K. Kavitha*, K.S. Sridevi sangeetha, K. Sujatha, S. Umamahewwari
Faculty of Pharmacy, Sri Ramachandra University, Porur, Chennai-116,Tamil Nadu,India.

Received on:17-05-2014; Revised on: 21-06-2014; Accepted on:18-07-2014

ABSTRACT

Justicia gendarussa Burm f. (family Acanthaceae) known as Willow-leaved justicia in English, it is native to China. It is commonly found throughout the greater part of India and Andaman islands. Justicia gendarussa Burm f. is one of the important herbal being used in Ayurvedic system of medicine. Mostly the leaves are used for the medical purposes. A wide variety of biologically active constituents such as flavonoids, alkaloids, steroids, terpenoids, saponins, phenolic compounds and carbohydrates are present in this plant. The leaves also contain friedelin, lupeol, β-sitosterol and aromatic amines. This plant exhibits anticancer, antibacterial, hepatoprotective, antioxidant, anthelmintic and antiangiogenic activities. This review will focus on the phytochemical constituents isolated from the plants and phytopharmacological properties of different parts of Justicia gendarussa.

KEY WORDS: Justicia gendarussa, Acanthaceae, Willow-leaved Justicia, Pharmacological activities, Traditional uses.

1. INTRODUCTION:

Among the innumerable gift of nature belong the fascinating varieties of natural in some guise have been inseparable parts of mankind history, since they fulfill many of our basic requirements. Some of the plants are used as food while others showed beneficial effect against various human suffering such as injuries and ailment. The drugs were isolated either from the whole plant or from different parts of the plant like leaves, stem, bark, root, flower and seed. Some drugs are prepared from excretory plant products such as gums, resins and latex.1 Plants have formed on the basis of sophisticated traditional medicine systems among which are Ayurvedic, Unani, and Chinese. These systems of medicine have given rise to some important drugs which are still in use. Natural products derived from plants have historically played an essential role in the discovery of novel new pharmaceuticals.2 The plant kingdom still holds various species of medicinal plants containing materials of medicinal value which have yet to be discovered.3

The genus Justicia Linn (acanthaceae) is shrubs and herbs distributed in the tropical regions of the world. It comprises about 300 species in all over the world among them nearly 50 species were recorded in India. Some of the species belongs to genus Justicia are Justicia betonia L. Justicia diffusa Wild, Justicia glabra J. Koening 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 Lf, Justicia betonica, Justicia beddomei (Clarke) Bennett, Justicia spicigera.4,5 The recently reported pharmacological activities of some species were shown in table 1.

Table 1: Pharmacological activity reported for other species

<table>
<thead>
<tr>
<th>Species</th>
<th>Study</th>
<th>Extract</th>
<th>Part</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Justicia tranquebariensis Lf</td>
<td>Antiarthritic</td>
<td>Methanol</td>
<td>Aerial part</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Antioxidant</td>
<td>Ethanol</td>
<td>Leaf</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Cardioprotective</td>
<td>Aqueous</td>
<td>Leaf</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Anti inflammatory</td>
<td>Petroleum ether, Chloroform, Alcohol, Water</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Justicia procumbens</td>
<td>Anti inflammatory</td>
<td>Alcohol, Aqueous</td>
<td>Whole plant</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Antiulcer</td>
<td>Ether</td>
<td>Leaf</td>
<td>11</td>
</tr>
<tr>
<td>Justicia betonica</td>
<td>Atinoconceptive</td>
<td>Ether</td>
<td>Leaf</td>
<td>12</td>
</tr>
<tr>
<td>Justicia simpex D. Don</td>
<td>Anti plasmodium</td>
<td>Methanol</td>
<td>Whole plant</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Analgesic</td>
<td>Hydro alcohol</td>
<td>Whole plant</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Anti-inflammatary</td>
<td>Methanol</td>
<td>Whole plant</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Antibacterial</td>
<td>Hexane, Chloroform, Methanol, Water</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Justicia spicigera Schltdl</td>
<td>Antihypertensive effect</td>
<td>Ethanol</td>
<td>Whole plant</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Antitumor, Antidiabetic</td>
<td>Ethyl acetate</td>
<td>Leaf</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Hepatoprotective</td>
<td>Methanol</td>
<td>Aerial part</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Antioxidant</td>
<td>Petroleum ether, Chloroform, Ethyl acetate, Water</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Justicia beddomei (Clarke) Bennett</td>
<td>Cytoxic</td>
<td>Ethyl acetate</td>
<td>Leaf</td>
<td>21</td>
</tr>
</tbody>
</table>

*Corresponding author.
K. Kavitha
Research scholar
Faculty of Pharmacy
Sri Ramachandra University
Porur, Chennai-600 116
Tamil Nadu, India.
2. **JUSTICIA GENDARUSSA BURM.F. DESCRIPTION:**

*Justicia gendarussa* Burm. f. Syn: *Gendarussa vulgaris* (figure 1) is an erect undershrub, 0.6 to 1.2 m in height with subterete branches. Leaves are simple, lanceolate or linear – lanceolate, 7.5 to 12.5 cm long, glabrous, short-petioled, pale green beneath and dark violet green above, 8 pairs of main nerves, mid rib and main nerves prominent on the under surface. Stems and branches are dark violet. Flowers are 5-12.5 cm long from the uppermost leaf-axils; white coloured, spotted with purple and clustered in the interrupted spikes. Fruits glabrous capsules. Calyx 3.8-5mm; with nearly glabrous linear segments. The leaves and roots are acrid, febrifuge, thermogenic, emetic, anodyne, emmenagogue, diaphoretic, insecticidal and antipyretic.\(^{22,23}\)

Root extract obtained from *Justicia gendarussa* is mostly prescribed for constipation, laxative action helps in normal bowel movement.

4. **SCIENTIFIC CLASSIFICATION:**

- **Kingdom:** Plantae
- **Division:** Magnoliophyta
- **Class:** Magnoliopsida
- **Order:** Scrophulariales
- **Family:** Acanthaceae
- **Genus:** *Justicia*
- **Species:** *gendarussa*

5. **LOCAL NAMES OF THE PLANT:**

- Burma: Bavanet, Bawanet
- Bombay: Kalaadulsa
- Sanskrit: Krishnanirgundi, Nilanirgundi, Indrani
- English: Black vasa, Black Malabar nut
- Hindi: Nilinargandi, Udasanbhalu
- Bengal: Jagatmadan, Jogmodon
- Deccan: Kalishanbali
- Chinese: Ch’in ch’iu
- Marathi: Bakas, Kalaadulsa
- Kannada: Karinekki
- Telugu: Addasarambu, Nallavavili,
- Malayalam: Vatankolli, Vatankutti, Karinochil
- Tamil: Vadaikkutti, Karunochi

6. **CHEMICAL CONSTITUENTS:**

The quantitative estimation of phytoconstituents of leaves of *Justicia gendarussa* shows the presence of alkaloids (1.62±0.081%w/w), flavonoids (2.03±0.105%w/w), triterpenoids (0.199±0.009%w/w), carotenoids (7.88±0.394%w/w), phenolic compounds (2.21±0.11%w/w), sugar (8.74±0.435%w/w) and starch (5.85±0.292%w/w).\(^{26}\) Some simple 0-distributed aromatic amine like 2-(2’-amino-benzylamino) benzyl alcohol and their respective 0-methyl ethers, 2-amino benzyl alcohol(1),\(^{27}\) stigmasterol(2), lupeol (3), 16-hydroxylupeol,\(^{28}\) ß-sitosterol(4), aromadendrin (5), ß -Sitosterol- ß -D-glycoside (6),\(^{29}\) and male antifertility compound like gendarusin A and gendarusin B\(^ {30}\) were also isolated from the plant. The leaves also contain beta-sitosterol, lupeol, an alkaloid, friedelin and aromatic amines. Chemical structures of some compounds are given in figure 2.
7. PHARMACOLOGICAL ACTIONS:

*Justicia gendarussa* plant exhibits antioxidant, hepatoprotective, anti-inflammatory, antiarthritic, antiangiogenic, antimicrobial, analgesic and antianxiety activities. The pharmacological actions of *Justicia gendarussa* are given in figure 3.

7.1. Antioxidant activity:

*Justicia gendarussa* extract was investigated for the antioxidant activity using DPPH, free radical scavenging activity, reduction of ferric ion in presence and absence of EDTA and hydrogen peroxide scavenging activity. The stem extract of the plant with various solvents like methanol, petroleum ether, chloroform and methanol were studied for the antioxidant activities using *in-vitro* models. The methanolic extract showed significant antioxidant activity than other fraction. It is due to the presence of high phenolic and flavonoid content which was determined by folin-ciocalteu’s method and aluminium chloride calorimetric assay.3

The antioxidant activity of the callus extracts of *J. gendarussa* was studied by using DPPH free radical scavenging activity and reducing power assay method. The leaf and stem derived callus were harvested and separately extracted with methanol, ethanol and ether. The methanol extract of stem derived callus cultured on solid medium showed highest reducing capacity (136.66±2.88mg) and scavenging activity (145.00±5.00µg/ml) than other extracts.3

7.2. Anti arthritic activity:

The anti arthritic activity of the ethanolic extract of *Justicia gendarussa* was investigated using collagen induced arthritis and Freund’s complete adjuvant induced arthritis in rats using aspirin as standard drug. The treated rats showed significant reduction in the paw volume of 43% and 47% in Freund’s complete adjuvant induced arthritic model and collagen induced arthritis respectively in comparison with the standard (aspirin) showed 26% and 38%.3

The ethanolic extract of leaves of *Justicia gendarussa* showed potent anti arthritic activity in Freund’s complete adjuvant and bovine type II collagen methods. In plant treated rats the increased levels of WBC count and C-reactive protein (levels rise dramatically during inflammatory) level was significantly suppressed and showed a potent recovery from anemia.3

7.3. Anthelmintic activity:

Methanolic extracts of leaves and stems showed significant anthelmintic activity against *Pheretima posthuma*.35 Various concentrations of stem and leaf extract (10, 20, 30, 40 and 50 mg/ml) were applied to different petri dishes containing earth worms. The paralysis time and
death time were observed and compared with the standard drug Albendazole. At the concentration 50 mg/ml the leaf and stem extracts showed paralysis at 35.33 min and 41.33 min respectively and they showed death at 70.67 min and 89.33 min respectively in comparison with reference drug showed paralysis at 17 min and death at 48 min at 10 mg/ml concentration.

7.4. Antifungal activity:
The in vitro antifungal property of different extracts of Justicia gendarussa were evaluated by agar cup diffusion technique against dermatophytic species.56 The chloroform, methanol and aqueous extracts of whole plant were tested against Trichophyton mentagrophytes, Trichophyton rubrum, Microsporum gypseum and Microsporum fulvum. The antifungal activity of different solvent extracts of Justicia gendarussa in term of inhibition zone diameter in decreasing order can be concluded as chloroform> methanol> water.

7.5. Antiangiogenic activity:
The leaves of the plant showed significant antiangiogenic activity.37 Angiogenesis or neovascularisation is a process involves the activation, proliferation and migration of endothelial cells from preexisting blood vessels. It plays a major role in wound healing. Antiangiogenic potential of leaves of Justicia gendarussa was studied by Chorio Allantoic Membrane assay (CAM) method. Acute toxicity of ethanol and aqueous extracts was studied by brine shrimp lethality bio assay and showed the LC50 values for both the extracts were more than 1000 ppm. β-1,4 galactan sulphate was used as reference. At low concentration (below 10µg/ml) both extracts did not showed any effect. In the concentration ranging from 10-100 µg/ml both extracts showed inhibition of neovascularization at dose dependent manner.

7.6. Analgesic activity:
The ethanolic extract of Justicia gendarussa showed significant analgesic activity, this was studied using hot plate method and acetic acid induced writhing test.38 Ethanolic extract of the plant at the dose of 250 and 500 mg/kg given orally to male Wistar albino rat showed increase in latency of response in hot plate method and decreased in the number of writhing in mice in acetic acid induced writhing. The result was compared with positive control aspirin.

7.7. Anti-anxiety activity:
The ethanolic extract of the aerial part of the plant was investigated for anti-anxiety activity in Swiss albino mice by light dark test and elevated plus maze test.39 The ethanolic extract of plant at concentration of 200 – 500 mg/kg body weight was administered orally for 21 days. Elevated plus maze test method showed that the ethanolic extract have lengthened the time spent in the open arms and number of entries into open arms. The extract also boost the time in light area in light dark test model. The result was compared with standard drug diazepam. This study suggested that ethanolic extract of plant possess significant (p<0.01) anti anxiety activity.

7.8. Anti-inflammatory activity:
The ethanolic and methanolic extract of the plant Justicia gendarussa showed significant anti inflammatory activity.40 The aerial part of the plant extract was studied for anti-inflammatory activity on rats by using cotton pellet granuloma method and carrageenan induced rat paw oedema. Acute oral toxicity of ethanol extract was determined as
per OECD 423 guidelines. The ethanolic extract (250 and 500 mg/kg) of plant showed significant reduction (P<0.001) of paw oedema at dose dependent manner. At 500mg/kg concentration the plant extract showed maximum inhibition (52%) in comparison with standard drug aceclofenac (58%). In cotton pellet granuloma method the maximum inhibition of 52% was observed at a dose of 500 mg/kg. The maximum inhibition of 45% was observed in wet and dry granuloma formation. The anti-inflammatory activity of methanolic extract of *Justicia gendarussa* leaves was evaluated in Freund’s complete adjuvant induced arthritic in rats by measuring the paw volume and its ability to stabilize lipid peroxide level in experimental animal. The drug was administered at a dose 300mg/kg orally for 14 days on experimental animals. After the administration of methanolic leaf extract in rats the paw volume and lipid peroxide level of hemolysate was significantly reduced to near normal level and also the low levels of enzymatic and non enzymatic antioxidant levels were increased to normal level. This study results suggest the possible mechanism for this effect may be through its stabilizing action on lipid peroxide, increase antioxidant levels and its free radical scavenging activity.

### 7.9. Antibacterial Activity:

The plant showed significant antibacterial activity against gram positive and gram negative bacteria in various extract. The antibacterial activity of leaves and stem extract of *Justicia gendarussa* tested against human pathogens by the disc diffusion method and broth dilution methods. The aqueous extract of stem and leaves showed more antibacterial activity than the ethanol extract. The order of inhibition of aqueous extracts of stem and leaves are *Staphylococcus aureus* (26.33mm), *Shigella flexneri* (26.20mm), *Proteus mirabilis* (24.50mm), *Escherichia coli* (21.40mm), *Bacillus subtilis* (20.25mm), *Salmonella paratyphi* A (19.50mm), and *Salmonella typhimurium* (17.20mm).

The chloroform extract of *Justicia gendarussa* showed significant (p<0.005) antibacterial activity against *Staphylococcus aureus* and *Pseudomonas aeruginosa* at 20 µl/ml than *Escherichia coli*, *Proteus mirabilis* and *Vibrio cholerae*. The ethanol and ethyl acetate extracts of leaves of *Justicia gendarussa* exhibited potent antibacterial activity at a 1000 µg/ml concentration against gram positive and gram negative strains.

The phytochemical extracts like alkaloid, terpenoid, flavonoid and glycoside extract of *Justicia gendarussa* also showed considerable antibacterial activity against gram positive and gram negative strains. This study showed that the alkaloid extract was found to be more significant inhibitor in both gram negative and gram positive bacteria than all other extracts.

### 7.10. Hepatoprotective

The methanolic extract of the plant *Justicia gendarussa* showed significant hepatoprotective effect activity against carbon tetra chloride induced hepatic damage in *in vitro* and *in vivo* models.

The *in vitro* hepatoprotective activity of methanolic extract of *Justicia gendarussa* Burn was studied using primary rat hepatocytes, carbon tetra chloride was used as hepatotoxin. The isolated primary rat hepatocytes were incubated with CCl4 (10 mM), and various concentrations of plant extract (10, 50 and 100µg/ml) and silymarin (100µg/ml). Cell viability was measured by Trypan blue exclusion assay. The transaminase enzymes in cell suspension were measured. Methanolic extract produced significant moderate hepatoprotective effect.

Hepatoprotective action of methanolic extract of *Justicia gendarussa* against Carbon tetra chloride induced hepatic damage by acute oxidative damage was studied in albino rats. The extract showed marked reduction in liver marker enzymes (AST, ALT) and with increase in antioxidant enzymes. The effect was observed to be significant at the dose of 300 mg/kg.

### 7.11. Anticancer

Methanolic extract of *Justicia gendarussa* showed significant cytotoxic activity.

Leaf and root extracts of the plant with various solvents like hexane, methanol and water were investigated for cytotoxicity of the plant using a brine shrimp lethality test. Methotrexate was used as the control drug. The test substances in different concentration (1-1000 µg/ml) were examined in triplicate using a brine shrimp lethality bioassay. The methanolic extract showed the highest cytotoxicity. LD 50 value was found to be 25.44 µg/ml. Methanolic leaf extract of the plant was studied for cytotoxicity in human cancer cell lines HT-29, HeLa and BxPC-3) by using MTT assay. The results showed that the methanolic leaf extract were effective against BxPC-3 and HeLa cells. The IC50 values are found to be 16 µg/ml and 5 µg/ml, respectively. It is suggested that *J. gendarussa* leaf extract have potential cytotoxic activity on human cancer cell lines particularly BxPC-3 cells.

### 7.12. Hyperuricemia

Ethanolic extract of *Justicia gendarussa* leaves significantly decreases uric acid level in plasma; this was studied in oxonate-induced hyperuricemia in rats. The test substance was given in doses of 1.3 g/kg bw, 2.6 g/kg bw, 5.2 g/kg bw, can decrease serum uric acid levels in hyperuricemic rats. The extract showed maximum activity at the dose of 5.2 g/kg bw.
8. CONCLUSION:
Herbal medicine plays a major role in the development of modern civilization. *Justicia gendarussa* is an interesting example of plant having traditional medicinal value for many years and have been proved by many research works.

This review article briefly explains the traditional uses, phytochemical and pharmacological actions of *Justicia gendarussa*. The plant was found to have broad spectrum of activities due to the presence of active constituents like alkaloids, flavonoids, phenolic compounds, steroids, carbohydrate, carotenoids and terpenoids. The plant have reposed to have variety of pharmacological actions like antioxidant, analgesic, anti-inflammatory, anti-anxiety, antiangiogenic, antiarthritic, hepatoprotective, anticancer, antibacterial, antifungal and anthelmintic. The mechanism of action for each pharmacological action has to be studied.

From the current review, we conclude that the plant *Justicia gendarussa* could be useful for the development of commercial drugs.

REFERENCES:


31. K.L.Krishna, K. Mruthunjaya and Jagruti A Patel, Antioxi


42. A. Siva sakti and M. Vijayalakshmi, In Vitro Evaluation of Antibacterial Activity of Chloroform Extract from Justicia


Source of support: Nil, Conflict of interest: None Declared