



## Review Article

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### PHYTOCHEMICAL AND PHARMACOLOGICAL ACTIVITIES OF *JUSTICIA PROCUMBENS* L.: A REVIEW

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#### ABSTRACT

*Justicia procumbens* L. is usually known as water willow which belongs to family Acanthaceae growing widely in southern regions of China, Japan, Vietnam, India and Australia. It is one of the important herbal being used in Ayurvedic system of medicine. The plant contains various active compounds like aryl naphthalide and diarylbutane lignans, glycosides, flavonoids. Few pharmacological properties including anti-inflammatory, anti-arthritis, anti-arrhythmic, anti-asthmatic, anti-proliferative, anti-allergic, antibacterial, cytotoxic and anti-HIV activities activity have been reported for this plant. Conventionally, it is used for the treatment of fever, inflammation, cold, cough, asthma, cancer, snake bites etc. The current review is created with an intended to focus on the numerous ethnobotanical and traditional uses as well as the phytochemical and pharmacological report on *Justicia procumbens*.

**Keywords:** *Justicia procumbens* L., Acanthaceae, water willow, traditional uses, phytochemistry, pharmacology

#### INTRODUCTION

Plants have been used as medicinal products for thousands of years, and are a source of many powerful and effective medicines around the world. According to the World Health Organization, for their primary health care needs 80 percent of the population of developing countries depend on conventional medicines, mainly plant drugs.<sup>1,2</sup> While modern medicine may be available in those countries, for historical and cultural reasons, herbal medicines have often retained popularity. Typically the secondary metabolites produced by the plants are responsible for the biological characteristics of plant species used worldwide.<sup>3,4</sup>

The family Acanthaceae is an important source of therapeutic drugs, comprising approximately 250 genera with 2500 species. *Justicia* is the largest genus of Acanthaceae, with approximately 600 species.<sup>5</sup> Plants of this genus have exhibited medicinal properties and fused to treat various diseases and disorders such as cancer, diabetes, fever, headache, asthma, arthritis and various gastrointestinal disorders.<sup>6,7</sup> Some of the species belongs to genus *Justicia* are *Justicia betonia* L., *Justicia diffusa* Wild, *Justicia glabra* J. Koenig ex Roxb, *Justicia glauca* Rottler, *Justicia micrantha* Wallich ex C.B. Clarke, *Justicia procumbens* L., *Justicia prostrate* (C. B. Clarke) Gamble, *Justicia simplex* D. Don, *Justicia tranquebariensis* L. f, *Justicia betonica*, *Justicia beddomei* (Clarke) Bennett, *Justicia spicigera*.<sup>8,9</sup>

*Justicia procumbens* L, commonly known as water willow, is a small annual plant that is widely distributed in southern regions of China, Japan, Vietnam, India and Australia. Grows at higher altitudes, found commonly in humid areas.<sup>10,11</sup> The plant is valuable for its medicinal uses. *Justicia procumbens* is used in the southern parts of India as folk medicine and highly valued for its uses in treating cold, cough, asthma and for snake bites.<sup>12</sup> Its young leaves were recorded as famine food in Malaysia and India

and were used in Taiwan as herbal tea ingredient.<sup>11</sup> The aerial parts of *J. procumbens* are also used in China as a common traditional medicine for fever and inflammation treatment are also used as a popular traditional medicine in China for treatment of fever and inflammation<sup>13</sup>.

#### Botanical description

*Justicia procumbens* L. (Figure 1) is a slender, often tufted, prostrate or ascending, branched perennial herb. The stems are 10-40 centimetres. The leaves are elliptic to oblong-ovate or ovate, 7-20 mm long, 5-20 mm wide, obtuse at both ends, and wholly or slightly crenate as to margin, glabrous or sparsely hairy, 1.5-3 cm long petioles. The flowers are pink, 6-7 mm long, and borne 1-5 cm long and about 5 mm in diameter in terminal, very thick, cylindrical spikes.

The sepals and bracts are green, linear-lanceolate and hairy; calyx 3-4 mm long, 4-partite deep; uneven, circular, sub acute, or acute segments, 4-6 mm thick, outdoor hairy, 2-lipped corolla; stamens 2; tied to the upper part of the corolla; unequally spaced anthers, ovary tip and style base hairy. The fruit (capsule) is slightly hairy and about 4 mm long, glabrous; orbicular seeds 1 x 1 mm, brown, striate drogues. Water Willow is found in all of India at altitudes of up to 1500 m.<sup>14-17</sup>

#### Taxonomical classification

The taxonomic classification of *Justicia procumbens* L. is given in the Table 1.

#### Vernacular names

The of vernacular names *Justicia procumbens* L. is given in the Table 2<sup>18</sup>.

Figure 1: *Justicia procumbens* L.Table 1: Taxonomy of *Justicia procumbens* L.

<b>Kingdom</b>	Plantae
<b>Phylum</b>	Tracheophyta
<b>Division</b>	Magnoliophyta
<b>Class</b>	Angiospermae
<b>Subclass</b>	Eudicots
<b>Order</b>	Laminales
<b>Family</b>	Acanthaceae
<b>Genus</b>	<i>Justicia</i>
<b>Species</b>	<i>Procumbens</i>

Table 2: Vernacular names of *Justicia procumbens* L.

Language	Name
English	Water Willow
Malayalam	Cheriyaridalthamara, Cherutharthaval, pittakkoti
Tamil	Knteyu, Kotakacalai, Kukkurm
Hindi	Karambal,
Konkani	Pitpapad
Marathi	Karambal, Pitpapada, Kalmashi
Nepali	Bissaune Jhaar, Khursaani Jhaar,
Gujarati	Pitpapado
Sanskrit	Parpata, renu, varatikta
Tulu	Poddolu poo
Chinese	Jhuchuang

### Traditional uses

*Justicia procumbens* plays a great part in the traditional medicine system. It is a traditional herbal medicine widely used as described in the 1977 edition of Chinese Pharmacopoeia. The whole plant of *Justicia procumbens* L. is used as a herbal remedy for fever, pain caused by pharyngolaryngeal swelling and cancer<sup>19-21</sup>. In China the aerial parts of *J. procumbens* were used for the treatment of fever and inflammation.<sup>13</sup> It is common in southern parts of India for the treatment of cold, cough, asthma and snake bites.<sup>12</sup> This plant also acted as one of the key herbs in *Jian-er* syrup, a compound of Chinese herbal medicine.<sup>22</sup> The decoction of the leaves and root decoction has been used against typhoid fever in Nepal.<sup>23,24</sup> Infusion of the herb is traditionally used for arthritis.<sup>25</sup> The diagnosis of asthma, cough, backache, flatulence and many skin conditions uses a decoction or an infusion. The leaf juice is used to treat ophthalmia. A decoction of the leaves is used in curvature care and bone diseases. Root juice is used in cough treatment where blood is coughed.<sup>26</sup>

### Phytochemistry and pharmacology

The chemical investigations of *J. procumbens* have mainly revealed the presence of several aryl naphthalide and diarylbutane

lignans and their glycosides. From this plant for the first time neojusticin-A was isolated.<sup>27</sup> Later Chen *et al.*, isolated nine known aryl naphthalide lignans, neojusticin A, justicidin B, justicidin A, taiwanin E methyl ether, neojusticin B, chinensinaphthol methyl ether, taiwanin E, chinensinaphthol, and diphyllin, and a new aryl naphthalide lignan 4'-demethylchinensinaphthol methyl ether from fractionation of the ethanolic extract of *Justicia procumbens* and conducted anti platelet bioassay. They found that the ethanolic extract of the whole plant of *J. procumbens*, at a concentration of 20 µg/mL, exhibited 50% inhibitory activity to the arachidonic acid induced aggregation of rabbit platelets and demonstrated that compounds neojusticine - A, justicidin B, taiwanin E methyl ether and taiwanin E possesses significant inhibitory activity of the platelet aggregation.<sup>28</sup> Further, studies by Yang *et al.*, reported that justicidin B targets the integrin αIIbβ3 protein in platelet aggregation.<sup>29</sup>

Neojusticin B and taiwanin E as well as the justicidins C and D were also isolated by Okigawa *et al.* And Ohta and Munakata respectively.<sup>30,31</sup> The lignan neojusticin B induced anti arrhythmic activity in rats.<sup>32</sup>

Shan He *et al.*, isolated four lignans justicidin B, justicidin A, 6'-hydroxyjusticidin C and lignan J1 from a crude sample of *J. procumbens* using HSCCC in stepwise elution mode for the first time.<sup>33</sup> One of the most promising areas of research in these species is as antiviral, since the lignans justicidine A, B, C and D; justicidinosides A, B and C, and the diphilineapioside isolated from methanolic extract of the aerial parts of *J. procumbens* have demonstrated significant activity against vesicular stomatitis virus. Also, in this study important cytotoxic activity in rabbit lung cells was found.<sup>34</sup>

A novel dibenzylbutane (5-methoxy-4,4'-di-O-methylsecolariciresinol-9'-monoacetate) and seven isomers of aryl naphthalene were isolated and characterized by Liu *et al.*, along with two glycosides of secoisolariciresinol dimethyl ether and 5-methoxy-4,4'-di-O-methylsecolariciresinol, one monoacetate of secoisolariciresinol dimethyl ether which were detected for the first time.<sup>35</sup>

Tiwari *et al.*, in India isolated anthocyanin peonidin 3-glucoside from the flowers of *Justicia procumbens*.<sup>36</sup> Two cytotoxic compounds, justicidin-A and diphyllin isolated by Fukamiya *et al.* and flavonoids peonidine 3-glucoside were later studied by Asano *et al.* and were demonstrated to be potent antiviral and antifungal.<sup>37-39</sup> Day SH *et al.*, have studied the potent cytotoxic effects against number of cancer cells *in-vitro* by using new lignan glycoside 4-O-α-L-arabinosyl-(1-2)-β-Dapiofuranosyldiphyllin named procumbenoside A and 11 known compounds were isolated from methanolic extract of the air dried whole plant of *Justicia procumbens*.<sup>40</sup> Study on the chemical constituents of *J. procumbens*, by Hong Jin *et al.*, resulted in the isolation of three other new 14-membered cyclopeptides alkaloids justicianene B, justicianene C, justicianene D.<sup>41</sup> Naphthofuranones, justicidin A, B, C, D, G and H and diphyllin, are also used for the treatment of osteoporosis.<sup>39</sup>

Joobyoun Yoon *et al.*, investigated the anti-allergic/anti-asthmatic effects of *J. procumbens* and identified that the components responsible for its bioactivity as Justicidin A and B.<sup>42</sup>

XU Xin-Ya, *et al.*, isolated three new lignans named as procumbenoside N, procumbenoside O and secoisolariciresinol dimethyl ether acetate along with 21 other known lignans from the aerial parts of *J. procumbens* and evaluated their cytotoxic and anti-HIV activities. It was reported that the new

secoisolariciresinol dimethyl ether acetate exhibited anti-HIV-1 activity with an IC50 value of 5.27  $\mu\text{mol}\cdot\text{L}^{-1}$  and the known aryl-naphthalene lignan procumbenoside A and diphyllin demonstrated inhibitory activity against HIV-1 with IC50 values of 4.95 and 0.38  $\mu\text{mol}\cdot\text{L}^{-1}$  respectively.<sup>10</sup>

A methanol extract of the whole plant of *Justicia procumbens* L. showed significant inhibitory activity *in vivo* against P-388 lymphocytic leukaemia growth and *in vitro* cytotoxicity in the 9-KB (human nasopharyngeal carcinoma) cell culture assay.<sup>43</sup>

Mruthyunjayaswamy BHM *et al.*, (1998) have screened the alcoholic extract of *Justicia procumbens* for *in-vitro* anti-inflammatory activity in albino rats at a dose of 100 mg/kg body weight. The activity has been attributed to the presence of steroids and flavonoids in the extract.<sup>44</sup>

Zeng Zhi-hong, HE Jian-Ren reported the antibacterial effects against on *Staphylococcus aureus*, *Escherichia coli* and *Salmonella*.<sup>45</sup>

## CONCLUSION

Herbal medicine plays an important role in the evolution of modern civilisation. *Justicia procumbens* is an interesting example of a plant that has traditional medicinal value for many years and many research works have proven this. The literature survey shows *Justicia procumbens* that is traditionally in cold, cough, asthma, typhoid, arthritis, backache, flatulence, ophthalmia, snake bites and many skin conditions. *Justicia procumbens* is an important source of many pharmacological and medicinally important phytochemicals such as aryl-naphthalide and diarylbutane lignans, glycosides, flavonoids. The plant is studied for its pharmacological activities like anti-inflammatory, anti-allergic, antibacterial, anti-arrhythmic, cytotoxic and anti-HIV activities. From the current review, we conclude that the plant *Justicia procumbens* could be useful for the development of commercial drugs.

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