Review Article

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Pharmacognostical and pharmacological activity of J*usticia gendarussa* burm.f.: a comprehensive review

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Abstract

Justicia gendarussa Burm .f. (family Acanthaceae) which is also known as willow-leaves and commonly known as Nili-Nirgundi, it is very commonly found nearby to China and its availability is very common in larger parts of India and Andaman islands. Traditionally it is used to treat various sorts of disorders such as wound healing, anti-inflammatory, anti-oxidant, anti-proliferative, anti-arthritic etc. *Justicia gendarussa* is one of the crucial herbs which has been used in the Ayurveda. Majorly leaves parts of the plant shows the pharmacological activity but the root of the plant *Justicia gendarussa* is also have the important medicinal values. A large variety of pharmacologically active constituents i.e., alkaloids, flavonoids, saponin, carbohydrates, steroids, triterpenoids, carotenoids, aminoacids, tannins, phenolics, coumarines and anthaquinones are also present in this plant and they makes the plant pharmacologically important. The activity of the plant is also dependent on the solvent which is used for the extraction the various vital chemical constituents. The different- different parts of the plants having the different medicinal values also differ in the chemical values. This review is not only focused on the essential phytochemical constituents which is available in the plant but it also explains their necessary medicinal value to shows the essential biological action and phytopharmacological actions of various parts of the plant.

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INTRODUCTION

Among too many things present in the nature belongs to the captivating varieties of nature in some uniqueness have been inseparable parts of mankind history, since they attain many basic requirements. These are choice of the plants using as food supplements while many others are using to treat the various human suffering such as disease treatment.

The targeted or specific chemical substance can be isolated from the whole part of the plant or from the various or different part of plant, like leaves, stem, bark, root, rhizome, flowers and seed etc. There are so many drugs are prepared from the execratory product of the plant such as gums, resin and latex.

The genus *Justicia gendarussa* Burm.f. (JG), family Acanthaceae is comes under shrubs and herbs distributed in the tropical region of the world. It contains about 300 species in whole the world in which nearly 50 species were recorded in India (Sangeetha *et al.*, 2014).

JG was used in Asia like as India, Sri Lanka, and Malaysia from the ancient time in Indian folk

medicine system in the treatment of various diseases like as rheumatism, bronchitis, fever, eczema, and jaundice (Ratih *et al.*, 2019).

Justicia Gendarussa Burm.F. Description

Justicia gendarussa Burm f. *Acanthaceae* is an erect shrub, 0.6 to 1.2 m in height. Plant leaves are simple, lanceolate, 7.5 to 12.5 cm long, glabrous, with short-petiolate. Color of leaves pale green beneath and dark violet green, having 8 pairs of main nerves, mid rib and main nerve portion is prominent on the under surface. Stems and branches are dark violet along with glabrous fruit capsules (Sangeetha *et al.*, 2014).

Flowers small, 4-12 long spikes, terminal or in axils of leaves. Teeth calyx smooth, linear, and which is about 3mm long. Corolla is somewhat smooth, 1.5cms long having white or pink with purple spots. Club shaped capsule, about 12mm long and smooth.

Leaves of *Justicia gendarussa* are rich in alkaloids, flavonoids, saponin, carbohydrates, steroids, triterpenoids, carotenoids, aminoacids, tannins, phenolics, coumarines and anthaquinones. Leaves of *Justicia gendarussa* have the alkaloid (Justicine) which is bitter in nature and also lavish in potassium salts. Bitter taste of root considered anodyne, antiperiodic, antiplasmodic, carminative, diaphoretic, diuretic, emetic, febrifuge and laxative (Ramees *et al.*, 2019).

Traditional Uses

The plant *Justicia gendarussa* is identify for its medicinal properties which is antioxidant and free radical scavenging, anti-arthritic, anti-inflammatory, analgesic, antifertility, anticancerous, hepatoprotective and larvicidal properties.

The various parts of the plant is using for the prevention of inflammation, bronchitis, vaginal discharges, eye diseases, dyspepsia and fever. The decoction of the leaves and tender shoots parts shows the diaphoretic and chronic rheumatism activity (Sangeetha *et al.*, 2014).

Chemical Constituents

Pharmacological Uses

The plant J*usticia gendarusa* (JG) shows antioxidant, hepatoprotective, anti-helmintic, anti-inflammatory, anti-arthritic, anti-angiogenic, antimicrobial, analgesic, anti-arthritic, anti-diabetic, cytotoxic, anti-viral, anti-bacterial, anti-fungal and anti-anxiety activities (Ramees *et al.*, 2019).

Anti-inflammatory Role

The plant extract (methanol) of *Justicia gendarussa* leaves and root having the ability showed the significant anti-inflammatory action on rats through carrageenan induced rat paw edema model at the dose of 50 and 100mg/kg body weight. Diclofenac used as a reference drug at the dose of 20mg/kg orally (Kavitha *et al.*, 2011). The plant root *Justicia gendarussa* which is extracted by using the methanol showed the anti- inflammatory activity. It is confirmed that through using the carrageenan induced rat paw edema model at the dose of 10mg/kg body weight/oral. The epigenin extract from the root of the plant *Justicia gendarussa* by using the methanol showed the anti-inflammatory action on the Human Peripheral Blood Mononuclear Cells (hPBMCs) induced with ox-LDL method. Epigenin has been shown the anti-inflammatory activity by the inhibition of NF-kB pathway (Kumar *et al.*, 2018). Ethyl acetate fraction which is isolated from the plant *Justicia gendarussa* roots extracted by methanol showed the significant anti-inflammatory activity on rats by carrageenan induced rat paw edema at the dose of 50mg/kg. Methanolic extract showed the anti-inflammatory action through the inhibition of iNOX and COX-2 expression by NF-kB pathway (Kumar *et al.*, 2012) . Extract of leaves (70% in aqueous ethanol) of the plant *Justicia gendarussam* has been shown the anti-inflammatory action by inhibition of the lipopolysaccharide stimulated nitric oxide and matrix metalloproteinase-9 expression in murine macrophage (Varma *et al.*, 2011).

The aerial part extracted with ethanol (95% v/v) of the plant *Justicia gendarussa* has been shown the anti-inflammatory activity on male wistar albino rats and swiss albino mice by carrageenan induced rat paw edema and cotton pellet induced granuloma model at the dose of 500-2000mg/kg^{-1} respectively (Jothimaniv *et al.*, 2010). The extract (95% ethanol) of the leaves *Justicia gendarussa* showed the anti-inflammatory activity on rat by using the carrageenan induced rat paw edema and formalin induced paw edema method at the various concentration 125, 250 and 500mg/kg respectively (Shikha *et al.*, 2010).

Anti-Oxidant Activity

The aerial part (leaf) extract of plant *Justicia gendarussa* evaluated for its anti-oxidant action through DPPH, free radical scavenging activity at the dose of 10μg/mL. The methanolic extract of the plant were studied for the anti-oxidant activities using in-vitro models (Kumaresh and Chowdhury, 2015). The plant extract of stem (methanol) *Justicia gendarussa* derived callus on the solid and liquid surface has been shown the remarkable anti-oxidant activity by DPPH scavenging at the concentration of 145 $\pm$ 5.00μg/ml and 185 $\pm$ 8.66μg/ml respectively (N

et al., 2013). The leaf extract using methanol of the plant *Justicia gendarussa* showed the remarkable anti-oxidant activity through DPPH radical scavenging method against the standard flavonoids (Ascorbic acid, Butylated hydroxyl toluene and Gallic acid). Extract (methanol) of the plant leaf *Justicia gendarussa* showed the anti-oxidant activity by Hydrogen peroxide scavenging activity method at the concentration of 50-200μg/mL^{-1} (Krishna *et al.*, 2009). Extract of leaf (Ethyl acetate extract) *Justicia gendarussa* Shows the remarkable anti-oxidant activity by Ferric Reducing Antioxidant Power (FRAP) assay. Plant *Justicia gendarussa* leaf extract showed the anti-oxidant activity by Nitric Oxide Scavenging activity. Ethyl acetate part of the plant leaf *Justicia gendarussa* has been shown the significant anti-oxidant activity by DPPH free radical scavenging activity (Nirmalraj *et al.*, 2015). The extract of various solvent (Aqueous, Ethanol, Acetone, Chloroform) of the plant *Justicia gendarussa* showed anti-oxidant activity by 2, 2 – diphenyl- 1 – picrylhydryzyl (DPPH) free radical scavenging activity (Rani *et al.*, 2017). Extract (Methanol) of the plant leaf *Justicia gendarussa* shown the remarkable anti-oxidant activity through DPPH radical scavenging activity and also shows No radical scavenging activity and OH radical scavenging activity (Mondal *et al.*, 2019).

Cytotoxic Activity

Methanolic extract of leaves of *Justicia gendarussa* shows the remarkable cytotoxic action in breast cancer. Tamoxifen used as a standard drug in MTT assay (Ayob *et al.*, 2014). Plant leaves extract of *Justicia gendarussa* shows the cytotoxic activity against human cancer cell lines (HepG2 and HeLa cell lines is a human liver carcinoma Cell lines) (Mangai, 2018). Plant *Justicia gendarussa* leaves extract has been shown the significant cytotoxic activity against the human cancer cell lines (HT-29, HeLa, BxPC-3) through the MTT assay (Ayob *et al.*, 2013). The hydroalcoholic extract of plant root and leaves *Justicia gendarussa* sowed the cytotoxic activity by using the brine shrimp lethality bioassay method (Sonal and Maitreyi, 2012).

Hepatoprotective Activity

The extract which is obtained by using the solvent methanol from the plant stem *Justicia gendarussa* shows the remarkable hepatprotective action against CCl_4 induced hepatotoxicity in albino rats at the dose of 300mg/kg^{-1} (Krishna *et al.*, 2010). Plant leaf methanolic extract of *Justicia gendarussa* Show the hepatoprotective action in carbofuran induced hepatic damage in rats at the dose of 500 and 1000mg/kg (Mondal *et al.*, 2019). The methanolic and ethyl acetate fraction of plant leaf *Justicia gendarussa* shows the hepatoprotective action in Carcon Tetrachloride (CCl4) induced hepatic damage at the dose of 200 and 400mg/kg b.w (Phukan *et al.*, 2014).

Anti-viral Activity

The diphyllin glycosides obtain from the methanolic fraction of leaf and stem of plant *Justicia gendarussa* shows the anti-HIV activity against the broad spectrum HIV strains (Zhang *et al.*, 2017a) . The extract (ethanolic) obtained from plant leaves *Justicia gendarussa* showed the anti-HIV effect against HIV-infected MT-4 (Human T-cell leukemia lines) (Widodo *et al.*, 2018). The arylnaphthalene lignin (ANL) glycoside, pententiflorin isolated from the MeOH extract from plant leaf and stem *Justicia gendarussa* shows the remarkable anti-HIV activity against the HIV-1 clinical isolates: BAL and SF162 (Both M-tropic), LAV0.04 (T-tropic), and 89.6 (dual tropic) using a standardized human PBMC (Human peripheral blood mononuclear cell) assay (Zhang *et al.*, 2017b).

Anti-arthritic Activity

The extract (95% ethanolic extract) obtained from the plant leaf *Justicia gendarussa* shows the action against arthritic in FCA (Freund's complete adjuvant) induced arthritis in male albino wistar rats at concentration of 100mg/kg (Paval *et al.*, 2009b). Ethanolic (95%) plant extract of leaves *Justicia gendarussa* shows the activity against arthritis in FCA (Freund's complete adjuvant) and also in bovine type II collagen induced arthritis in male albino wistar rats at the dose of 100mg/kg (Paval *et al.*, 2009a).

Trypsin and Protein denaturation inhibitory activity

Justicia gendarussa root and leaf shows the Trypsin (Proteinase) and remarkable inhibition of protein denaturation at the dose of 10, 100 and 1000μg/ml and 10, 25 and 50μg/ml leaf and root respectively. Methanolic extract of the plant gives this activity (Patel and Zaveri, 2014).

Collagenase (Matrix Metalloproteinases) inhibitory assay

Plant methanolic extract of leaf *Justicia gendarussa* has been shown the Collagenase (Matrix metalloproteinases) inhibitory activity at the various concentration (100, 250, 500 and 1000μg/ml) (Patel and Zaveri, 2016).

Anti-bacterial activity

Plant *Justicia gendarussa* stem extract (aqueous and hexane extract) has been evaluated their anti-bacterial action against the *Eschericha coli* and *Staphylococcus aureus* by using the dics diffusion

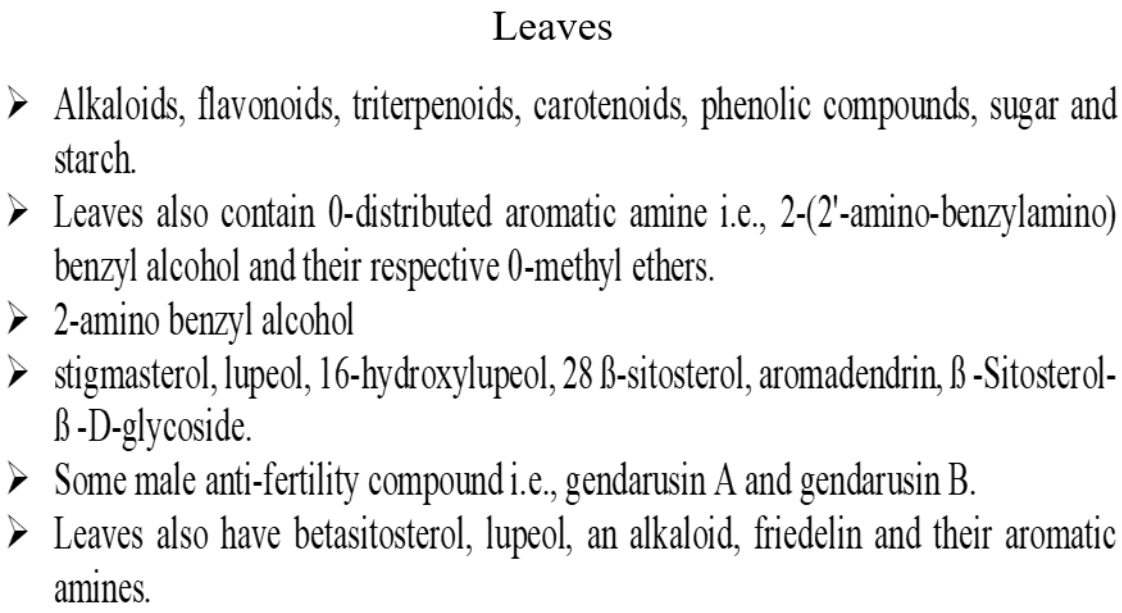

Figure 1: The various classes in the flavonoid group are differentiated by additional oxygen having hetrocyclic rings and hydroxyl groups. These contain catechins,leucoanthocyanidins, flavonones, anthocyanidins, flavonols, chalcones, aurones and isoflavones.

method (Venkatachalam *et al.*, 2019). The solvent (methanolic, chloroform and petroleum ether) is used for the extraction of plant *Justicia gendarussa* showed the anti-bacterial activity through the disc diffusion method at the concentration of 25, 50, 75, 100μl (Murugesan, 2017). The Hexane, diethyl ether, dichloromethane, ethyl acetate and methanol is used for the Justicia gendarussa leaves extraction shows the remarkable anti-bacterical action which is evaluated against the bacteria (gm +ve and gm -ve) such as, *Staphylococcus aureus, Staphylococcus mutans, Bacillus subtilis, Micrococcus luteus, Proteus vulgaris, Klebsiella pneumonia, Escherichia coli* and *Shigella flexneri* through the disc diffusion method (Nirmalraj and Perinbam, 2015).

Anti-fungal activity

Hexane and aqueous extract from the plant stem *Justicia gendarussa* shows the significant anti-fungal action against *candida albicans* through using the disc diffusion method (Venkatachalam *et al.*, 2019).

HRBC membrane stabilization assay

The plant leaves extract of the *Justicia gendarussa* showed the in-vitro membrane stabilization activity against the HRBC membrane stabilization assay at three different concentration 250, 500 and 1000 g ml^{-1} (Nirmalraj and Perinbam, 2015).

In-vitro anthelmintic activity

The plant *Justicia gendarussa* leaves and stem extract obtained by using the solvent methanol shows the significant in-vitro anti-helmintic action at the dose of 10, 20, 30, 40 and 50mg/mL. Albendazole used as a reference drug at the concentration of 10mg/mL (Saha *et al.*, 2012).

Analgesic activity

Aerial part with ethanol (95% v/v) of the plant *Justicia gendarussa* showed the significant analgesic activity through the hot plate and acetic acid induced writhing test method at the concentration of 250 and 500mg/kg^{-1} (Jothimaniv *et al.*, 2010). The 95% ethanolic extract of leaves *Justicia gendarussa* shows analgesic activity on swiss albino mice through the acetic acid-induced writhing assay and hot plate method at the concentration of 125, 250 and 500mg/kg (Shikha *et al.*, 2010).

Anti-depressant activity

The aerial part of the plant *Justicia gendarussa* hydro-alcoholic (ethanol and water at 30:70 ratio) extract showed the anti-depressant activity by forced swimming test (FST) method at the dose of 250-500mg/kg (Mythili and Jothimanivannan, 2017).

Osteoblastic Activity

Justicia gendarussa leaves extract (96% ethanol) has been shown the significant osteoblastic action against the mouse osteoblastic cell line (MC3T3-E1) (Supparmaniam and Bohari, 2015).

Sedative and Hypnotic activity

The 95% v/v ethanolic extract of plant leaves *Justicia gendarussa* shows the sedative and hypnotic

activity on the male swiss albino mice against the traction test and thiopental-induced sleep method at the concentration of 250 and 500mg/kg, p.o. (Subramanian *et al.*, 2014).

Anti-anxiety activity

Aerial part extract of (95% v/v ethanol) *Justicia gendarussa* shows the anti-anxiety activity on the swiss albino mice of either sex by elevated plus maze test and light dark test at the concentration of 250 and 500 mg kg^{-1} b.wt. orally (Jothimaniv *et al.*, 2013).

Anti-diabetic activity

The plant methanolic extract of leaf *Justicia gendarussa* shows the anti-diabetic action against alloxan induced diabetic mice at the concentration of 200 and 400 mg/kg (b.w.) and the cytotoxicity assay was performed of the plant extract on brine shrimp (*Artemia salina*) nauplii using the Meyer method (Mohammed *et al.*, 2015).

Anti-hyperurcemic activity

Leaves of the plant *Justicia gendarussa* showed the anti-hyperuracemic activity in oxonate-induced hyperuracemia in rats in ethanol at the concentration of 5.2 g/g bw (Sangeetha *et al.*, 2014).

Anti-angiogenic activity

Determination of the anti-angiogenic activity of ethanolic and aqueous extract of the plant leaves *Justicia gendarussa* showed by Chrio Allontoic Membrane assay (CAM) assay. Both extract shows the inhibition of the neovascularization in concentration ranging from 10-100μg/ml (Sangeetha *et al.*, 2014).

CONCLUSIONS

Since ancient times many plants has been used in the treatment of various diseases. Herbal medicine plays a very vital role in the development of modern medicinal system. In the plants system they have the various kind of chemical substances which is differed to each other and also differ in activity like the chemical obtain from the same plant have the different activity. *Justicia gendarussa* is a fascinating blueprint of traditional medicinal system which is having value for several years and their role is already evaluated through several research works. This article broadly elaborates the traditional uses, phytoconstituents and pharmacological action of the plant *Justicia gendarussa*. *Justicia gendarussa* have been found for its broad spectrum activity because of availability of active phytoconstituents i.e., alkaloids, flavonoids, phenolic compounds, steroids, carbohydrates, carotenoids and terpenoids.

The plant *Justicia gendarussa* has been founded various sort of pharmacological action i.e., anti-inflammatory, anti-oxidant, cytotoxic, hepatoprotective, anti-viral, anti-arthritic, anti-bacterial, anti-fungal, analgesic, anti-depressant, osteoblastic, sedative and hypnotic, anti-anxiety, anti-diabetic, anti-hyperurcemic, anti-angiogenic, protein denaturation inhibition, and HRBC membrane stabilization assay.

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Conflict of Interest

Authors declares no conflict of interest.

Declaration

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