and its associated traditional knowledge has become a priority for the overall development of several countries. In Brazil, promoting better use of biodiversity is imperative due to the intense process of genetic erosion that has affected most of the native vegetation. Only 7% of the Atlantic Forest is preserved, and the Cerrado and Caatinga are gradually being replaced by monocultures of eucalyptus, sugarcane, soybeans and livestock. Currently, the native vegetation of Minas Gerais faces the greatest threat from major international mining companies, such as Vale (CVRD) and AngloGold Ashanti, which plan to expand their activities into conserved and biodiverse areas. Therefore, the plants originally documented by naturalists in Minas Gerais run the risk of extinction. Better efforts are necessary to protect this heritage and to promote it´s better use.

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