Schinus Terebinthifolius Raddi, Popular Use, Chemical Composition, and Biological Activity: A Systematic Review

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Abstract

Introduction: The advance of quantitative and qualitative research has been proving the use of plants as medicine. Considering that many people are adept at popular practices and Schinus terebinthifolius Raddi is native to South America, abundant in the coastal regions of Brazil, where it is popularly known as ‘aroeira’ (Brazilian peppertree).

Objective: Identify the primary studies regarding the popular use, chemical composition, and the main biological activities of Schinus terebinthifolius Raddi.

Metodology: This study attempted to identified, through a previous defined methodology, the systematic review, primary studies regarding the popular use, chemical composition, and the main biological activities of Schinus terebinthifolius Raddi. The survey was conducted in virtual libraries commonly accessed by the scientific community following a script execution and inclusion of some articles.

Results: After all steps of selection, we obtained a total of eighty-one, a number of studies on popular use, the chemical composition, and biological activities of the plant were achieved. The biological activity found and described for this plant is quite extensive. Thirty-eight works surveyed demonstrate that are several scientifically proven recommendations for using different parts of the plant.

Conclusion: This review enabled to systematize the knowledge produced on the main popular use, the main researches related to biological activity, and the range of chemical constituents of Schinus terebinthifolius Raddi already isolated.

Keywords: Brazilian peppertree (Schinus); Antimicrobial; Bioactive plants

Introduction

The use of plants for medicinal purposes formed the therapeutic basis of medical practice for several centuries [1]. According to World Health Organization (WHO) it is estimated that 80% of the population of the planet uses, somehow, bioactive plants as medicines [2]. The growing interest of the scientific community by herbal medicine in the last two decades led to the development of several practices and sayings-based researches [3].

Plants are responsible for producing a series of chemicals during their metabolism, some of these are known as active principle and are capable of causing...
some type of biological response when introduced in the body by any route, suggesting that the misuse of certain species as medicinal is very dangerous and may lead to side effects [4]. In recent years, the importance of herbal medicine was reaffirmed due to improvements in biological surveillance techniques and scientific validation [5].

Brazil presents a particularly rich medicinal flora that became the object of ethnopharmacological and ethnobotanical studies in the second half of nineteenth century and early twentieth century [6]. Among the plants of broad popular use is *Schinus terebinthifolius* Raddi [1]. This plant belongs to the family Anacardiaceae, and is a common plant of coastal vegetation [7]. It is popularly known in Brazil as “aroeira vermelha” or “pimenta rosa” [8]. It is a native plant to Brazil and was introduced in Europe where it is much admired for its beauty and size, and is used in urban streets afforestation [9]. It presents itself as a medium-sized tree, monoecious, with aromatic compound leaves which are used in cookery. In France it is named “poivre rose”, a kind of sweet pepper [10]. It has abundant small red fruit during maturation [11]. The wood is hard and has multiple uses including for production of charcoal and firewood [11]. This plant is widely used in Brazilian popular medicine and there are a growing number of studies about it in the medical literature [12].

The systematic review is a type of scientific inquiry that aims to gather, makes critical evaluation, and conducts a synthesis of multiple primary studies results [13]. In systematic reviews, the “subjects” of the investigation are the primary studies (units of analysis) selected through a systematic and pre-defined method. The systematic review is traditionally a retrospective study [14].

Due to the advancement in number and quality of the researches demonstrating the use of herbal medicine with some bioactive activity, and because many people are adept at popular practices, the objective of this research was to identify primary studies on popular using, chemical composition, and biological activities of Brazilian pepper tree – *S. terebinthifolius* Raddi.

**Material and Methods**

This systematic review study was conducted in the period from April 5 to May 5, 2012. It was made a survey of results in databases SciELO, PubMed, and Scholar Google, in any date of publication. SciELO – Scientific Eletronic Library Online – was chosen because it contains studies from Latin America, Spain and Portugal, PubMed, by bringing together leading medical studies, and Google Scholar was used in this study with the main objective to find studies that are not indexed in journals published regionally, including thesis, dissertations, and conferences. The search strategy in SciELO and PubMed was the use of the keyword “*Schinus terebinthifolius*”. Two different surveys were made in Google Scholar; with results only in Portuguese, and the keyword anywhere in the text, in the first search the term “*Schinus terebinthifolius*” was used on “with all the words” and the term “popular usage” on “with the exact phrase”.

In the second search term “*Schinus terebinthifolius*” was used on “all the words”, and the term chemical composition was used on "with the exact phrase".

After searching, all studies found were selected and filed away. The titles and the abstracts of all articles were read, and a second selection was done for discarding those results that did not fit the purpose of the search. A third selection was made with a complete reading of all texts selected in the second step. Thus, the total result of the studies that formed this review was achieved. The selection criteria adopted were the articles of primary knowledge that dealt with the popular usage of the plant, its chemical composition, and the main biological activities in healthcare.

**Results**

The selection of results found, as show in Figure 1, resulted in 81 publications, covering papers, Regional publications, conferences publications, and thesis and dissertations.
Out of 81 selected articles, 13 were repeated among searching, that is, appeared as a result in more than one search base. Therefore, the total of publications used in this article comprises 68 files. Among the search bases, we obtained results as shown in Table 1. Focusing the popular usage 18 articles was found, on chemical composition 12 articles were found, and 38 dealt with the evaluation of biological activity of plant extracts which allowed the completion of data.

<table>
<thead>
<tr>
<th></th>
<th>SciELO</th>
<th>PubMed</th>
<th>GA – chemical composition</th>
<th>GA – popular usage</th>
<th>TOTAL</th>
</tr>
</thead>
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<tr>
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<td>44</td>
<td>35</td>
<td>111</td>
<td>59</td>
<td>249</td>
</tr>
<tr>
<td>After 1st reading</td>
<td>22</td>
<td>23</td>
<td>26</td>
<td>23</td>
<td>94</td>
</tr>
<tr>
<td>After 2nd reading</td>
<td>19</td>
<td>21</td>
<td>21</td>
<td>20</td>
<td>81***</td>
</tr>
</tbody>
</table>

Table 1: Results obtained based on the search at each stage of selection.
*GA – chemical composition: Google Scholar, with the exact phrase “chemical composition”
**GA – popular usage: Google Scholar, with the exact phrase “popular usage”
*** 13 articles were repeated in different search bases

### Discussion

Over the years, popular observations have led to the accumulation of relevant information of the effectiveness and the medicinal effects of the plants [15]. According to Guerra et al. who conducted a study on the use of herbal medicine practice in a particular rural village, the reality in these communities is that the predominance of the use of medicinal herbs is due to the traditional habit of people seeking healing from sickness taking advantage of existing resources in their environment [16]. In accordance to this, others authors, have also conducted similar studies investigating and doing a survey about which species were most commonly used by regional populations [4,6,17-29].

Among these investigative studies with different regional groups, the main popular indications for using Brazilian peppertree are related to oral pathologies 28-20-18, because of its healing action 19-25, or as an antiseptic 24. According to the study by Boscolo et al. the bark of the trunk and fruit of this plant are indicated for respiratory disorders and uterine inflammation [4]. Lopes reported that the decoctions of bark and leaves are used for healing, for staunching bleeding and even for strengthening teeth [22]. As the aforementioned authors, Guerra et al. restated what has been described pointing the popular usage for Schinus bark in different forms of extraction, the cooking is useful for inflammation and ulcers, infusion is useful in injuries, bruises, and inflammation, syrup is indicated in case of influenza, and bark powder and macerated bark are used for healing injuries and bruises [16]. Mentz et al. suggested that the infusion of the leaves is effective for digestive disturbances, or even that baths have depurative and anti-rheumatic action [6]. Regarding this use, Silva et al. also found the popular usage of this plant for gastrointestinal disorders [26]. Fenner et al. investigated plants to be used as popular antifungal medicine and highlighted Schinus as one of them [30].

Oliveira et al. and Carriconde, wrote booklets containing the main medicinal plants of popular use in the states of Paraiba and Pernambuco (Brazil), demonstrating how to collect, dry and prepare the plants to be used, as well the indicated amount and for how long it should be used, based on information obtained in the popular investigation [31-32].

Regarding its composition, a number of authors describe the isolation of chemicals from several portions and different plant extracts. Richter et al. suggest a new chromatography technique used to insulate chemical compounds of essential oil from the Schinus fruit [33].

Clemente performed the chemical analysis of the essential oil of Schinus terebinthifolius Raddi [34], and other authors have also investigated its essential oils composition, as shown in Table 2.
El-Massry et al. by chromatography of the essential oil from Schinus leaves, found monoterpenes, sesquiterpenes, oxygenated monoterpenes, and oxygenated monoterpenes [40]. Roveda et al. have also observed monoterpenes concentration, but in essential oil of the fruit [8]. Silva et al. have isolated alpha-pinene, delta-carene, limonene, and alpha-phellandrene from fruit essential oil, in their investigation [37].

Santos et al. by evaluating chemical changes in the essential oil of the leaves from three exemplars of the plant, in different phonological phases, identified sabine, alpha-pinene, cariophyllene, and germacrene D as main substances [35]. The samples were different from each other in relation to their main components. However, the authors suggested that the differences may be related to genetic character, micro-environment, and physiological age of the trees.

Hayashi et al. isolated a xanthine oxidase inhibitor [36]. Ceruks et al. made a phytochemical study of hydroalcoholic extract of Schinus leaves, and isolated ethyl gallate, myricetin, and methyl gallate [10]. Barca studied the decoction of Schinus bark and concluded that it has a high amount of tannins, making it an anti-inflammatory and astringent plant, by causing local vasoconstriction and coagulation of proteins, forming a coat slightly antiseptic, and under it the tissue regeneration occurs [39]. In relation to influences on the extract, Vasconcelos et al. evaluated the influence of temperature for obtaining the plant extract in their final product [41].

Bendaoud et al. isolated the sesquiterpene compound from essential oil of Schinus fruits, which had an action against breast cancer in humans, according their researches [38]. Another similar study Queires et al. researched the effects of polyphenols isolated from Schinus and its activity against prostate carcinoma [42]. Jain et al. evaluated a terpenoid, the schinol, to test the inhibition of phospholipase A2 [43]. Tirelli et al. quantified tannins in Schinus bark and compared with other plants [44].

Taking into account the different biological activities of Schinus terebinthifolius Raddi, the findings were various. As for activity against bacteria, Costa et al. evaluated four extracts from different plants against Enterococcus faecalis, an important dental oral bacteria, revealing the antibacterial action of the Schinus extract. Similarly, Lima et al. tested the ethanol extract of the stem bark and leaves, as well as some fractions of these extracts, against certain susceptible strains of Staphylococcus aureus and Escherichia coli, and resistant strains of Staphylococcus aureus [45-46]. Melo et al. verified the activity of Schinus against bacteria isolated from alveolitis in rats, and the plant achieved an efficient outcome [5]. Silva et al. aimed to test the essential oil from the leaves of Schinus against Staphylococcus spp. isolated from external otitis in canines and evaluated cytotoxicity with laboratory animals, concluding that the extract has a potent antimicrobial action and no evidence of toxicity [37].

According to Amorim et al. women from northeastern Brazil often use Schinus decoction for treating vaginitis and cervicitis [47]. In this study they have shown the in vivo use, with significant results in the treatment of bacterial vaginosis. Leite et al. conducted a very similar study, comparing the use of Schinus and metronidazole in the treatment of bacterial vaginosis, but the antibiotic had a higher cure rate [48].

Santos et al. evaluated the effect of Schinus leaves extract against some species of fungus isolated from flowers which showed growth inhibition of Colletotrichum

<table>
<thead>
<tr>
<th>Plant Part</th>
<th>Extract</th>
<th>Main compounds</th>
<th>Ref.</th>
</tr>
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<tbody>
<tr>
<td>Leaf</td>
<td>Essential oil</td>
<td>Monoterpenes/Oxygenated Monoterpenes/Sesquiterpenes/Oxigenated/Sesquiterpenes</td>
<td>12</td>
</tr>
<tr>
<td>Leaf</td>
<td>Essential oil</td>
<td>Sabinene/Alpha-pinene/Cariophyllene/D-Germacrene</td>
<td>35</td>
</tr>
<tr>
<td>Leaf</td>
<td>EHA</td>
<td>Ethyl gallate/Myricetin/Methyl gallate</td>
<td>36</td>
</tr>
<tr>
<td>Fruit</td>
<td>Essential oil</td>
<td>Monoterpe,ne</td>
<td>8</td>
</tr>
<tr>
<td>Fruit</td>
<td>Essential oil</td>
<td>Alpha-pinene/Delta-carene/limonene/Alpha-phellandrene</td>
<td>37</td>
</tr>
<tr>
<td>Fruit</td>
<td>Essential oil</td>
<td>Sesquiterpene</td>
<td>38</td>
</tr>
<tr>
<td>Bark</td>
<td>Decoction</td>
<td>Tannins</td>
<td>39</td>
</tr>
</tbody>
</table>

Table 2: Chemical composition of S. terebinthifolius Raddi described by different authors
spp and Fusarium spp [49]. Ruiz et al. evaluated thirteen herbal plants, including Schinus, to test their mutagenic properties against Aspergillus nidulans, and showed that only one, Momordica charantia, had genotoxic effect [50].

Johann et al. investigated the antifungal effect of various plants against Paracoccidioides brasiliensis, and Schinus was not among the plants with best results [51]. But in another study Johann et al. using hydro alcoholic extract from leaves and bark of Schinus, isolated some compounds, among them, schinol and NC-byphenil were active against the fungus Paracoccidioides brasiliensis. In this study they also found that portion schinol combined with Itraconazole showed synergistic effect [52].

Tonial, showed the antimicrobial activity of methanol extract of Schinus leaves [53]. Schmourlo et al. evaluated the activity of the plant against some yeasts of Candida, Trichophyton and Cryptococcus genera [54]. Schinus showed positive results against Candida spp. Similarly, Guerra et al. tested the fluid extract of Schinus terebinthifolius Raddi leaves against Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, and Candida albicans [55]. They obtained a positive result, but with a broader action against the yeast. Santos, tested the action of Schinus extract against Staphylococcus aureus, Pseudomonas aeruginosa, Escherichia coli, Bacillus subtilis, Candida albicans, Candida tropicalis, Candida krusei, Candida guilliermondii, Trichophyton rubrum, Microsporum gypseum, Aspergillus flavus, and Aspergillus niger [56]. The results were positive for bacteria, but ineffective against fungi. Pereira et al. also tested ethanol extract from some plants, including Schinus, against various microorganisms: Candida albicans, Streptococcus mutans, Staphylococcus aureus, and Aggregatibacter actinomycetemcomitans, and the extracts showed some antimicrobial activity [57].

There are different results regarding the healing mediated by the Schinus extract. The healing activity was showed in the nineteenth and early twentieth centuries with experiments in rats with hydroalcoholic extract of bark, in bladder Lucenaa et al. linea Alba Nunes et al. and colon Coutinho et al.[2-7-12]. However, in the same biological model, Santos et al. used a similar protocol and evaluated the healing of the stomach and observed that there was no change in the healing process [3]. Branco-Neto et al. used a different technique from the others, by evaluating the topical use of the plant in the healing dorsal wounds in rats, and observed that the extract delayed the reepithelialization of skin woods [1].

Lipinski, compared the effect of Schinus bark with other plants on wound healing process by secondary intention in cattle, resulting in a beneficial effect of this plant [58]. Lanzoni, verified the action of polar and non polar extracts of Schinus leaves, as well as their combination, in tissue repair of induced transfixing lesions in rats tongue [59]. Polar extract was more effective in the initial process of repair, and non polar extract was the best in collagen production and repair of ulcers. Ribas et al. evaluated the tissue repair in ulcerated lesions on the oral mucosa of rats and also found positive results [9].

Medeiros et al. tested the anti-inflammatory action of a compound formed by four plants, including Schinus, popularly used in northeastern Brazil, in experimental studies with ear and paw edema in rats [60]. The compound showed anti-inflammatory property, and the recommended dose is the same used by the population. The same product was tested by Paulo et al. for toxicological effects [61]. These authors conducted toxicological clinical trials, phase 1, in human beings, using an herbal product, and proved that it has low toxicity. In in vivo assays, Lima et al. evaluated hydro alcoholic extract toxicity of Schinus bark on rats, and concluded that the plant produces no toxic effects [62].

An interesting biological activity, concerning the use of Schinus terebinthifolius Raddi, is described by Silva et al. and Silva et al. who state that the essential oil obtained from Schinus fruits is an alternative to antibiotics in the feed of broilers, because it improves production rates and intestinal absorptive surface, promoting better feed conversion, weight gain, and final weight [63-64].

Previous studies, with scientific impact, on the action of medicinal plants against tumor cells, were performed. Barbosa evaluated the toxicological effects of some plants, including Schinus, and analyzed the action of their extracts on tumor cells [65]. Mesquita, evaluated the action of various extracts of plants from Brazilian savanna against three human cancer cell lines – melanoma, colon, and glioblastoma [11]. Schinus was classified as active against those cells.

Varela-Barca et al. argued that Schinus has genotoxic properties and claimed that its flavonoid fractions cause damage to bacterial DNA. The DNA is the target for Fpg -formamidopyrimidine-DNA-glycosylase and MutY-glycosylase, via BER –Base Excision Repair [66]. Similarly, Carvalho et al. by the trunk bark decoction, found several components and attributed to the antioxidant potential flavonoids [67]. In this study, the extract caused damage
and mutation in bacterial DNA, suggesting a kind of plant action on these microorganisms, and it is of utmost importance for the scientific substantiation of the use of medicinal plants.

Other activities related to Schinus are described by Bertoldi, who evaluated the performance and the antioxidant potential of the phenolic fraction of the essential oil and oleoresin [15]. Machado et al. investigated experimentally the anti allergic of ethyl acetate fraction of Schinus which showed positive results, proving this indication [68].

Freitas et al. in a palynological analysis, from the removal of wax and the resin, cited Schinus as being a component of brown propolis from Atlantic Forest of Rio de Janeiro (Brazil) [69]. Teixeira, also pointed out Schinus as a component of propolis originating from three regions of state of Minas Gerais (Brazil), and assigned the complexity of propolis chemical composition to valuable pharmacological properties, considering some compounds alone, or the synergism between them, which leads to a broad spectrum activity against different microorganisms of varying degree of pathogenicity for man and other animals [70]. He also cited important studies on proven biological properties, as antioxidant, cytotoxic, and immunomodulatory actions.

Conclusions

This review enabled to systematize the knowledge produced on the main popular use, the main researches related to biological activity, and the range of chemical constituents of Schinus terebinthifolius Raddi already isolated. It was possible to demonstrate the richness and the high potential of this bioactive medicinal plant, but it needs more research to deepen knowledge and its therapeutic use.

References


