



Contents lists available at UGC-CARE

# International Journal of Pharmaceutical Sciences and Drug Research

[ISSN: 0975-248X; CODEN (USA): IJPSPP]

journal home page : <https://ijpsdronline.com/index.php/journal>

## Review Article

# Unveiling the Pharmacological Spectrum of *Justicia gendarussa*: A Comprehensive Review

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## ARTICLE INFO

### Article history:

Received: 15 May, 2024

Revised: 30 June, 2024

Accepted: 04 July, 2024

Published: 30 July, 2024

### Keywords:

*J. gendarussa*, Chemical constituents, Plant part, Morphology, Activity, Pharmacological.

### DOI:

10.25004/IJPSDR.2024.160421

## ABSTRACT

*Justicia gendarussa* Burm. f. (*J. gendarussa*) is a flora part of the Acanthaceae family. It is an herbal remedy localized to numerous regions of Asia, which has been used since ancient times for its traditionally claimed pharmacological activities. *J. gendarussa* is a fast-developing bush that is discovered in tropical, shady and moist places. Mostly this plant is found in China, hence also known as Chinese medicinal plant. Over the past few years, it has gathered significant attention due to its diverse pharmacological activities and rich chemical composition. Pharmacological investigations have revealed that *J. gendarussa* possesses a broad spectrum of biological activities, comprising, although not restricted to, anti-HIV, anti-inflammatory, analgesic, anxiolytic, antimicrobial, hepatoprotective, antifungal, antioxidant, larvicidal, anthelmintic and antiarthritic. Furthermore, chemical analyses of *J. gendarussa* have identified a wide array of bioactive constituents, like alkaloids, flavonoids, terpenoids, phenols, carbohydrates and fatty acids. These phytochemicals play pivotal roles in mediating the observed pharmacological activities and hold promise for the creation of novel medications or supplements targeting various health conditions. This review focuses on the pharmacological profile, bioactive components, and ethanobotanical significance of *J. gendarussa*. This inclusive assessment provides an extensive study of the current state of research on *J. gendarussa*, encompassing its pharmacological effects and chemical constituents. By consolidating existing knowledge, scholars and practitioners alike can benefit greatly from this review, fostering advanced exploration of this remarkable plant species for therapeutic purposes.

## INTRODUCTION

The majority of developing nations have used herbal vegetation and offerings prepared as a therapeutic agent to treat various illnesses.<sup>[1]</sup> Traditional remedies have a rich cultural legacy in India.<sup>[2]</sup> These simple medicines are routinely given to patients of all ages because they are always affordable, easily available and have no side effects. Many works on medicinal plants provide detailed descriptions of the therapeutic effects and applications of these medications found in the ancient literature on indigenous remedies. Traditionally, a wide range of ethno-medicinal applications for several *Justicia* species have been investigated.<sup>[3]</sup>

*J. gendarussa* is one of the traditionally used *Justicia* species for different pharmacological activities (Fig. 1).

*J. gendarussa* goes by several common names, including Bakas and Kala adulsa in Marathi, in Hindi Krishna nirgundi and Nili nirgunthi, in Sanskrit Vaidhyasinh and Kasanah, and Karunochi in Tamil<sup>[4]</sup> [Tables 1 and 2]. The plant's bioactive components and pharmacological effects have also been studied. Hepatoprotective, antianxiety, antifungal, anti-inflammatory, analgesic, antioxidant, immunosuppressive, adulticidal, antimicrobial, antiangiogenic, diuretic, sedative, cytotoxic and anti-HIV are just a few of the potential therapeutic applications for these compounds that have been demonstrated.<sup>[5]</sup>

## Taxonomy

The taxonomical classification of *J. gendarussa* is as follows shown in Table 1.

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Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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**Fig. 1:** *Justicia gendarussa* plant

**Table 1:** Taxonomy of *J. gendarussa*

Kingdom	Plantae
Phylum	Tracheophytes
Class	Angiosperms
Subclass	Eudicots
Subclass	Asterids
Order	Lamiales
Family	Acanthaceae
Genus	<i>Justicia</i>
Species	<i>gendarussa</i>
Common name	Willow Leaved Justicia, Nili Nirgundi, Bakas, Gandrusa

**Table 2:** Vernacular Names

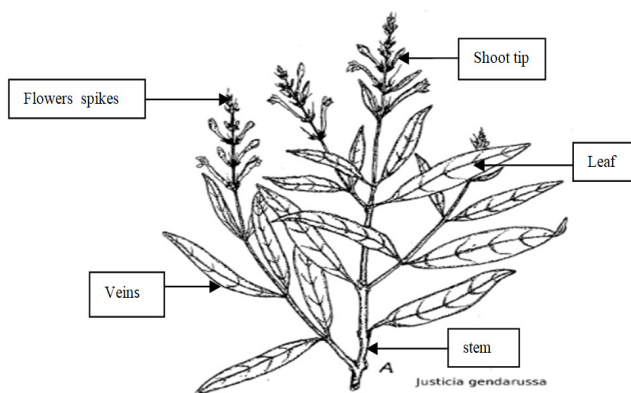
Marathi	Kala adulsa, Bakas, Tev
Hindi	Nili nirgundi, kala bashimb
Sanskrit	Krishnanirgundi, bhutakeshi
Tamil	Vadaikkutti
Bengali	Jagatmadan
Malyalam	Vathamkolli, karunochi
Oriya	Nilanirgundi
Telugu	Gandharasamu

**Table 3:** Morphology

S. No.	Particular	Description
1	Leaves	Lanceolet, purplish green in colour
2	Stem	Short, brown colored
3	Corolla	Five lobed
4	Calyx	Fused with 2-4 carpels
5	Flower / inflorescence	Present in the form of spikes, purplish white color
6	Fruit	Round, turns black or brown at maturity
7	Root	Nodular, scars on the root
8	Seeds	4 seeded, oval

**Vernacular names**

*J. gendarussa* is called by different common names at different regional places [Table 2].



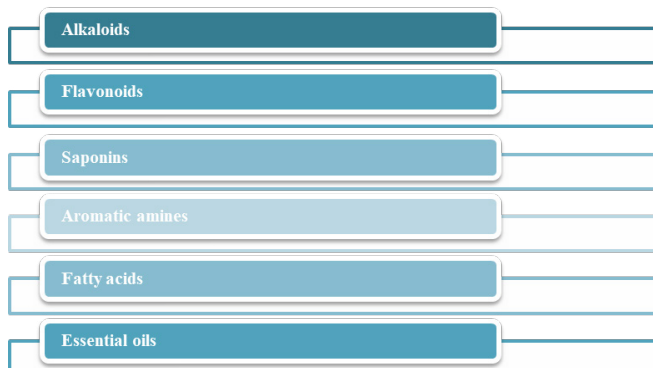
**Fig. 2:** Morphology of plant

**Morphological Description**

*J. gendarussa* is a rapidly expanding perennial shrub that grows best in moist, shaded areas.<sup>[1]</sup> *J. gendarussa* can reach a height of two meters and has an upright, shrubby shape. When young, the dark purple leaves on the lignified, rectangular stem turn a rich brown as they age. *J. gendarussa* is a solitary plant with lanceolate leaves that are 5 to 15 cm in length, 1 to 4 cm in width, feathery, contrary, even, tapering foliage margins, dark green, and have a short stem. *J. gendarussa* produces tiny white blooms resembling closed grains or Malay flowers, and they extend from the tip of the stalk<sup>[6]</sup> (Table 3 and Fig. 2).

**METHODOLOGY**

We gathered the information that supported our aim to do a full investigation utilizing resources from data archives like Science Direct®, Pub Med®, and Google Scholar®. Following their collection, the data were sorted and assembled in a sequential fashion so that they could be categorized under several headings, including the medicinal qualities of natural herbs, the pharmacological actions of herbal plants, and the *J. gendarussa* bioactive molecules. The separated bioactive and phytochemical components were collected, and plant parts with similar medicinal and alleviating qualities were amalgamated to further tailor the investigation. This greatly simplified task organization and made the study’s course evident.



**Fig. 3:** Phytoconstituents

## Chemical Constituents

The various chemical constituents were found in the *J. gendarussa*, like<sup>[7-9]</sup> (Figs 3-5).

### Alkaloids

The alkaloid test results for *J. gendarussa* are positive. Justridisamide [A, B, C, and D] is among the alkaloids found in *J. gendarussa*. The biological functions of these alkaloids are diverse. Squalene,  $\beta$ -sitosterol, and lupeol, in addition to brazoides A–D are also present in *J. gendarussa*.

### Flavonoids

All of the admirable chemical components in *J. gendarussa* are flavonoids. Numerous flavonoids, such as quercetin, kaempferol, naringenin, and apigenin, are present in the plant. These flavonoids have a range of biological functions.

### Saponins

Saponins, glycosides having an aglycone that is either steroid or triterpenoid, are found in *J. gendarussa*. In

addition to lupeol, beta-sitosterol, and stigmasterol, the plant also includes a variety of additional saponins, such as gendarussin B, C, and D. Different biological functions are possessed by these saponins.

### Aromatic amines

*J. gendarussa* contains a range of amines, such as 2-(2' amino-benzyl amino) benzyl alcohol and its equivalent phenyl methanol. These amines exhibit a variety of biological characteristics.<sup>[11]</sup>

### Fatty acid

The fatty acids found in *J. gendarussa* include oleic acid, linoleic acid, and estra-1, 3, 5 (10)-trin-17-beta-ol.

### Essential oils

Essential oils are volatile substances with potent fragrances that also appear in *J. gendarussa*. These essential oils exhibit many biological functions.

### Therapeutic Activity

#### Antiarthritic

When the immune system unintentionally targets the body's own tissue, it results in rheumatoid arthritis (RA), leading to persistent inflammation and gradually damaging the articulations and synovial membrane.<sup>[34]</sup> One of the prevalent conditions that affects millions of people and significantly limits their everyday activities is arthritis and which causes musculoskeletal abnormalities.<sup>[35]</sup>

Research has demonstrated the antiarthritic properties of *J. gendarussa* leaf extract in alcohol.<sup>[36]</sup> Phytochemical analysis of *J. gendarussa* leaf extract indicated the presence of two flavonoids: apigenin and vitexin. Research has shown that both apigenin and vitexin possess anti-inflammatory qualities.<sup>[1]</sup> Apigenin's antiarthritic effects are attributed to its inhibition of inflammation and protection against cartilage degradation. Additionally, research has been done on the antiarthritic effects of the flavonoid vitexin, which reduces inflammation and oxidative stress that are associated with arthritis.<sup>[31]</sup> Another study discovered that components extracted from both the foliage and base [root] of *J. gendarussa* exhibit good protein stabilization and a greater trypsin inhibitory action, which contributes to its antiarthritic activity.<sup>[37]</sup>

#### Plant Part Activities

*J. gendarussa* plants parts shows different therapeutic activities which are summarized as in Table 4.

#### Hepatoprotective

The liver is the primary site of most metabolic activities. Anti-TB medications, alcohol use, and many other factors can contribute to hepatotoxicity. According to traditional belief, herbs are utilized to protect the liver cells and enzymes since herbal treatments have fewer adverse effects.<sup>[26]</sup>

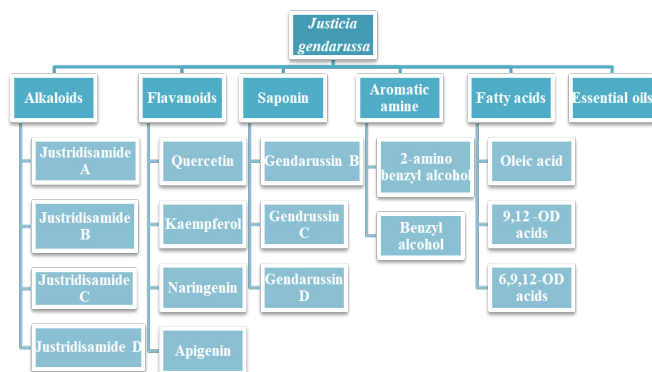


Fig. 4: Chemical constituents present in *J. gendarussa*<sup>[7, 10]</sup>

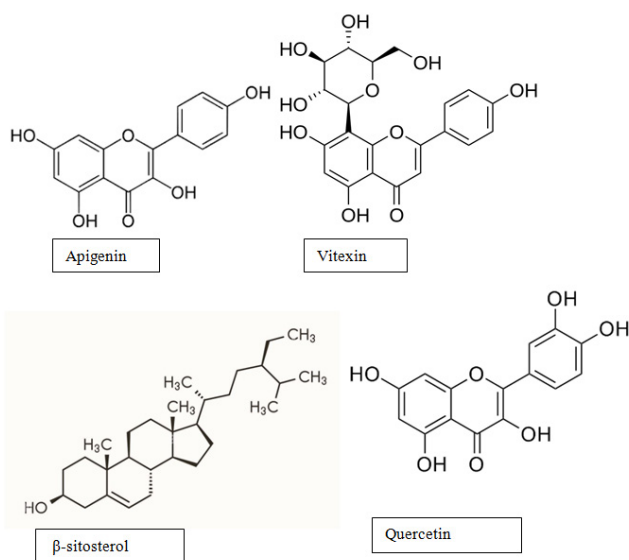


Fig. 5: 2D structure of apigenin, vitexin, betasitosterol and quercetine<sup>[12-16]</sup>



**Table 4:** Plant parts along with pharmacological activity <sup>[17-33]</sup>

<i>Plant part used</i>	<i>Activity</i>	<i>Description</i>	<i>References</i>
Aerial part	Anti-inflammatory	The presence of flavonoids is accountable for the anti-inflammatory activity by the suppression of various autocoid formations and releases.	Jothimanivannan C <i>et al.</i> , 2010. <sup>[17]</sup>
	Analgesic	Flavonoids contribute to analgesic activity by modulating pain pathways in the body, that is it, influence the release and activity of neurotransmitters involved in pain signaling.	Jothimanivannan C <i>et al.</i> , 2010. <sup>[17]</sup>
	Antidepressant	<i>J. gendarussa</i> shows antidepressant activity by modulating the neurotransmitter levels such as serotonin, dopamine and norepinephrine in brain.	Mythili A <i>et al.</i> , 2017. <sup>[18]</sup>
	Antianxiety	By directly binding to GABA receptors or by modifying the activity of enzymes involved in GABA metabolism, such as GABA transaminase, <i>J. gendarussa</i> improves GABAergic transmission by, which shows antianxiety activity.	Subramanian N <i>et al.</i> , 2013. <sup>[19]</sup>
	Sedative and hypnotic	Bioactive substances with anti-inflammatory and antioxidant qualities found in <i>J. gendarussa</i> guard against brain damage and lessen neuroinflammatory processes that disrupt sleep. The plant indirectly encourages relaxation and enhances the quality of sleep through the mitigation of harm caused by reactive oxygen species and swelling.	Subramanian N <i>et al.</i> , 2014. <sup>[20]</sup>
Leaves	Anti-inflammation	Cytokines and another inflammatory mediators are prevented from escaping from cell membranes by the procurement of <i>J. gendarussa</i> leaf, which has strong anti-inflammatory qualities. This plant extract helps to modulate immune cells, macrophages, and lymphocytes and inhibit the oxidative stress, NF-kB factor, and production of NO.	Nirmalraj S <i>et al.</i> , 2015. <sup>[21]</sup>
	Anthelmintic	The alcoholic herbal extract contains stigmaterol, fagarsterol, and betulin, which are responsible for its anthelmintic effects. These substances cause the parasites' cellular membranes to rupture, obstruct vital enzyme functions, and interfere with their metabolism—all of which ultimately result in the parasites' death.	Saha MR <i>et al.</i> , 2012. <sup>[22]</sup>
	Antibacterial	The existence of phenolic chemicals in the plant extract hinders the development and multiplication of bacteria by interfering with enzymes responsible for bacterial cell wall construction, DNA replication, and protein synthesis.	Nirmalraj S <i>et al.</i> , 2015. <sup>[21]</sup>
	Anti-HIV	The flavonoids existing in the leaves are accountable for anti-HIV action, mainly gendarusin A. It shows activity by inhibition of reverse transcriptase enzyme and viral fusion process.	Hikmawanti NP <i>et al.</i> , 2020 <sup>[23]</sup>
	Hepatoprotective	Bioactive substances found in <i>J. gendarussa</i> , including flavonoids, phenolic acids, and other antioxidants, scavenge free radicals and lessen oxidative stress in the liver. The plant extract serves to prevent cellular damage and maintain the structural and functional integrity of hepatocytes by neutralizing reactive oxygen species (ROS) and reducing lipid peroxidation.	Bonoranjan Phukan BP <i>et al.</i> , 2014. <sup>[24]</sup>
	Hyperuricemia treatment	It shows activity by inhibiting the xanthine oxidase, uric acid synthesis is decreased, which lowers blood uric acid levels.	Basah K <i>et al.</i> , 2011. <sup>[25]</sup>
	Antioxidant	Leaf extract exhibits the antioxidant action by elimination of the free radicals, counteraction of the reactive oxygen species (ROS) and reactive nitrogen species (RNS) and enhancement of Glutathione peroxidases (GPx) and Superoxide dismutase (SOD).	Krishna K L <i>et al.</i> , 2009. <sup>[26]</sup>
	Antimicrobial	The leaf extract disrupts the cell membrane, contributing to spillage of the cellular content and eventually causing the cell death. This is due to the presence of alkaloids and flavonoids.	Subramanian N <i>et al.</i> , 2012. <sup>[27]</sup>
	Antiangiogenic	<i>J. gendarussa</i> increases the expression of the vascular endothelial expansion multiplier, and fibroblast expansion multiplier and also modulates the MAPK and Akt / PI3K pathway.	Periyanayagam, K <i>et al.</i> , 2009. <sup>[28]</sup>
	Antinociceptive	<i>J. gendarussa</i> impairs sperm motility and viability. It inhibits the sperm's ability to bind the egg.	Shikha P <i>et al.</i> , 2010. <sup>[29]</sup>

Plant Part used	Activity	Description	References
Stems	Anti-HIV	Shows activity by inhibiting the attachment and entry of HIV into cell and also inhibit the HIV reverse transcriptase.	Saha MR <i>et al.</i> , 2012. <sup>[22]</sup>
	Anthelmintic	<i>J. gendarussa</i> contain lupeol, a stigmasterol-like substance that disrupts the nervous system, metabolism, and reproductive cycle of the worm, finally causing it to be expelled from its host.	Saha MR <i>et al.</i> , 2012. <sup>[22]</sup>
	Antioxidant	The stem of <i>J. gendarussa</i> combines scavenging free radicals, oxidative stress inhibition, metal ion chelation, induction of antioxidant enzymes, and anti-inflammatory properties to produce its antioxidant effects.	Krishna K 2010. <sup>[30]</sup>
	Hepatoprotective	Stem extract shows the hepatoprotective effect by balancing the liver enzyme level and occurs due to the presence of phenolic and flavonoid elements.	Krishna K 2010 <sup>[30]</sup>
	Antimicrobial	Stems contain antimicrobial properties due to the presence of alkaloids and flavonoids; it disrupt the cell membrane, leading to the death of microorganisms.	Subramanian N <i>et al.</i> , 2012. <sup>[27]</sup>
Whole Plant	Antiarthritic	The whole plant contains various chemical constituents that contribute to the antiarthritic, like phenols, alkaloids flavonoids. With the help of pro-inflammatory mediators tries to reduce the inflammation related to the arthritic.	Paval J <i>et al.</i> , 2009. <sup>[31]</sup>
Roots	Anti-inflammatory	<i>J. gendarussa</i> roots ethyl acetate fraction has anti-inflammatory properties that prevent mononuclear cells from producing high-output NO and prostaglandins by suppressing the development of iNOS and COX-2 or their functions.	Kumar KS <i>et al.</i> , 2012. <sup>[32]</sup>
	Antiarthritic	The <i>J. gendarussa</i> root contained steroids, triterpenoids, saponins, polysaccharides, and phenolics, which are attributed to the antiarthritic activity.	Patel SS <i>et al.</i> , 2014. <sup>[33]</sup>

The antioxidant action of the herbal extract was detected using methods for DPPH free radical scavenging, hydrogen peroxide scavenging, and reduction of ferrous ions, both with and without EDTA. The moderate action of hepatoprotectiveness of *J. gendarussa* leaf extract may be explained by its ability to scavenge free radicals and function as an antioxidant. Its high flavonoid and total phenolic content contribute to its hepatoprotective and antioxidant qualities.<sup>[38]</sup> Marker liver enzymes are a good indicator that the medicine is having a hepatoprotective effect. The levels of transaminase enzymes like GOT GPT serve as the main indicators of liver activities.<sup>[30]</sup>

The hepatoprotective impact of extracts has been associated with antioxidant activity, which has been found to be influenced by total phenolic concentration. The increased levels of the liver enzymes serum glutamate oxaloacetate transaminase (SGOT), serum glutamate pyruvate transaminase (SGPT), and serum alkaline phosphatase (SALP) were decreased in the experimental group in comparison to the control and toxic groups, indicating that the plant extract, at two different doses, improved liver function. The multitude of liver biochemical investigations, including those on total bilirubin (TB) and free radical scavenging enzymes including glutathione reductase (GSH), and superoxide dismutase (SOD).

An additional investigation assessed the hepatoprotective potential of the methanolic extract of *J. gendarussa* leaf using carbofuran-introduced liver damage in rat species.

It is found that leaf extract causes a significant decrease in liver injuries by decreasing the enzyme level. This research indicates that the extract's antioxidant properties are what give it its protective effects.<sup>[39]</sup>

### Anti-inflammatory

*J. gendarussa's* anti-inflammatory qualities are due to the presence of flavonoids. It functions by preventing the production and release of different autocooids. Apigenin, a bioflavonoid, has demonstrated anti-inflammatory qualities. Apigenin is engaged in the TLR-NF- $\kappa$ B signaling cascade and inhibits a number of adaptor proteins, including TRIF, MyD88, and TRAF6, in addition to the cell surface receptor TLR4. The significant enzyme COX-2, which is engaged in the development of inflammation, the suppression of pro-inflammatory cytokines, and the turning on of IL-10, indicates the shielding impact.<sup>[1]</sup> The methanolic extract obtained from the leaves of *J. gendarussa* exhibits strong anti-inflammatory properties, because it stabilizes the membrane and stops cytokines, prostaglandins and other inflammatory mediators from leaving the cell.<sup>[21]</sup>

### Antioxidant

An antioxidant is any substance that, when present at low concentrations, either entirely prevents or significantly delays the oxidation of oxidizable substrates.<sup>[40]</sup> The methanolic *J. gendarussa* leaf extract has demonstrated



free radical scavenging activity and in studies, it's determined by the DPPH assay method; 2, DPPH is a free radical molecule. It's been employed to evaluate different sample's capacity to scavenge free radicals and serve as reducing agents.<sup>[41]</sup>

A further investigation assessed the antioxidant capacity of a 70% aqueous ethanolic extract derived from *J. gendarussa* leaves. Using many well-established *in-vitro* systems, including nitric oxide (NO) scavenging, DPPH radical scavenging, hydroxyl (OH) radical scavenging,  $\beta$ -carotene linoleic acid module system ( $\beta$  CLAMS) and anti-lipid peroxidation, As per the findings, flavonoids are the culprit of the antioxidant activity that EJ possesses.<sup>[42,43]</sup>

The reason behind its hepatoprotective and antioxidant properties is its elevated flavonoid and total phenolic content.<sup>[44]</sup>

### Antifungal

*J. gendarussa* demonstrates potential as a naturally occurring source of antifungal drugs. Extraction from *J. gendarussa* has been shown to be effective against a range of fungi-related illnesses, such as *Aspergillus* species (caused by aspergillosis), *Candida* species (caused by candidiasis), and dermatophytes (caused by skin illnesses such as ringworm).<sup>[45]</sup>

Flavonoids, alkaloids, terpenoids, and phenolic compounds are some of the bioactive substances that give *J. gendarussa* its antifungal activity. These compounds are assumed to cause disruption of membrane integrity, inhibition of fungal enzymes, interference with essential metabolic pathways, and interference with the development of fungal cell walls, all of which lead to the suppression of fungal growth.<sup>[46]</sup>

### Antimicrobial

*J. gendarussa* has been shown to possess antibacterial activities in numerous investigations. Antibacterial activity of *J. gendarussa* extracts was observed against multiple species of microbes, such as *E. coli*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus*.<sup>[47]</sup>

The different microorganisms were inhibited by *J. gendarussa* methanolic extracts. The maximum level of suppression shown in opposition to *Bacillus subtilis* and *Escherichia coli* is attributed for a variety of phytochemicals, including flavonoids, aspirins, tannins, and terpenoids; additionally,  $\beta$ -sitosterol, friedelin, lupeol, 2-amino benzyl alcohol, and O methyl ethers.<sup>[21,48]</sup>

### Antidiuretic

When a drug has antidiuretic activity, it means that it can make the body retain more water and produce less urine. According to the research, *J. gendarussa* ethanolic extract has potent and dose-responsive diuretic action. It is possible that this plant contains phytochemicals, including sterols, tannins, flavonoids, alkaloids, and/or nitrogenous bases, which have been shown in earlier research to have

antioxidant potential and the ability to either dissolve stones or have diuretic effects.<sup>[49]</sup>

### Anti-HIV

Research has examined the potential of *J. gendarussa* extracts or compounds extracted from the plant as an antiviral against HIV. A number of mechanisms, such as host immune response regulation, interference with viral replication processes, and suppression of viral entry into cells may describe the antiviral efficacy of *J. gendarussa* against HIV. The bark and stems of *J. gendarussa* were effectively used to isolate two novel anti-HIV main compounds, known as justiprocumins A [1] and B [2].<sup>[50]</sup> A method called as bioassay-guided separation was used to extract patentiflorin A (1), an anti-HIV aryl naphthalene lignan (ANL) glycoside, from the plant's stem and root extracts. The molecule was evaluated contrary to both T- and M-tropic HIV-1 separates, and the results indicated that it had a substantially stronger inhibitory effect than AZT, a clinically used anti-HIV medication.<sup>[51]</sup>

Another study revealed that the 70% ethanol extract inhibits the MT4 cell that is HIV-positive, the fractionated 70% ethanol extract, and the water extract of *J. gendarussa* leaves.<sup>[52]</sup>

In this work, *J. gendarussa* leaf extracts (70% fractionation, which releases alkaloids) and (70% ethanol extract, which does not) are tested for their anti-HIV effects on HIV-positive MOLT-4 cells *in-vitro*.<sup>[23]</sup>

To completely comprehend *J. gendarussa's* antiviral qualities and its possible use in the prevention or treatment of HIV, more study is required. In addition, caution should be used, and more research—especially clinical trials—is required to ascertain the substance's safety and effectiveness in people.

### Analgesic

The sensitive feeling of pain, which is a complicated defense mechanism signaling tissue injury, is subjective, unpleasant, and heavily emotional.<sup>[53]</sup> Analgesic properties have been observed in studies conducted on the n-hexane fraction of *J. gendarussa* leaves. The n-hexane fraction of *J. gendarussa* leaves was identified by the enzyme dependable for the liberation of arachidonic acid, which inhibits lipooxygenase and cyclooxygenation, by restraining prostaglandins, leukotrienes, and thromboxane. Steroids and terpenoids found in this fraction have the ability to both limit the activity of the enzyme phospholipase and promote the manufacture of lipomodulin protein.<sup>[6,54]</sup>

### Antianxiety

Antianxiety action is demonstrated by the alcoholic [ethanol] extract of the aerial portion of *J. gendarussa*. By evaluating *J. gendarussa* extract (EJG) at doses of 250 and 500 mg kg<sup>-1</sup> for antianxiety preclinical examinations. The study found that *J. gendarussa* extract was able to significantly reduce freezing time in mice when

compared to control animals, as well as increase the amount of time and arm entries that mice spent in the open arms of the elevated plus-maze and the illuminated side of the light-dark test. These findings suggest the efficacious antianxiety properties of *J. gendarussa* ethanolic extract.<sup>[55]</sup>

### Male Contraceptive Drugs

The people have long utilized the leaves of *J. gendarussa* as a method of male contraception. A flavonoid called gendrusin A [6,8-di- $\alpha$ -L-arabinocylapigenin] was discovered in an ethanolic extract of leaves by phytochemicals and pharmacological analysis. This flavonoid has male contraceptive characteristics. Gendarusin A is reported to reversibly block spermatozoa hyaluronidase activity, a sperm-promoting enzyme that is used *in-vitro* fertilization. The chemical ingredient responsible for *J. gendarussa*'s male contraceptive effect is thought to be gendarusin A.<sup>[56-58]</sup>

In a different investigation, a male antifertility chemical was identified in the *J. gendarussa* leaf n-butanol fraction. Major compounds is 6,8-di- $\alpha$ -L-arabinosyl-apigénine and minor compounds are 6-C- $\alpha$ -L-arabinopyranosyl-4', 5, 7-trihydroxy-8-C- $\beta$ -D-ylopiranosyl-flavone.<sup>[57,58]</sup>

### Estrogen Replacement Therapy

*J. gendarussa* leaves contains isoflavon, which is a phytoestrogen. In this study, female mice treated with 10, 20, and 30% concentrations of *J. gendarussa* leaf extract showed increases in their levels of estradiol and antral ovarium follicles.<sup>[58]</sup>

### Hyperuricemia

A higher-than-normal blood level of uric acid, known as hyperuricemia, can occur by either a fall in uric acid excretion or a rise in uric acid synthesis. A condition termed as hyperuricemia can result in the accumulation of uric acid crystals in the bowl, which can cause pain. Gout clinical reports indicate that the critical component uric acid is related to a higher risk of cardiovascular dysfunction in addition to an increased risk of gout. In this study, the effect of *J. gendarussa* leaf extract was examined by oxonate-induced hyperuricemia in male rats [albino]. The dose of about 5.2 gm/kg of leaf extract was discovered to be useful in treating hyperuricemia.<sup>[59]</sup>

### CONCLUSION

*J. gendarussa* is an intriguing herbal species with a large record of ancient therapeutic usage. This review paper includes the taxonomy of plant specimens, morphological description, chemical constituents, and the plant part's pharmacological activities. Discovered medicinal properties of this plant include anti-HIV, antidepressant, anti-inflammatory, anxiolytic, sedative-hypnotic, antiangiogenic, antiarthritic, hepatoprotective, antioxidant, antimicrobial, and anthelmintic properties. These properties can be associated with bioactive

components present in *J. gendarussa*, such as flavonoids, lignan glycosides, phenolic compounds, alkaloids, carotenoids, and terpenoids. Molecular studies might reveal the mechanism of action. In light of the conclusions, it is possible to conclude from the study's results that *J. gendarussa* plant is an optimistic applicant for the development of new medicinal formulations.

### ACKNOWLEDGMENT

We would like to extend our heartfelt appreciation to everyone who so kindly contributed their knowledge, wisdom, and experiences, which improved the scope and complexity of this review study. Our special gratitude goes out to Dr. D. Y. Patil College of Pharmacy, Akurdi, Pune, for giving us the chance to work on and contribute to this review study.

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**HOW TO CITE THIS ARTICLE:** Sontakke PA, Patil VP, Wankhade PP, Vhyawahare NS. Unveiling the Pharmacological Spectrum of *Justicia gendarussa*: A Comprehensive Review. *Int. J. Pharm. Sci. Drug Res*. 2024;16(4):716-724. DOI: 10.25004/IJPSDR.2024.160421

