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## Journal of Ethnopharmacology

journal homepage: [www.elsevier.com/locate/jep](http://www.elsevier.com/locate/jep)

## Research Paper

## Useful Brazilian plants listed in the manuscripts and publications of the Scottish medic and naturalist George Gardner (1812–1849)

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## ARTICLE INFO

## Article history:

Received 9 September 2014

Received in revised form

1 November 2014

Accepted 21 November 2014

Available online 29 November 2014

## Keywords:

Brazil

Useful plants

George Gardner

Manuscripts

Historical records

## ABSTRACT

**Ethnopharmacological relevance:** Information regarding the beneficial use of native Brazilian plants was compiled by a number of European naturalists in the 19th century. The Scottish surgeon botanist George Gardner (1812–1849) was one such naturalist; however, the useful plants recorded in his manuscripts have not yet been studied in depth.

**Aim of the study:** To present data recorded by Gardner in his manuscript *Catalogue of Brazilian Plants* regarding the use of native plants by Brazilian people and evaluate the extent to which they have been explored.

**Materials and methods:** Data on useful plants were obtained from Gardner's manuscript *Catalogue of Brazilian Plants* deposited in the Archives of the Royal Botanic Gardens, Kew, UK. The identification of each plant was determined and/or updated by consulting the preserved botanical collections of Gardner deposited in the Herbarium of the Royal Botanic Gardens, Kew (hereafter K), and expert determinations in other herbaria where duplicates are held. Correlated pharmacological studies for each plant were obtained from the PubMed database. Information recorded in Gardner's diary and previously published elsewhere complemented these data.

**Results:** A total of 63 useful plants was recorded from the *Catalogue* and a further 30 from Gardner's book *Travels in the Interior of Brazil* (Gardner, 1846). Of the recorded names in the *Catalogue*, 46 (73%) could be identified to species by consulting specimens collected by Gardner and held at Kew. Thirty-six different traditional uses were registered for the identified plants, the most common being as febrifuges, to treat venereal complaints and as purgatives. Fewer than 50% of these species have been the focus of published pharmacological studies, yet for those which have been thus investigated, the efficacies reported by Gardner were confirmed.

**Conclusion:** The data recorded by Gardner represent a rich, relatively unexplored source of information regarding the traditional uses of Brazilian plants which merits further investigation.

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## 1. Introduction

## 1.1. Medicinal plants in Brazil

Medicinal plants are still in use in both rural and urban areas of Brazil, but established phytotherapy, especially in southern parts of the country, has become strongly based on exotic plants such as chamomile (*Chamomilla recutita*), mint (*Mentha* spp.), and melissa

(*Melissa officinalis*), to name just a few (Stehmann and Brandão, 1995; Begossi et al., 2002; Brandão et al., 2004). The popularity of non-native plant remedies is a consequence of the intense miscegenation of cultures over recent centuries in Brazil: many plants are used according to folk tradition brought to the country by Europeans and Africans, popularising European rather than Amerindian medicine. This phenomenon is also related to the accelerated destruction of native vegetation, which has contributed to a gradual loss of native medicinal species (Shanley and Luz, 2003; Voeks and Leony, 2004). Today only 7% of the Atlantic Forest survives, whilst other ecosystems such as the savannas (cerrado) and caatinga are rapidly being replaced by monocultures of eucalyptus, sugarcane, soybeans and livestock (Felfili et al., 2004; Giulietti et al., 2005).

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According to the World Health Organization (WHO), between 65% and 80% of the population in developing countries currently use medicinal plants as remedies (WHO, 2011). This situation highlights the necessity to promote the appropriate use and conservation of medicinal species from Brazil: the world's richest country in terms of plant diversity known to science (Forzza et al., 2012). Many important medicines used today such as pilocarpine, tubocurarine and emetine were identified from Amerindian knowledge (Li and Vederas, 2009; Nogueira et al., 2010), and the Brazilian flora doubtless holds the key to many more of the world's medical challenges. Whilst contemporary traditional knowledge forms the basis for the majority of studies in this field, historic records can provide important insights into medicinal uses that may no longer be extant. Over the last ten years we have concentrated efforts to recover data, images and samples of plants used in traditional medicine in the past, mainly from data recorded by naturalists who travelled in Brazil (Brandão et al., 2008, 2009, 2012; Breitbach et al., 2013; Cosenza et al., 2013).

Brazil was colonised by the Portuguese from 1500 to 1822, and foreign interest in the potential of Brazil's biodiversity was evident from the outset of colonisation. Jesuit priests were the first to record information on the use of plants, and in 17th century, Guilherme Piso organised the first book specifically about native medicinal plants used by the Amerindians (Pisonis, 1648). The data contained in this book served as the primary source of information on Brazilian biodiversity until the beginning of 19th century, when the Portuguese royal family moved to Rio de Janeiro, fleeing from Napoleon Bonaparte's invasion of their home country. The nineteenth century is marked in the history of Brazil by many visits to the country by eminent personalities, among them notable European naturalists. The Scottish medic and naturalist George Gardner (1812–1849) was among the important scientists who travelled in Brazil in the early part of the nineteenth century.

## 1.2. George Gardner in Brazil

George Gardner, the son of a gardener to the 5th Earl of Dunmore, was a naturalist and qualified surgeon. During his medical studies at the Andersonian University, Glasgow, he had attended Sir William Jackson Hooker's botany classes and developed a lifelong interest in the subject. In apparently poor health, and with strong recommendations from Hooker (later to become the first Director of the Royal Botanic Gardens, Kew), Gardner decided to travel and collect in Brazil. Although the flora of the country was already widely studied, few collectors had travelled extensively in the interior of Brazil, especially the northeast, where Gardner made a point of heading for. Landing in Rio de Janeiro in July 1836, he spent six months collecting extensively in the area around Rio de Janeiro, especially the Organ Mountains, and perfecting his Portuguese. His first set of collections from there, eventually to number about 6,000 from the whole expedition (in sets of between 15 and 30 duplicates, totalling some 60,000 specimens), was packed and sent back to England before he started his main expedition.

Gardner travelled via Bahia to Pernambuco, Alagoas, Ceará, Piauí, Goiás, and Minas Gerais, returning to Rio de Janeiro in October 1840. He studied the environment of those places, the fauna and flora, history and geography and analysed the habits of the populations visited. Some of Gardner's botanical descriptions were published between 1842 and 1848 in the *London Journal of Botany*, of which Hooker was Editor, as "Contributions towards a Flora of Brazil". His collections were to be arranged and sold by George Bentham and Sir William Hooker, via Pamplins of Soho, London, to help finance his expedition – at the rate of £2 per 100 specimens. The material sent back also included many live plants, seeds, fossil fishes (which went to Louis Agassiz) and an assortment of other natural history collections. Several collections, such as his insects,

bats and some animal skins, did not survive the expedition. The insects and other fragile material were effectively destroyed by being dropped in a river twice in one day: first by a mule and then, having been dried and repacked, by a horse.

Gardner left Rio de Janeiro in early May of 1841 and made for Maranhão before returning for Liverpool and England. He landed on 10th July 1841 and almost immediately began working on his collections in both Hooker's and Bentham's private herbaria. After a brief period as Professor of Botany and Natural History at the Andersonian University, Glasgow, and as an assistant to Henry Barron Fielding (with whom he subsequently fell out), he was appointed (in May 1844) 'Superintendent and Chief Gardener of the Royal Botanic Garden, Peradeniya', Sri Lanka. He worked there until his death in 1849, most probably from a brain haemorrhage, the precursor of which was a riding accident whilst in Brazil that knocked him unconscious. *Travels in the Interior...*, his second book, was published in 1846, the second edition coming out shortly after his death.

A unique manuscript exists in the Archives of the Royal Botanic Gardens, Kew, titled *Catalogue of Brazilian Plants* (Gardner, undated, hereafter referred to as the *Catalogue*), summarizing most of Gardner's prolific collections save the fungi, lichens, mosses and ferns. This manuscript has been transcribed and can be easily accessed online ([www.kew.org/science/tropamerica/gardner/Catalogue.pdf](http://www.kew.org/science/tropamerica/gardner/Catalogue.pdf)). Also available online is a 'diary' ([www.kew.org/science/tropamerica/gardner/diary.html](http://www.kew.org/science/tropamerica/gardner/diary.html)) – based on *Travels in the Interior* showing the dates when Gardner reached various localities, allowing scholars some understanding of the challenges in interpreting the localities provided in the *Catalogue*; Gardner often numbered his collections at the end of a section of his journey or at the end of a day, so plants were not always numbered in same order as they had been collected. However, specific data on useful plants recorded in his *Catalogue* have not yet been studied in detail.

Here, we present data recorded by Gardner regarding the use of native plants by Brazilian people. It is important to bear in mind that by the time of Gardner's travels there had been centuries of racial mixing in Brazil between the Amerindian communities, Luso-Brazilian settlers and African-origin slaves. In the course of this process traditional knowledge relating to plants was inevitably borrowed, adapted and to some extent hybridised. Gardner made little direct reference to the sources of the information he gathered, and whilst it is likely that he had some contact with indigenous communities on his travels, the vernacular names he recorded suggest that for the most part his information originated with non-indigenous sources.

## 2. Methods

### 2.1. Survey of George Gardner's catalogue of Brazilian Plants

Data on the use of native useful plants were transcribed from the *Catalogue* of George Gardner, which is deposited in the Royal Botanic Gardens, Kew. The *Catalogue* is composed of six sections, the last of which contains information on "Medicinal and economical plants and fruits of the north of Brazil". The data on each plant (collection number, vernacular names, locality and uses where recorded) were copied and organised in a spreadsheet. For many plants it was possible to associate the collection number of the plant listed in the *Catalogue* with the herbarium specimens collected by Gardner and deposited in K and other major herbaria. These latter species, which could be cross-referenced to a specimen, are presented in Table 1, while observations recorded by Gardner (often under a vernacular name) but not supported by a preserved specimen are listed in Table 2. For specimens in Table 1,

**Table 1**  
Useful species described by G. Gardner in his *Catalogue, Travels in the Interior*, and on herbarium specimens.

Family/species	Catalogue data	Collection locality	Traditional uses	Studies corroborating traditional use reports
Current name, obtained by reconciling reported name and specimens (where available) with current literature	Name(s) common and scientific as written by Gardner [and number of his corresponding herbarium specimens, where supplied, with herbaria acronyms]	Geographic location of collection, as reported by Gardner	Uses as reported in <i>Catalogue</i> , with additions from <i>Travels in the Interior</i> (referenced by page) and herbarium specimens [referenced by Gardner's 2–4 digit collection number]	Uses documented by laboratory studies
*=taxon mentioned both in Gardner's <i>Catalogue</i> and in his <i>Travels in the Interior</i> . Other symbols indicate taxa also cited as useful by other collectors: §=cited by Von Martius in <i>Materiae Medicae</i> (Martius, 1843) δ=cited by Von Martius for the Amazon (Breitbach et al., 2013) #=cited by St. Hilaire in his field book (Brandão et al., 2012) £=cited by St. Hilaire in other bibliography	Collection numbers in italics were not listed in the 'Medicinal & Economical plants' section of the <i>Catalogue</i> but have been identified as vouchers. !=specimen seen for this study at K \$=specimen not found at K		<sup>C</sup> = <i>Catalogue</i> <sup>T</sup> = <i>Travels in the Interior</i> (Gardner, 1846) <sup>H</sup> =Herbarium	Based on a search of PubMed database and other web-based resources under current name and synonyms.
<b>ADIANTACEAE</b>				
<i>Adiantum deflectens</i> Mart.	Vinca ( <i>Adiantum</i> ) [2019 K!]	Serra de Araripe, Ceará	The leaves of this used in infusion as tea, is sudorific, and much used in pectoral complaints. <sup>C</sup>	None
<b>AMARYLLIDACEAE</b>				
<i>Habranthus sylvaticus</i> Herb. §	Cebôla brava ( <i>Amaryllis</i> ) [1857 K!, HVFB]	Crato, Ceará	The root of this is an active emetic-purgative. It is very much used in asthma and other afflictions of the lungs. <sup>C</sup>	None
<b>ANACARDIACEAE</b>				
<i>Anacardium occidentale</i> L. *§	Cajú ( <i>Anacardium occidentale</i> Linn.) [sn. K!, IPA]	Not described	The juice of the ripe fruit is considered antisyphilitic. <sup>C</sup> Edible fruit (p. 89 and 193). <sup>T</sup>	Antibacterial (Kubo et al., 1999; Aiswarya et al., 2011)
<i>Spondias tuberosa</i> Arruda *§	Imbú ( <i>Spondias</i> ) [2086 K!, IPA]	St. Antonio, Piauí	A low wide spreading tree very common in the Sertões. Fruit about the size of a Green gage plum – yellow when ripe and has something the taste of a nearly ripe gooseberry. After eating about a dozen of them the teeth become very sore from the acid which they contain. They have a powerful diuretic effect. Each tree has attached to its roots several large fleshy masses about the size of any head, which when scraped down and expressed yields a considerable quantity of very excellent water they contain. <sup>C</sup> A dish much esteemed in the Sertão, called Imbuzada, is prepared with milk, curds, sugar and the pulpy parts of this fruit. The black-coloured tubers about 8 in. in diameter can yield a pint of excellent quality water (p. 231 and 236). <sup>T</sup>	Many studies as functional food
<b>APOCYNACEAE</b>				
<i>Allamanda blanchetii</i> A.DC. (= <i>A. violacea</i> Gardner) *§	Quatra patacas ( <i>Allimanda</i> ) [1980 K!, HVFB]	Crato, Ceará; Olho d'Ágoa do Inferno	The root of this shrub is a powerful purgative. It is principally used in malignant fevers (also in p. 228). <sup>CT</sup>	None
<i>Aspidosperma pyrifolium</i> Mart. *	Pereira [1753 K!, NY]	Icó, Ceará	The bark is used in infusion in Puerpural fever; and in practice in sore throats and in buboes – Very bitter. <sup>C</sup> Infusion of bark used against lice and cow parasites (p. 162 and 167). <sup>T</sup>	Insecticidal (Trindade et al., 2008). Antibacterial (Oliveira et al., 2005)
<i>Hancornia speciosa</i> Gomes ( <i>H. speciosa</i> Gomes var. <i>lundii</i> ) * #	Mangaba [1064 K!, NY,SP], Mangaba do Morro	Itamarica, Pernambuco; Serra do Duro Ceará	This small tree affords one of the most delicious fruits indigenous to Brazil. <sup>C</sup> Edible fruit size of a large plum, yellow colour, fruit not considered good to eat until fallen on the ground (p. 87, 214, 335). <sup>T</sup>	Many studies as functional food
<b>AQUIFOLIACEAE</b>				
<i>Ilex paraguariensis</i> A. St.-Hil. * #£	(Yerba de Paraguay) [346 K!]	Minas Gerais	Kind of tea commonly made (p. 479). <sup>T</sup> The leaves of it are used as a very good substitute for tea [346]. <sup>H</sup>	Several studies confirm similar effects
<b>ARECACEAE</b>				
<i>Mauritia flexuosa</i> L.f. (= <i>M. vinifera</i> Mart.) *§	Burati, buriti [\$]	Piauí	The yellow pulpy substance which is found between the scales and the nut, when scraped off and boiled with sugar makes a very excellent preserve (doce). This pulp which is of	Many studies as functional food

Table 1 (continued)

Family/species	Catalogue data	Collection locality	Traditional uses	Studies corroborating traditional use reports
			an acid nature is used as a refrigerant. <sup>C</sup> For <i>M. vinifera</i> [= <i>M. flexuosa</i> ]: juice of the stem also forms a favourable drink, a reddish coloured liquid, the flavour of sweet wine [palm wine] (p. 226). <sup>T</sup>	
<b>ARISTOLOCHIACEAE</b>				
<i>Aristolochia chiquitensis</i> Duch. *	Papa de Peru ( <i>Aristolochia</i> ) [1834 K1]	Serra de Araripe, Ceará	An infusion of the bruised root in spirits is considered an excellent cure for snake bites. <sup>C</sup>	None
<b>ASTERACEAE (COMPOSITAE)</b>				
<i>Ageratum conyzoides</i> L. §	Matruz ( <i>Ageratum conyzoides</i> ) [63 K1, E, NY]	Praia Grande (Rio de Janeiro)	The leaves and stems of this plant are used by the washerwomen at Natividade as an assistant to their soap in washing clothes. <sup>C</sup>	Antibacterial and antifungal (many studies)
<i>Egletes viscosa</i> (L.) Less. *	Marcella [1739 K1, BM, HVFB, HUEFS]	Ico & Crato, Ceará	Used in infusion in Dyspepsia in the same manner as Chamomila. It is a very powerful bitter. <sup>C</sup>	Gastroprotective (Guedes et al., 2002, 2008)
<b>BORAGINACEAE</b>				
<i>Cordia oncocalyx</i> (Allemão) Taub. * (= <i>Auxemma gardneriana</i> Miers, <i>A. oncocalyx</i> (Allemão) Baill.)	Pau Branca ( <i>Patagonula americana</i> Linn.) [1779 K1, BM, MO]	Below Icó, Ceará	An infusion of the inner bark is used in coughs. <sup>C</sup>	Anti-inflammatory (Ferreira et al., 2004)
<b>CARYOCARACEAE</b>				
<i>Caryocar coriaceum</i> Wittm. *#§	Piki ( <i>Caryocar</i> ) [1494 K1, BM, NY, IPA, F, HVFB,G]	Crato, Ceará	The fruit of this tree which is about the size of the fist contains from 2 to 4 nuts which are surrounded by a fatty substance and which on expression yields an excellent table oil. The kernel, as well as the raw fatty substance are much relished by the Brazilians but the latter has such a rancid smell that I could not eat it. <sup>C</sup> A large tree common in the caatingas near Crato, the fruit is said to be eaten by the natives when cooked. The wood is hard and used in mill work [1494]. <sup>H</sup> Edible fruit (p. 192). <sup>T</sup>	Many studies as functional food
<b>CLUSIACEAE</b>				
<i>Garcinia gardneriana</i> (Planch. & Triana) Zappi #	Bacopari [1922 K1, BM]	Barra do Jardim, Ceará	This also yields a subacid fruit about the size of a gooseberry and is likewise much esteemed. It is of a yellow colour when ripe and crowned by the persistent 3-lobed stigma. 1 celled, 3 seeded, 2 of them aborting nidulating in a yellowish white pulpy cotyledons inseparable – radicle next the hilum. When the cotyledons are cut across a thick yellow juice exudes from the cut surfaces. <sup>C</sup>	Many studies as functional food
<b>CUCURBITACEAE</b>				
<i>Luffa operculata</i> L. §	Paulista ( <i>Momordica operculata</i> Linn.) [3744 K1, BM, MO]	Arrayas, Goiás	About a fourth part of one of the spongy capsules in decoction is a very drastic purge. It often produces superpurgation with bloody stools. During my stay in the city of Oeiras a woman died from an over dose of this medicine. It is a very common purge and used on almost all occasions. <sup>C</sup>	None
<b>DILLENIACEAE</b>				
<i>Curatella americana</i> L. £§	Cambaiba ( <i>Curatella cambaiba</i> A. St.-Hil.) [913 K1, NY, IPA]	Itamarica, Pernambuco	The bark of this tree which is very astringent is used in infusion and decoction to treat sores etc. <sup>C</sup>	Anti-ulcerogenic and healing (Hiruma-Lima et al., 2009)
<b>EUPHORBIACEAE</b>				
<i>Cnidocolus quercifolius</i> Pohl (= <i>Cnidocolus phyllacanthus</i> (Müll.Arg.) Pax & K.Hoffm.)*	Favella (Jatropha) [2304 K1]	Boa Esperanza, Piauí	A decoction of this tree is used to poison fish. <sup>C</sup> Scrape down bark and wood and put into pools where large pigeons and other birds resort, after drinking poisoned water they die or become very stupefied and in this state are taken and eaten by the people (p. 236). <sup>T</sup>	Poisonous to animals (Oliveira et al., 2008)
<i>Croton adenocalyx</i> Baill. *	Catinga branca ( <i>Croton</i> ) [2309 K1, F, G, HVFB]	Boa Esperanza, Piauí	The bark of this shrub is used to dye yellow. A shrub about 5 ft high, common near Boa Esperanza. <sup>C</sup>	Not applicable
<i>Croton piauhiensis</i> Müll. Arg.	Velami [2307 K1, F, NY,G]	Oeiras, Piauí	The milk of this bush stems is applied to chancres, and the root which is an active purgative is used in all kinds of venereal complaints. <sup>C</sup> Root purgative used in venereal complaints [2307]. <sup>H</sup> Velame is used 'both externally and internally to some effect against syphilis, but under this treatment sooner or later the secondary symptoms make their appearance' (p. 196). <sup>T</sup>	None
<i>Euphorbia lycioides</i> Boiss.	Purga de Marinheiro ( <i>Euphorbia</i> ) [2301 K1, F, G, HVFB]	Oeiras, Piauí	The root in decoction is used as a purge in malignant and other fevers. <sup>C</sup>	None

Table 1 (continued)

Family/species	Catalogue data	Collection locality	Traditional uses	Studies corroborating traditional use reports
<i>Jatropha mollissima</i> (Pohl) Baill. (= <i>J. gossypifolia</i> L.) *	Pinhão ( <i>Jatropha gossypifolia</i> Linn.) [1132 K!]	Torré, Pernambuco	The milky juice of the plant with sugar is used by the cirugião-mor of Oeiras in haemorrhages. <sup>C</sup>	Healing processes of internal organs (Aquino et al., 2006; Maia et al., 2006; Servin et al., 2006)
<b>FABACEAE (LEGUMINOSAE)</b>				
<i>Copaifera coriacea</i> Mart. §	Pao d'olho ( <i>Copaifera coriacea</i> Mart.) [1929 K!]	Serra de Barra do Jardim, Ceará	The oil of this tree is used as a balsam in recent wounds – and as an embrocation in gonorrhoea and as an emmenagogue. <sup>C</sup>	None
<i>Geoffroea spinosa</i> Jacq. *	Mari ( <i>Geoffroya</i> ) [1911 K!, NY, IPA], Umari, Rabo de Tatú	Crato, Ceará	In times of scarcity the boiled fruit of this tree is eaten by the inhabitants of the Sertão. <sup>C</sup> Fleshy fruit the size of a walnut, taste of kernel not unlike that of boiled beans (p. 133, 179). <sup>T</sup>	Studied as functional food (Silva, 2013)
<i>Pterodon emarginatus</i> Vogel *#	Sicupira ( <i>Dipterix</i> ) [2522 K!, NY, IPA]	Paranaguá, Piauí extending to Goiás	The essential oil contained in the pericarp of this beautiful tree is used to cure toothache. <sup>C</sup> The same for <i>Commilobium polygalaeiflorum</i> . <sup>T</sup> Tree easily recognised at a great distance by numerous panicles of lilac flowers (p. 296). <sup>T</sup>	Essential oil anti-inflammatory (Dutra et al., 2009)
<i>Tachigali aurea</i> Tul.	Tatarêma [3117 K!]	Natividade	An infusion of the bark is astringent and used to cure the sores made by insects in cattle. The dry wood when burned gives out a foetid odour resembling that of excrement. <sup>C</sup> The wood when burning is so foetid that no-one can remain near it [3117]. <sup>H</sup>	Antimicrobial (Toledo et al., 2011)
<b>IRIDACEAE</b>				
<i>Trimezia juncifolia</i> (Klatt) Benth & Hook. f.	Rhubarbo do Campo [2951 K!] [3470 K!]	Goiás	Within the dry bases of the leaves there is a small yellow coloured kind of tuber from whence the fibrous roots proceed. Ten or twelve of these in infusion are said to be powerfully purgatic. It is used in malignant fevers. A person in the neighbourhood of Natividade who is a self taught practitioner of medicine assures me that it has cured several cases of what appears to me from his description to be inflammations of the membranes of the brain. <sup>C</sup> Root used as a purge [2951]. <sup>H</sup>	None
<b>LAURACEAE</b>				
<i>Cassytha filiformis</i> L. (= <i>Cassytha americana</i> Nees var. <i>puberula</i> Meisn). *	Cipó de Chumbo ( <i>Cassytha</i> ) [1830 K!, HVFB, NY]	Serra de Araripe, Ceará	This plant in all its parts is very mucilaginous, well bruised and boiled the decoction is used in coughs and other pectoral complaints, and in inflammatory fevers. <sup>C</sup>	Antimalarial, fevers (Ogunkunle et al., 2014)
<b>MEMECYLACEAE</b>				
<i>Mouriri elliptica</i> Mart.	Pussá Frade [2597 K!, 3175 K!]	Paranaguá, Piauí; Goiás	A tree about 20 ft high- fruit calva yellow-green about the size of an Orleans plum – not very good. <sup>C</sup> Common. District of Rio Preto. Fruit yellowish when ripe [2597,3175]. <sup>H</sup>	None
<i>Mouriri pusa</i> Gardner *	Pusá ( <i>Mouriria pusa</i> , Gard. Mss.) [1608 K!, NY, G, F, IPA] Pussá Roxa [2596 K!, 2864 K!]	Crato, Ceará; Serra do Duro Piauí	This small tree produces a very delicious fruit about the size and colour of the common purple plum. The country people bring it for sale to the Villa do Crato. <sup>C</sup> A small tree with an upright stem and horizontal branches, about 10 ft high. This species has afforded matter for a short paper which I have drawn up for publication in the journal if you deem it worthy of that honour [Oct 1838]. Common on dry hilly places near Crato. The fruit is highly esteemed when ripe vern. Pusa; similar to jabuticaba, <i>Eugenia cauliflora</i> (p. 193). <sup>T</sup> Pussá Roxa ( <i>Mouriria</i> ): a large[r] tree. – fruit purple size of the last [Pusá] but much superior. <sup>C</sup> Common in the South of Piauhy and at Duro [2596, 2864]. <sup>H</sup>	Many studies as functional food
<b>MENISPERMACEAE</b>				
<i>Cissampelos ovalifolia</i> DC. #£§	Orelha de Onça ( <i>Cissampelos</i> ) [1445 K!, NY]	Serra de Araripe, Ceará	The root in infusion is used in scarlet fever, and in malignant and intermittent fevers. It is also considered as a specific in the bite of a snake called Rainha, and another called Gripeba, along with sulphur. <sup>C</sup>	Antimalarial, intermittent fevers (Fischer et al., 2004)
<b>MORACEAE</b>				
<i>Dorstenia cayapia</i> subsp. <i>asaroides</i> (Hook.) C.C.Berg (= <i>Dorstenia asaroides</i> Gardner ex Hook.) *§	Contraerva ( <i>Dorstenia asaroides</i> Gard. Mss.) [2001 K!]	Crato, Ceará	An infusion of the bruised parts in sulphur is used in snake bites. The roots boiled with sugar is used in all kinds of fevers but particularly those of an intermittent type [Jan 1839]. <sup>C</sup>	Terpenoids may account for anti-ophidic use (Vilegas et al., 1997)
<i>Maclura tinctoria</i> (L.) D. Don ex Steud. #	Tatajuba ( <i>Morus tinctoria</i> Linn.) [2002 \$]	Barra, Ceará	The wood is used to dye yellow. <sup>C</sup>	Not applicable

Table 1 (continued)

Family/species	Catalogue data	Collection locality	Traditional uses	Studies corroborating traditional use reports
<b>MYRTACEAE</b> <i>Psidium laruotteanum</i> Cambess. *	Marangaba ( <i>Psidium nanum</i> , Gard. Mss.) [1611 K1, G, NY]	Serra de Araripe, Ceará	The fruit of this little shrub is about the size of an ordinary gooseberry, and the flavour is richer than that of any of the other Araças. – It grows only on the tops of the Serras, and is brought to Crato for sale. <sup>C</sup>	None
<b>PAPAVERACEAE</b> <i>Argemone mexicana</i> L. *§	Cardo Santo ( <i>Argemone laurifolia</i> , Linn.) [1915 K1]	Barra do Jardim, Ceará	A handful of leaves with 1/4 oz of the seeds infused in warm water is used in jaundice (also in p. 176). <sup>CT</sup> The seeds are given as an emetic in asthma. <sup>C</sup>	Hepatoprotective (Das et al., 2009)
<b>PASSIFLORACEAE</b> <i>Passiflora laurifolia</i> L. *	Maracuja Piroba ( <i>Passiflora</i> ) [1633 K1, NY, HVFB]	Aracaty, Ceará	This, which is common in the woods near Crato, yields a fruit very similar to the common Maracuja, but smaller and is much relished by the inhabitants. <sup>C</sup>	None
<b>PLUMBAGINACEAE</b> <i>Plumbago scandens</i> L. §	Loco ( <i>Plumbago scandens</i> , Linn.) [102 K1]	Morro do Flamengo, Rio	The bruised leaves with vinegar are used as an Otistic. <sup>C</sup>	Antimicrobial (Paiva et al., 2003)
<b>POLYGALACEAE</b> <i>Bredemeyera floribunda</i> Willd. *	Quiricolana ( <i>Comesperma</i> ) [1455 K1, G, NY]	Crato, Ceará	The root rasped down and given in cachas[a] [=cane spirit] is considered an effectual remedy in snake bites. <sup>C</sup>	Snake antivenom activity (Daros et al., 1996)
<b>RUBIACEAE</b> <i>Coutarea hexandra</i> (Jacq.) K. Schum. (= <i>C. alba</i> Griseb.) *	Quina, Quina branca ( <i>Coutarea</i> ) [2196 K1], Quina, Quina Roxa ( <i>Coutarea</i> ) [2195 \$]	St. Antonio, Piauí; Cana & Canaveira, Piauí	The bark of this small tree is a powerful bitter and is much used in infusion and decoction in intermittent fevers in Piauí, so that nearly all the trees by the road-side had large portions stripped in consequence (p. 228). <sup>T</sup> Quina Roxa: the bark of this species is used like the last, but the other is considered the most efficient. <sup>C</sup>	Antimalarial (Argotte-Ramos et al., 2006)
<i>Simira gardneriana</i> M.R.V. Barbosa & Peixoto *	Pereira da Tinta [2313 K1]	Boa Esperanza, Piauí	The inner bark is used to dye red – a fast colour. <sup>C</sup>	Not applicable
<b>SAPINDACEAE</b> <i>Magonia pubescens</i> A. St.-Hil. *#	Tingí ( <i>Magonia glabrata</i> St. Hil.) [1502 K1, NY, HVFB]	Crato, Ceará	The stem bark well pounded is used in the cure of old ulcers. The root bark is used to poison fish and the large cotyledons boiled with a little tallow a very excellent soap (also in p. 191). <sup>CT</sup> Common in the catingas near Crato where it grows gregariously. An infusion of the root is used to poison fish, the large cotyledons make good soap and an infusion of the bark is used to heal ulcers. It flowers before leaves appear. <sup>H</sup>	Antimicrobial (Pimenta et al., 2000)
<i>Talisia esculenta</i> (A. St.-Hil.) Radlk. *#	Pittomba ( <i>Sapindus esculentus</i> St. Hil.) [1501 K1, NY] [951 K1]	Crato, Ceará, Pernambuco	This tree yields abundance of a fruit about the size of a large gooseberry, which is much relished by the Brazilians. The part, which is eaten, is a whitish subacid fleshy substance, which surrounds and adheres to the kernel. <sup>C</sup> The kernels (seeds) are said to poison turkeys if eaten by them (p. 232). <sup>T</sup>	Not applicable
<b>SELAGINELLACEAE</b> <i>Selaginella convoluta</i> (Arn.) Spring §	[2020 K1]	Crato, Ceará	An infusion of this plant is used in malignant and intermittent fevers. <sup>C</sup>	None
<b>SIMAROUBACEAE</b> <i>Simarouba versicolor</i> A.St.-Hil. *#§	Parahiba ( <i>Simarouba versicolor</i> ) A.St.-Hil.) [1513 K1, IPA, HVFB]	Crato, Ceará	The bark in infusion is used in intermittent fevers in the province of Piauí, and also to destroy lice in the heads of children. <sup>C</sup>	Acaricide (Valente et al., 2014); antimalarial (Albernaz et al., 2010).
<b>SMILACACEAE</b> <i>Smilax cissoides</i> Mart. ex Griseb. *	<i>Smilax subaculeata?</i> Spreng. [2010 K1]	Crato, Ceará	At Crato the root of this is used as Sarsaparilla in secondary venereal complaints and with good effect. <sup>C</sup> Common in woods near Villa do Crato. The roots are used in place of the true Sarsaparilla [2010]. <sup>H</sup>	None
<b>SOLANACEAE</b> <i>Brunfelsia uniflora</i> (Pohl) D. Don §	Manaca ( <i>Franciscea manaca</i> , Gardn. Mss.) [1798 K1, NY]	Crato, Ceará	An infusion of the root is used in secondary syphilitic complaints, in malignant fevers, and in the first stage of small pox to assist in putting them out. <sup>C</sup>	Antibacterial activity (Queiroz e Costa Brighente, 2009)
<i>Cestrum axillare</i> Vell. ( <i>C. laevigatum</i> Schtdl. var. <i>puberulum</i> Sendtn.) #§	Coirama ( <i>Cestrum</i> ) [1794 K1, BM, G]	Crato, Ceará	The fleshy berries of this shrub yields a very fine purple dye, but it does not hold. <sup>C</sup>	Not applicable

Table 1 (continued)

Family/species	Catalogue data	Collection locality	Traditional uses	Studies corroborating traditional use reports
<b>VIOLACEAE</b>				
<i>Hybanthus calceolaria</i> (L.) Oken ( <i>Ionidium ipecacuanha</i> Vent.) §	Ipecacuanha branca ( <i>Ionidium</i> ) [2039 K1]	Common, Piauí	A decoction of the root is emetic-purgative and is much used in fevers &c. In clysters it is considered emmenagogue. <sup>c</sup>	None

HVFB = Martius's *Flora Brasiliensis*.

examination of the relevant specimen(s) or an image thereof at K or in other herbaria was usually sufficient to allow the botanical identification of each collection to be determined or confirmed and updated in line with currently accepted species concepts and nomenclature as required (Forzza et al., 2014). For plants listed in Table 2, the lack of herbarium material citing uses or vernacular names made authoritative determinations of species difficult if not impossible. However, wherever feasible the vernacular names and genera cited by Gardner were referred to the relevant current genera, sometimes in consultation with family specialists.

The orthographic variations in vernacular names between the registered data and the current plant names were also analysed. For example, the popular name registered as burati refers to buriti; piki to pequi; velami to velame; pao d'olho to pau d'oleo, canela d'emú to canela-de-ema and sicupira to sucupira. It is unclear to what extent these differences reflect local variation, change in usage over time or Gardner's ability to transcribe vernacular names accurately. In order to avoid potential confusion arising from the intrinsic problems of translating variable vernacular names into scientific names, and likewise of interpreting synonyms and obsolete taxonomic names, we have separated 'vouchered' data (referring to verifiable collections) from the *Catalogue* (Table 1) from 'unvouchered' data (Table 2), since interpretation of the latter is inevitably more precarious. Likewise we have presented data from Gardner's *Travels in the Interior* (see below), many of which are not clearly referenced to his collections, separately from those derived from the *Catalogue*.

## 2.2. Survey of data on useful plants in bibliography

Gardner also recorded data on useful plants in his book *Travels in the Interior*, first published in 1846. Data from this book relating to species cited in the *Catalogue* have been included in Tables 1 and 2 (species marked with "\*"). Data on plants that were cited by Gardner only in *Travels in the Interior* (Gardner, 1846) are presented in Table 3. To facilitate comparison with the work of other authors, species also reported as useful by the French naturalist Auguste de Saint-Hilaire are marked with "#" or "£" respectively in Table 1, and those cited by the German Carl Friedrich Phillip von Martius with "§" or "δ". We chose these naturalists for this comparative study because they travelled in some of the same places in Goiás and Minas Gerais as Gardner.

## 2.3. Survey of laboratory studies performed with the recorded plants

A search was conducted on PubMed and other web-based resources for pharmacological studies of the species listed in Table 1, reported under their current scientific name and some important synonyms. The results of laboratory studies that correlated with the traditional uses reported by Gardner are summarised in Table 1. Whilst the authors recognise that some negative screening results for pharmacological activity may have remained unpublished, potentially resulting in an under-estimate of research efforts and an over-estimate of positive results, this uncertainty cannot be resolved.

## 3. Results

A total of 63 useful plants were registered by Gardner in his *Catalogue* from Brazil (Tables 1 and 2). A further 30 species (Table 3) were mentioned only in *Travels in the Interior* (Gardner, 1846). Of the total recorded plants from the *Catalogue*, 47 (75%, representing 51% of all Gardner's useful plants) could be directly linked to Gardner's numbered herbarium collections, and for 46 of these the relevant material was found and examined at K (Table 1). The common and distinctive palm *Mauritia flexuosa* L.f., listed only by its vernacular name in the *Catalogue*, was not collected by Gardner but has been included in Table 1 on the assumption that its identification is correct. These identified species are distributed among 32 families, Euphorbiaceae being the most strongly represented with five species, followed by Fabaceae (Leguminosae) with four, and Apocynaceae with three. The families Anacardiaceae, Asteraceae (Compositae), Memecylaceae, Moraceae, Rubiaceae, Sapindaceae and Solanaceae are each represented by two species and the remaining families by one species each.

Data on 29 of the species presented in Table 1 were published by Gardner in *Travels in the Interior* (Gardner, 1846). Twenty-six of the plants in Table 1 were also recorded as useful by Saint-Hilaire and/or Martius while travelling in Brazil (14 of these Gardner reported only in his *Catalogue* while a further 12 were also mentioned in *Travels in the Interior*). The species most cited by all these naturalists were *Caryocar coriaceum* Wittm. (Caryocaraceae), *Curatella americana* L. (Dilleniaceae), *Cissampelos ovalifolia* DC. (Menispermaceae) and *Simarouba versicolor* A. St.-Hil. (Simaroubaceae). By contrast, 22 of the species in Table 1 were recorded by neither Saint-Hilaire nor Martius in their manuscripts or books: *Adiantum deflexens* Mart. (Adiantaceae), *Aspidosperma pyrifolium* Mart. (Apocynaceae), *Aristolochia chiquitensis* Duch. (Aristolochiaceae), *Egletes viscosa* (L.) Less. (Asteraceae), *Cordia oncocalyx* Allemão (Boraginaceae), *Cnidoscylus quercifolius* Pohl, *Croton adenocalyx* Baill., *Croton piauihensis* Müll. Arg., *Euphorbia lycioides* Boiss. and *Jatropha mollissima* (Pohl) Baill. (Euphorbiaceae), *Geoffroea spinosa* Jacq. and *Tachigalia aurea* Tul. (Fabaceae), *Trimezia juncifolia* (Klatt) Benth & Hook. (Iridaceae), *Cassytha filiformis* L. (Lauraceae), *Mouriri elliptica* Mart. and *Mouriri pusa* Gardner (Memecylaceae), *Psidium laruotteanum* Cambess. (Myrtaceae), *Passiflora laurifolia* L. (Passifloraceae), *Bredemeyera floribunda* Willd. (Polygalaceae), *Coutarea hexandra* (Jacq.) K. Schum. and *Simira gardneriana* M.R.V. Barbosa & Peixoto (Rubiaceae), and *Smilax cissioides* Mart. ex Griseb. (Smilacaceae).

A total of 26 different traditional medicinal uses were recorded for the plants identified in Tables 1–3. The most common uses were as a febrifuge (17 citations; malignant, intermittent, inflammatory and puerperal fevers), purgative (11), anti-venereal (9), chancres, gonorrhoea, antisyphilitic, inflammation of the lymph glands, anti-ophidic (6) and bitter/tonic (6). Other uses included treatment of pectoral complaints (4: including infections of the lung) and as emetic (4), antitussive, emmenagogue (3), anti-inflammatory, anti-asthmatic, anti-hemorrhagic, acaricidal, wound healing, anti-rheumatic, astringent and antidyspeptic remedies (2 citations each). Other uses were cited just once.

**Table 2**Useful plants in the *Catalogue* with vernacular and some scientific names cited by Gardner but not supported by preserved specimens or identified to species level.

Name in catalogue	Traditional uses	Notes and possible identification
Betonica ( <i>Hyptis</i> )	The root is much used to aromatize baths.	The name Betônica-brava is commonly used for <i>Marsypianthes chamaedrys</i> (Vahl) Kuntze (Lamiaceae), used in Brazil in the form of hot baths to treat rheumatism (Mors et al., 2000). Gardner collected this species, but the specimen has not been seen.
Chapada	The inner bark of this tree is used to dye black.	The name Chapada is commonly used for <i>Leptolobium dasycarpum</i> Vogel (Fabaceae). Gardner collected this three times, but specimens seen do not cite the use or common name.
Folha nova ( <i>Diplusodon</i> )	The new leaves are mucilaginous, and in infusion are used in gonorrhoea in the north of the Province of Goyaz.	Gardner collected many <i>Diplusodon</i> (Lythraceae) species, but specimens seen do not cite the use or common name.
Jaiú ( <i>Jatropha</i> )	The large tuberous root of this plant is a powerful purgative. It is used principally in fevers and inflammatory complaints.	Gardner collected several <i>Jatropha</i> (Euphorbiaceae) species but specimens seen do not cite the use or common name. Many species are used as purgatives worldwide.
Jakitiba ( <i>Lecythis</i> )	The inner bark of this tree is used to make ropes. Nuts eaten by monkeys (p. 92).	The name Jequetiba is commonly used for <i>Cariniana</i> spp., though Gardner also collected <i>Eschweilera serratula</i> Miers under the name <i>Lecythis</i> . These uses could be attributed to many Lecythidaceae.
Jurobeba <sup>a</sup>	The root in infusion is used in secondary venereal complaints as sarsaparillo, and it is said with excellent effect. It is also used in Rheumatism.	Various species of <i>Solanum</i> are known as Jurobeba, most commonly <i>S. paniculatum</i> L. but also <i>S. crinitum</i> Lam. (collected by Gardner). They are widely used for medicinal purposes including venereal diseases, and <i>S. paniculatum</i> has proven antiviral properties (Valadares et al., 2009).
Lingua de Vaca	Used in infusion as a diaphoretic in small pox and in malignant fevers.	The name Lingua-de-vaca is used for various Asteraceae genera including <i>Elephantopus</i> and <i>Vernonia</i> , many of which have widespread medicinal uses. Gardner collected several species of these genera.
Mãe Caterina ( <i>Hyptis</i> )	This under shrub is very common about the city of Oeiras – all its parts have a very powerful aromatic smell – an infusion is considered emmenagogue.	The name Catirina is commonly applied to <i>Hyptis spicigera</i> Lam. (Lamiaceae), a widely used medicinal herb. Gardner collected this species, but the specimen seen does not cite this use or common name.
Malva branca ( <i>Sida</i> )	An infusion of the whole plant with sugar is a common remedy in coughs and pectoral complaints.	The name Chapada is commonly used for <i>Sida cordifolia</i> L. (Malvaceae). Gardner collected this species, but specimens seen do not cite the use or common name. <i>S. cordifolia</i> , which is used to treat respiratory disorders in many parts of the world, has proven analgesic and anti-inflammatory properties (Franzotti et al., 2000).
Pao de Leite	The milky juice of this tree is purgative. In doses of a spoonful to a spoonful and a half it is used by the Cirurgião Mor of Oeiras in the cure of tympanites.	The name Pau-de-leite is commonly applied to <i>Himatanthus</i> spp. (Apocynaceae) in northeast Brazil. Various species are used as purgatives.
San João ( <i>Cassia</i> )	An infusion of the root of this shrub is used along with spirits in snake bites.	The name São João is commonly applied to <i>Senna spectabilis</i> DC and <i>S. macranthera</i> (Collad.) Irwin and Barneby. Gardner collected both species, but specimens do not cite the use or common name.
Toca-je ( <i>Bignonia</i> )	The root bruised and infused in cold water till the water becomes well tinged, is considered a specific in all kinds of internal haemorrhages, but particularly in those of the uterus.	<i>Arrabidaea chica</i> (Humb. & Bonpl.) B. Verl. (Bignoniaceae), which produces a red dye, is widely used to treat bleeding and uterine problems in Brazil, but this species was not collected by Gardner.
Virgateza ( <i>Hyptis</i> )	An infusion of this plant is considered in the Province of Goyaz a powerful aphrodisiac.	Various species in several families are referred to as Vergateza in Brazil and used to stimulate sexual potency.
<i>Centaurea minor</i>	Infusion used as a tonic – very bitter.	The presence of this temperate species would be surprising. Gardner may be referring to another species in the Gentianaceae (he collected several including <i>Schultesia</i> spp.), most of which are bitter.

<sup>a</sup> Written in the *Catalogue* as *Solanum maccaia* Rich, but this is an invalid name.

At least 20 species from Table 1 (42%) have been the subject of laboratory-based pharmacological studies whose results support the uses reported by the naturalist(s). Extracts from *Egletes viscosa* (L.) Less., for example, showed gastroprotective activity (Guedes et al., 2002, 2008), *Jatropha gossypifolia* L. was effective as a healing agent for internal organs (Aquino et al., 2006; Maia et al., 2006; Servin et al., 2006), the essential oil of *Pterodon emarginatus* Vogel was anti-inflammatory (Dutra et al., 2009) and *Cissampelos ovalifolia* DC. showed antimalarial activity (Fischer et al., 2004). *Selaginella convoluta* (Arn.) Spring was antinociceptive (Sá et al., 2012) and *Simarouba versicolor* A. St.Hil. showed acaricidal and insecticidal activities (Coelho et al., 2006; Valente et al., 2014).

Other plant uses were also described by Gardner. Fourteen species were cited for their edible fruits, four were reported to be used for dyeing (black, yellow, purple and red), seven as good wood for construction, and two each as insecticides, fish poisons and ingredients for soap. Single species were recorded as useful for (respectively) aromatised baths and as kitchen oil. The taste of the fruits was carefully observed and recorded by Gardner, as in the case of *Hancornia speciosa* Gomes (Apocynaceae) which he considered “one of the most delicious fruits indigenous to Brazil”. Other local use as a famine food was recorded for *Geoffroea spinosa*

Jacq. (Fabaceae): “in time of scarcity the boiled fruit of this tree is eaten by the inhabitants” (Table 1).

One species, melão de São Caitano (*Momordica*) was listed in the ‘Medicinal and Economical Plants’ section of Gardner’s *Catalogue* without specific reference to use and has therefore been excluded from Table 1. This may refer *Momordica charantia* L., commonly known as melão-de-São-Caetano and widely used for a broad range of medicinal purposes (Grover and Yadav, 2004). Some other useful plants are likewise mentioned in *Travels in the Interior* (Gardner, 1846) without direct reference to their uses such as Cajú rasteiro (p. 315) – probably *Anacardium humile* A. St.-Hil. [collected by Gardner: 3089] whose pseudofruits and seeds are both edible. A few exotic species were also recorded by Gardner but are not considered in this study, for example agrião (*Nasturtium officinale* R.Br.).

#### 4. Discussion

In this study we present data on 93 useful Brazilian native plants found in the manuscripts and publications of George Gardner (*Catalogue* and *Travels in the Interior*). The plants used by the people he came into contact with (see discussion above) were carefully



**Table 3**Species cited by Gardner only in his *Travels in the Interior*: traditional uses and location of observation.

Family/species (vernacular name) [and collection number]	Identification in text	Traditional use (pages on which cited)	Location of observation
<b>AMARANTHACEAE</b> <i>Gomphrena arborescens</i> L.f. = <i>Gomphrena officinalis</i> Mart. (Paratudo) [5142]	<i>Gomphrena officinalis</i>	Large tuberous roots, much used as purgative, is considered good for every complaint (p. 396).	Arraias to São Romão; Minas
<b>ANACARDIACEAE</b> <i>Schinus terebinthifolius</i> Raddi (Aroeira) [1269]	<i>Schinus</i> , perhaps <i>S. aroeira</i> St. Hil.	Wood used for construction (p. 173).	Alagoas
<b>APOCYNACEAE</b> <i>Mandevilla tenuifolia</i> (J.C. Mikan) Woodson (Cauhy)	<i>Echites tenuifolia</i> Mikan	Tuberous root, size and colour of a large black turnip-radish, is eaten by the inhabitants of Sertão, and when cooked is said to be very palatable, in raw state it is not unlike a turnip. Favourite food of the Peccary ( <i>Dicotyles torquatus</i> Cuv. [Pecari tacaju]) (p. 235).	Ceará/Piauí border
<b>ARAUCARIACEAE</b> <i>Araucaria angustifolia</i> (Bertol.) Kuntze (Araucária)	<i>Araucaria brasiliana</i>	Food (p. 512)	Ouro Preto
<b>ARECACEAE</b> <i>Acrocomia aculeata</i> (Jacq.) Lodd. ex Mart. (Shódó)	Shódó	Indians eat nut breaking it between 2 stones (p. 317).	Duro near Natividade
<i>Copernicia prunifera</i> (Mill.) H.E.Moore (Carnahuba)	Carnahuba	Stems used in house construction [adobe], very durable, and cattle enclosures, leaves for thatch, packsaddles, hats. Wax obtained from young leaves. In times of scarcity young leaves given to horses and cattle, and people prepare farinha [flour] from the inside or young stems (p. 156, 157).	Aracaty
<i>Euterpe edulis</i> Mart. (Palmito) [2180]	<i>Euterpe edulis</i> Mart.	Food: vegetable tasting not unlike asparagus (p. 59, 519).	Serra dos Órgãos, RJ; Diamantina; Ouro Preto
<b>ASTERACEAE (COMPOSITAE)</b> <i>Trixis</i> (Raiz de cobra) <sup>a</sup>	<i>Trixis</i>	Snake bites, cure for the bite of a rattle-snake. It is a suffruticose species of <i>Trixis</i> , about 4 ft high. Root has a musky smell, said that the smell alone is sufficient to kill a snake! (p. 386).	Natividade to Arraias, Arraias to São Romão
<b>BIGNONIACEAE</b> <i>Tabebuia</i> sp. (Pau darco)	<i>Bignonia</i>	Indians make bows from wood, and wood splinters tied together are used for torches (p. 148).	Alagoas
<b>BROMELIACEAE</b> <i>Tillandsia</i> sp.	<i>Tillandsia</i>	Base of leaves contain large quantities of [drinking] water, one plant yielding about a pint (p. 503).	Serra [do Espinhaço]
<b>CACTACEAE</b> <i>Pilosocereus gounellei</i> (F.A.C.Weber ex K.Schum.) Byles & G.D.Rowley (Sheeke Sheeke) [XiqueXique]	Sheeke-sheeke	Fleshy stems and branches after being stripped of spines are roasted and eaten in times of scarcity, in similar circumstances given raw to cattle (p. 124).	Traipú, Pernambuco
<b>DENNSTAEDTIACEAE</b> <i>Pteridium caudatum</i> (L.) Maxon (Samambia)	<i>Pteris caudata</i>	Young shoots cut into small pieces and boiled or stewed in pork are eaten (p. 478, 516).	Ouro Preto
<b>EUPHORBIACEAE</b> <i>Jatropha</i> sp. (manacóba) [maniçoba] <sup>b</sup>	<i>Jatropha</i>	Small tree and its roots in times of scarcity are used to make flour (p. 227).	Alagoas, Crato to Piauí
<b>FABACEAE (LEGUMINOSAE)</b> <i>Anadenanthera colubrina</i> (Vell.) Brenan (Angica) [Angico]	<i>Mimosa</i>	Virgin forest, almost entirely made of a kind of <i>Mimosa</i> called Angica. Bark is use in all Sertão for curtume, gum is the main food for Marmoset monkeys (p. 249, 357).	Olho d'água do inferno
<i>Copaifera langsdorffii</i> Desf. = <i>Copaifera nitida</i> Hayne (Copaiba) [1929, 3636, 4111]	<i>Copaifera nitida</i> Mart.	Oil used in skin ulcers and in friction for rheumatism, trunk yields an abundance of oil (p. 216).	Alagoas
<i>Hymenaea</i> sp. (Jatobá)	<i>Hymenaea</i> (Jatobá)	Wood for construction (p. 192)	Alagoas
<b>CHRYSOBALANACEAE</b> <i>Licania tomentosa</i> (Benth.) Fritsch (Oiti) [992]	<i>Moquilea tomentosa</i> Benth.	Best wood for ship construction (p. 137). He notes that the type description of the species came from material that he sent to Bentham.	Pernambuco
<b>GENTIANACEAE</b> <i>Deianira nervosa</i> Cham. & Schtdl. [4281, 4282, 3894]	<i>Calliopisma</i>	Being intensely bitter is used medicinally as a substitute for Gentian by the inhabitants of Goyas, who collect it when in full flower, dried bundles of it are seen hanging up in almost every house, it is used in infusion in dyspepsia, and also to strengthen those recovering from fever (p. 370).	Natividade to Arraias
<b>LOGANIACEAE</b> <i>Strychnos pseudoquina</i> A.St.-Hil. (Quina) [4273, sn.]	<i>Strychnos pseudoquina</i> St. Hil.	Bitter barks against fever curing intermittent fevers, tree most commonly procured in the upland campos (grasslands). A strong infusion of coffee with a mixture of salt is also sometimes administered (p. 368).	Natividade to Arraias
<b>MALVACEAE</b> <i>Apeiba tibourbou</i> Aubl. (Pau de jangada)	<i>Apeiba tibourbou</i>	Wood for construction (p. 80, 192). A small tree not uncommon. It is from the trunk of this that the raft boat called jangadas are made. The wood is very soft and light [1476].	Alagoas; Pernambuco
<b>MYRTACEAE</b> <i>Eugenia cauliflora</i> Mart. (Jabuticaba)	<i>Eugenia cauliflora</i> Mart.	Edible fruit (p. 449) black colour, size of greengage plum, very refreshing.	Diamantina

Table 3 (continued)

Family/species (vernacular name) [and collection number]	Identification in text	Traditional use (pages on which cited)	Location of observation
<i>Psidium pigmeum</i> Arruda (Marangaba)	<i>Psidium pigmeum</i>	Fruit size of a gooseberry, is greatly sought after on account of its delicious flavour, which resembles that of a strawberry (p. 193).	Alagoas
<b>MARASMIACEAE</b>			
<i>Neonothopanus gardneri</i> (Berk.) Capelari M, Desjardin DE, Perry BA, Asai T, Stevani CV. (Flor de Coco)	<i>Agaricus gardneri</i>	Grows on decaying leaves of a dwarf palm beautiful phosphorescent fungus, a few give sufficient light to read by night (p. 346).	Natividade
<b>MELIACEAE</b>			
<i>Cedrela fissilis</i> Vell. or <i>C. odorata</i> L. (Cedro) [Cedrela sp. 2409]	Cedro	From the wood resembling colour and smell that of the true cedar. And the wood is much used for making doors, tables and articles of furniture (p. 229).	Crato to Piauí
<b>RHAMNACEAE</b>			
<i>Zizyphus joazeiro</i> Mart. (Joazeira) [959, 1266, 1522]	<i>Zizyphus</i>	Edible fruit (p. 279).	Oieras to Paranaguá
<b>RHIZOPHORACEAE</b>			
<i>Rhizophora mangle</i> L.	<i>Rhizophora mangle</i>	Fuelwood, burns extremely well in its green state (p. 146, 552).	Maceió
<b>ROSACEAE</b>			
<i>Rubus</i> sp.	<i>Rubus</i>	Edible fruit, fruit green when ripe has somewhat the flavour of strawberry (p. 457).	Diamantina
<b>RUBIACEAE</b>			
<i>Chiococca alba</i> (L.) Hitchc. (Raiz preta) [324, 1418, 1961, 3211, 6041]	<i>Chiococca anguifuga</i>	Emetic, purgative, useful in snake bites. Decoctions given to drink, and poultices are applied to wounds. Acts as a violent emetic and purgative and induces copious perspiration (p. 52).	Serra dos Órgãos, RJ
<i>Palicourea</i> spp. (Erva de rato, Mata Rato)	<i>Palicourea</i>	Poison (p. 93); Mata Rato (Pernambuco) different species to Erva de rato (Rio), but with same qualities.	Serra dos Órgãos, RJ; Pernambuco
<b>SYMPLOCACEAE</b>			
<i>Symplocos</i> sp.	<i>Symplocos</i>	Leaves dried over fire to be brittle and made into a kind of tea [tisane] (p. 479).	Diamantina
<b>VELLOZIACEAE</b>			
<i>Vellozia</i> sp. (Canela d'Emú) [4370]	<i>Vellozia</i>	Bare resinous stems used as a fuel (p. 344).	Natividade, Diamantina

<sup>a</sup> In his *Catalogue* this common name is marked alongside Gardner 4266 from 'Posse & S. Pedro', cited in *London J. Bot.* 6: 461 (1847) as the type collection of *Trixis ophiorrhiza* Gardner.

<sup>b</sup> Gardner 2764 is *Jatropha elliptica* (Pohl) Oken.

recorded in Gardner's *Catalogue*, especially those from the interior of Ceará. In contrast, few useful species from Rio de Janeiro, Minas Gerais and Goiás are described. The traditional use most frequently noted for the plants was as a febrifuge, for which use seventeen species are recorded. Gardner classified the febrifuges as used for treating malignant, intermittent, inflammatory and puerperal fevers, probably due to his medical knowledge. Fever was a very common health problem at that time and intermittent fever, a typical symptom of malaria (a potentially fatal disease caused by the *Plasmodium* parasite) was considered particularly serious. The medical cure for malaria originated in the 17th century when Spaniards learned, from the Amerindians living in Peru, of the use of "china" or "quina" bark from *Cinchona* spp. (Rubiaceae), especially *Cinchona succirubra* Pav. ex Klotzch. These plants produced quinine, a potent antimalarial that is still effectively used to treat cases where the parasite is resistant to the usual chemotherapies, and notably in the treatment of cerebral malaria.

Only two species of *Cinchona* are known to occur in Brazil, but many naturalists registered the use of other Brazilian plants named "quina" that were also used to treat fevers (Cosenza et al., 2013). Curiously, among the plants registered by Gardner, only five species from his *Catalogue* and one from his *Travels in the Interior* (Gardner, 1846) were recorded specifically as useful to treat intermittent fevers, and of these only two – *Coutarea hexandra* (Jacq.) K. Schum. (Rubiaceae) and *Strychnos pseudoquina* A. St.-Hil. (Loganiaceae) – were named as "quina". This result is quite unlike those of other naturalists, such as Saint-Hilaire and von Martius, who appear to have prioritised the documentation of many substitutes for Peruvian quinas as febrifuges (Brandão et al., 2012; Breitbach et al., 2013). This difference is certainly a consequence of the ecosystems where Gardner collected his information – the Caatinga and Cerrado – where the rain is scarcest and malaria is not a great problem, rather than in the rainforests of Amazonia and the Atlantic Forest.

Plants used as emetics and to treat diarrhoea were also very important in the 19th century and the most known and used was the root of ipecacuanha, *Psychotria ipecacuanha* (Brot.) Standl. (Rubiaceae). The beneficial effect of this plant was described as early as the 16th century, and is the result of the presence of the alkaloids emetine and cephaeline. These substances act specifically on *Entamoeba* parasites that cause diarrhoea, which were prevalent and often fatal in Gardner's time. As in the case of the quinas, many Brazilian species received the name ipecacuanha and were used as substitutes for the original species, as observed by Gardner for *Hybanthus calceolaria* (L.) Oken (Violaceae). However, no studies have been carried out to date to verify the efficacy of these plants.

Other well-documented plants included purgatives, of which Gardner recorded 11 species. These plants were widely used at that time because the local people believed that diseases were due to a "dirty body" and that it was necessary to "purge" for cleansing. Nine species were recorded as useful to treat venereal complaints, among them *Smilax cissioides* Mart. ex Griseb., a kind of salsaparrilha. The use of salsaparrilhas as "depuratives" (for cleansing blood) has been known since the first colonisation of the American continent, in 16th century, and tons of their roots were transported to Europe for use in the treatment of syphilis. In the 19th century the salsaparrilhas were a well-known remedy, with several different species of *Smilax* being used. Plants to treat snakebites were also frequently mentioned by Gardner in his *Catalogue*, including *Aristolochia chiquitensis* Duch. (Aristolochiaceae). Various species of *Aristolochia* are commonly used in Brazil to treat snakebites, but only Gardner appears to have recorded this particular species. Similarly *Dorstenia* species (Moraceae) are also known to have similar uses, but Gardner's record of the use of *Dorstenia asaroides* Gardner ex Hook. for this purpose is apparently unique. Hence the data collected by Gardner are important because he broadens the number of species known to be medicinal.

Gardner described in *Travels in the Interior* (Gardner, 1846) his excursions to the botanic gardens of Rio de Janeiro, Olinda and Ouro Preto. With regard to the latter, he reported that the garden was maintained by the government and intended primarily for the propagation of useful exotic plants to be distributed free. In fact, the colonial Portuguese project did not have an interest in evaluating the potential of native products, and instead promoted the cultivation of plants introduced from other continents to Brazil (Nepomuceno, 2008), which tend to grow better away from their natural predators and diseases. By the mid-sixteenth century, for example, Brazil witnessed the successful cultivation of cinnamon from Ceylon, pepper from Malabar, ginger from China, coconuts from Malaysia, mangos from Southeast Asia, jackfruit from India and cacao from Middle America (Ferrão, 2004; Voeks and Leony, 2004). In contrast, a wide variety of edible fruits was recorded by Gardner in his *Catalogue*, including species previously described by other authors such as *Anacardium occidentale* L. (cajú), *Garcinia gardneriana* (Planch. & Triana) Zappi (bacopari) and *Hancornia speciosa* Gomes (mangaba), as well as others recorded only by Gardner such as *Mouriri pusa* Gardner (Pusá), *Geoffroea spinosa* Jacq. (Mari) and *Psidium lauruotteanum* Cambess. (marangaba). The nutritional value of some of these native species has been confirmed by several studies, but their potential and that of many other edible native species, as well as their toxicity, remains little studied (Oliveira et al., 2012).

Very few exotic species were registered by Gardner in his *Catalogue*, which focused more on native Brazilian species in use at that time. It is also interesting to note that, in contrast to the species recorded by Saint-Hilaire, very few species described by Gardner were included in the first edition of the Brazilian Official Pharmacopoeia, edited by the Brazilian Government in 1926 (Brandão et al., 2008). At that time medicinal preparation was primarily based on vegetable extracts, and several native species were used in both traditional and conventional medicine. The minimal representation of the plants reported by Gardner in the Brazilian Official Pharmacopoeia is a consequence of the remoteness of the places where he travelled, where plant use knowledge was localised and not disseminated to other parts of the country.

## 5. Conclusion

In the present study we present a list of Brazilian useful plants recorded by Gardner in his *Catalogue*. Some 50% of the data presented here have never been published – by Gardner or anyone else. The data on the use of the plants were obtained from a primary source (local people and practitioners) at a time when Brazil's native vegetation was still largely intact and traditional medicine was primarily based on native plants. The updated plant identifications on which our analyses rely are also based on a primary source: the herbarium specimens prepared by Gardner and deposited at the Royal Botanic Gardens, Kew, with duplicates in other European herbaria. These represent a vital resource which allows us to link Gardner's vouchered observations from over 170 years ago to current PubMed records in an authoritative and unambiguous fashion. Conversely, about 50% of Gardner's use observations are of diminished value today because we lack the specimens required to connect them to current botanical concepts at species level. Practicing ethnobotanists and ethnopharmacologists are urged to note the central importance of carefully prepared voucher specimens, deposited in secure, well-curated herbaria. Such specimens not only add value and credibility to contemporary use observations but also ensure their lasting scientific value for centuries to come.

Fewer than 50% of the species which Gardner recorded to be useful have been investigated in detail through published

laboratory studies, yet all of those thus far examined have had their traditional uses to some extent confirmed, showing the potential of these plants as sources of new medicine. We suggest that the remaining species recorded by Gardner be further explored, potentially contributing to the conservation of biodiversity and Brazilian traditional heritage.

## Acknowledgements

We thank FAPEMIG (PPM 0019/2010), CAPES and CNPq (563563/2010-9/ REFLORA and 563311/2010-0) for fellowships and financial support and the Royal Botanic Gardens, Kew for facilities for our studies.

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