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Review Article

PHYTOCHEMISTRY AND PHARMACOLOGICAL BIO-ACTIVITIES OF *LANNEA COROMANDELICA*: A REVIEW

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ABSTRACT

Lannea coromandelica is extensively employed as a medicinal herb across the globe. This research work focuses primarily on the phytochemistry, pharmaceutics, and bio-exertion of *L. coromandelica*. In ethnomedicine, several members of this species function as astringents, aiding in anti-oxidant, anti-inflammatory, and anti-diabetic and are helpful in other physiological functions. In addition, *Lannea* species' therapeutic benefits were acknowledged in numerous scientific investigations. The conclusions derived from the current study corroborate that the therapeutic activities of *L. coromandelica* can be linked to the presence of a broad spectrum of secondary metabolites and bioactive phytocompounds such as phenols, flavonoids, tannins, and proteins, according to the current study. This review highlights phyto-assembly and phyto-activities such as a diuretic, cardiovascular, and bioactivities such as antiepileptic, antimicrobial, and anti-convulsant, and pharmaceutical activities such as anti-cancer, anti-diabetic, and anti-asthmatic properties.

Keywords: *Lannea coromandelica*, Phytochemistry, Ethnobotanical uses, Pharmacological properties, Flavonoids.

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INTRODUCTION

Plants, trees, herbs, shrubs, weeds, etc., are essential supplies of nutrition, protection, and medication for people. Discovering how plants can be used to address ailments is crucial to living a better life. Our predecessors utilized countless botanicals as remedies, and these herbal remedies are scientifically validated. *Lannea coromandelica* is one of the significant species that may be found throughout India. Indian territory undoubtedly has an abundant herbal reservoir that is able to mitigate and avert numerous illnesses [1-5]. At present, these therapeutic remedies are on par with manufactured medical products due to their minimal or no detrimental or harmful effects on humans.

L. coromandelica also termed as Jhingini in Sanskrit and woodier or Indian ash tree in English is a representative of the Anacardiaceae genus that pullulates in the tropical regions of the Asian continent. This species is said to be beneficial in ethnomedicine for local edema, soreness, irritation, inflammation, and redness, as well as for tumor growths, ulceration, sprains, injuries, dermal diseases, melanoma, and diarrhea [6]. In South India, it is addressed as Odiar or Gumphini. Indian tribes have maneuvered this species to target a variety of ailments, including bodily discomforts/aches, toothaches, stomachaches, gastritis, gastritis, and sexual sterility. Several studies on the plant's pharmacological applications have been conducted. Polyphenols, such as bioflavonoids, terpenes, gums, and saccharides, are found in abundance in the plant [7,8].

Herbal plant species contribute a significant role in generating antioxidants due to the prevalence of polyphenols. The secondary metabolites contribute significantly in elevating human health. The ingestion of various phenolic chemicals can result in serious medical conditions such as chronic and degenerative diseases. The reactive oxygen species will cause oxidative stress and injury. Micronutrients can either boost the ROS factors or limit the availability of free radicals [9].

The plant is also known as Bhadi, Jeol, Jialbhandi, Jhingangummi, Jhingam, and Indian Ash Tree in India. Tekeshwar K and Vishal J identified it in arid and humid forests of the Himalayas (Swat to Bhutan), Assam, Burma, Indo-China, Ceylon, Andamans, China, Thailand, Cambodia, Laos, Vietnam, and Malaysia. The plant's chemical components, polyphenols, and flavonoids have been extracted in large quantities [10,11].

The North and West African communities have utilized these species as food additives and in pharmaceuticals. The slightly acidic fruits are used in culinary to make sweets and puddings. *L. coromandelica* is acknowledged as one of the pivotal herbs in the biosphere because of its anti-inflammatory, anti-oxidant, and anti-diabetic properties [12-16].

L. coromandelica is a versatile tree with a wide range of medicinal and pharmacological benefits. The review mainly focuses on the therapeutic phytochemical and pharmacological properties of *L. coromandelica*. Prior studies have shown that the bark of *L. coromandelica* is effective in the treatment of injuries, lesions, wound infections, scars, bruises, abrasions, ulcerations, gastric ulcers, enterocolitis, leukorrhea, eye infections, peptic ulcer disease, colitis, stomatitis, odontalgia, dislocations, sprains, diarrhea, and constipation, and that the foliage is efficacious in the management of elephantiasis, inflammatory disorders, and neuralgia [17].

PHYTO-ASSEMBLY

The genus *Lannea* is designated after Lannes de Montebello, a French who introduced the plant from Japan to France in 1870, while the species *coromandelica* is titled after Coromandel, a small town on the southern-eastern coast of India. Approximately 30–40 kinds of shrubs and trees belong to the genus *Lannea* which commonly flourishes in Africa e Except for *L. coromandelica* [18], which is grown in tropical and subtropical regions of Asia. It can reach a maximum of 14 m in areas with sufficient sunshine and adequate irrigation, and it has a red blaze. Barks are light-colored with branchlets that congregate at the ends of branches. Starry hairs cover the branchlets in minuscule amounts. Imparipinnate leaves are alternately placed. While juvenile, the leaflets are 5–7 in number, opposite, oval, sharp tip, whole edge, and coated with velvety hairs. Flowers are unisexual and have a green color. They have four broad oval sepals that are roughly 1 mm long [19,20]. Petals are four in number, 2 mm long, rectangular in shape, and greenish-yellow in color, with stamens twice as many as petals and turn yellow

during abscission. The tree blooms during February and April. The fruits are drupes with 3–5 locules and a dull red to pink colors [21].

L. coromandelica has alternative names such as kanbelimarnu and paalkaara, pithmari, pithmari, pithmari, and pithmari, and the plant's twigs are used as tooth sticks by local communities, the bark is used for skin diseases by Toraja people, tender leaves and roots are used for stomach ache by Toraja and Gadaba communities, and past research has revealed that the fruits of this plant are pulverized and combined with water and used as a fish poison. In Oriya, it's known as Raji Mohi, and tests found that the bark constituted flavonoids and terpenoids, but no alkaloids or steroids. The Garo tribes settled in the Madhapur forest region of Bangladesh employed the stem bark of *L. coromandelica*, known as Jiga Bark, for seminal insufficiency and profuse seminal discharges. The tribes of Mt. Yingying, Hainan Island, China, called the Indian ash tree Ziza and used it to cure wounds and hematochezia, the crushed and macerated secondary metabolites of the plant's leaves and bark were administered orally [22-25].

In Mizoram, India, the tree bark is called Tiatasha which is traditionally used as an astringent in ulcers and sores, while the leaf is effective in treating swellings, injuries, bruises, sprains, and body aches. Gumphini was the indigenous name for this plant in Srihari Kota Island, Nellore, India. Conventionally, the juice was used to treat ulcers and toothaches, while the stem bark was blended into a paste to treat body ailments and the wood was used to build agricultural implements. It is utilized spiritually to ward off evil spirits. Locals in Goa refer to it as Moi, and they employ the plant's bark in tanning. It was reported to be administered in medicine as an antidote for necrotic coma patients, as well as to relieve dyspepsia, sprains, and bruises [20,26,27].

The lambada tribes of Nizamabad District, Andhra Pradesh, India, utilize *dumpidi* plant bark as a dressing to cure bone fractures. People in Rajasthan, India, referred to *Lannea* as Jingini. Gelly was traditionally soaked in water and used to treat pain. The interior mass of wood bark was smashed, and the fluids were recovered and were used in the treatment of tetanus [28-32]. The total import value index of plants in the *Mota Magra* Forest in Udaipur, Rajasthan, was reported, and the values of plants growing in other forest zones were given in comparison. According to reports, the plant is as important as Neem, India's sacred tree. *L. coromandelica* hardwood is used to make bleachable pulp and to feed wild silkworms.

Scientists are investigating indigenous medicinal plant extracts on various physicochemical and biological paradigms to explore the bioactive components they possess and to examine their medicinal potential. Lipoma, scurvy, tumors, ulceration, cancer growths, bruises, injuries, dermal problems, dysentery, hematochezia, and constipation are all treated with leaf extracts. Other than that, the leaves are served as livestock fodder [33-35]. Food additives, flavoring agents, dental powders, and impregnating agents in fishnet stockings are the benefits attained from bark and its extracts/powders. Contusions, inflammatory diseases, chronic gastritis, canker sores, scars, skin rash, and other conditions are treated with the bark. Traditional applications, as well as the abovementioned pharmacological findings, support the plant's therapeutic potency [36,37].

PHYTO-CHEMISTRY AND CONSTITUENTS

The biochemical contents of all plant parts, including gums, stems, leaves, flowers, and bark, were examined. Carbohydrates, gums, proteins, glycosides, terpenoids, and polyphenols are among the major constituents found in the plant. Terpenoids and flavonoids were discovered in the qualitative phytochemical investigation of the barks. ß-Sitosterol and physicochemical were found in the petroleum ether extract of stem bark. The subsequent hot chloroform extract of the preceding contained Physcionanthranol-B [38]. All the phytochemicals are predominantly present in the mother liquor. The ether extracts yielded ß-sitosterol (H), while the acetone extract yielded leucocyanidin. Phenolics such as tannins, flavonoids, flavanols, flavanones, isoflavones, and flavanol glycosides, have been found in abundance in the flowers. Tannins, such as ellagic acid and a flavonoid glycoside, Quercetin- 3-arabinoside, were isolated from fresh flowers using ether and ethyl acetate fractioned alcoholic extract [39,40]. Isoquercitin was found in a crude alcoholic extract of flowers (g). The plant's leaves have been found to contain ß-Sitosterol, Ellagic acid, Quercetin (a), Quercetin-3-arabinoside, leucocyanidin (c), and leucodelphinidin (d). Morin (e), a flavonoid aglycone, was also extracted from the plant, with the structure 3,5,7,2',4'-OH-flavone reported as the probable structures [41].

The qualitative examinations of the leaves indicated the presence of carbohydrates, alkaloids, glycosides, tannins, flavonoids, polyphenols, saponins, amino acids, gums, and mucilages in the water extract while triterpenoids were present only in the methanol extract. Whereas steroids, volatile oils, fats, and fixed oils were completely absent [42,43].

PHARMACOLOGICAL EFFECTS ON SECONDARY METABOLITES

Steroids, tannins, flavonoids, alkaloids, saponins, triterpenoids, and saponins were found in the phytochemical screening of extracts of *L. humilis* and *L. barteri*. Flavonoids, sugar, protein, triterpenoids, alkaloids, tannins, and phenols were found in *Lannea coromendelica* bark extracts. Chemical analysis revealed that *Lannea welwitschia* consists of oil, sugar metabolites, alkaloids, saponins, and tannins. Only flavonoids and tannins were extracted from the plant leaves of *Lannea kerstingii* using ethyl acetate [44,45]. The petroleum crude ether extract solely includes steroids and triterpenes. Terpenes, carbohydrates, glycosides, alkaloids, flavonoids, fats, oils, waxes, and tannins were found in the leaf's extracts of *L. coromandelica* including 4'-methoxymyricetin 3-O-α-L-rhamnopyranoside, myricetin (3-O-α-L-rh), amnopyranoside, myricetin 3-O-β-D-glucopyranoside, vitexin, isovitexin, gallic acid, and epicatechin have been considered as major components leaf extract of *Lannea macrocarpa* [46-48].

PHYSICOCHEMICAL ENTERPRISE

ANTIOXIDANT ACTIVITY

Phytochemical screening of odina woodier leaf and *in vitro* anti-oxidant study of DPPH radical scavenging at different concentrations in methanol and ethyl acetate extract of odina woodier leaf was measured. With the increase in concentration, the radical scavenging effect was discovered to increase. Using DPPH, the previous research described the varied quantities of ethanolic extract of bark in terms of radical scavenging activity. The IC50 value for ethanolic extract of bark was 83.28 ug/mL [57].

The leaves and barks of *L. coromandelica* are rich in flavonoids and other phenolic compounds. The solubility of phenolic compounds validates their polar nature. The DPPH assay showed maximum absorption at 517 nm which subsequently declined with the presence of anti-oxidants in the medium [58]. The ethyl acetate fractions of bark exhibited the most effective free radical scavenging properties with the least IC50 value corresponding to 3.8 ug/ml. The antioxidant capacity of the ethyl acetate fractions of the leaves and barks was reported to be 46.67 mg and 33.78 mg of L-ascorbic acid/dried extract as per the results of a study conducted [58].

The extracts' free-radical scavenging ability toward stable DPPH was measured using a spectrophotometer at 515 nm. The ethyl acetate extract exceeded the methyl alcohol extract and aqueous fractions in terms of DPPH scavenging activity. The DPPH scavenging efficacy of both standards and plant extracts decreased at a dosage of 100 mg/mL. The reducing power assay is frequently used to assess an antioxidant's ability to give electrons. Ascorbic acid was used as a reference to equate the reducing potential of the leaf extraction [59-61]. With the increase in concentration, the reducing power of all samples increased significantly. The most frequent free radical produced is the superoxide anion. Superoxide radical-scavenging capabilities of *L. coromandelica*

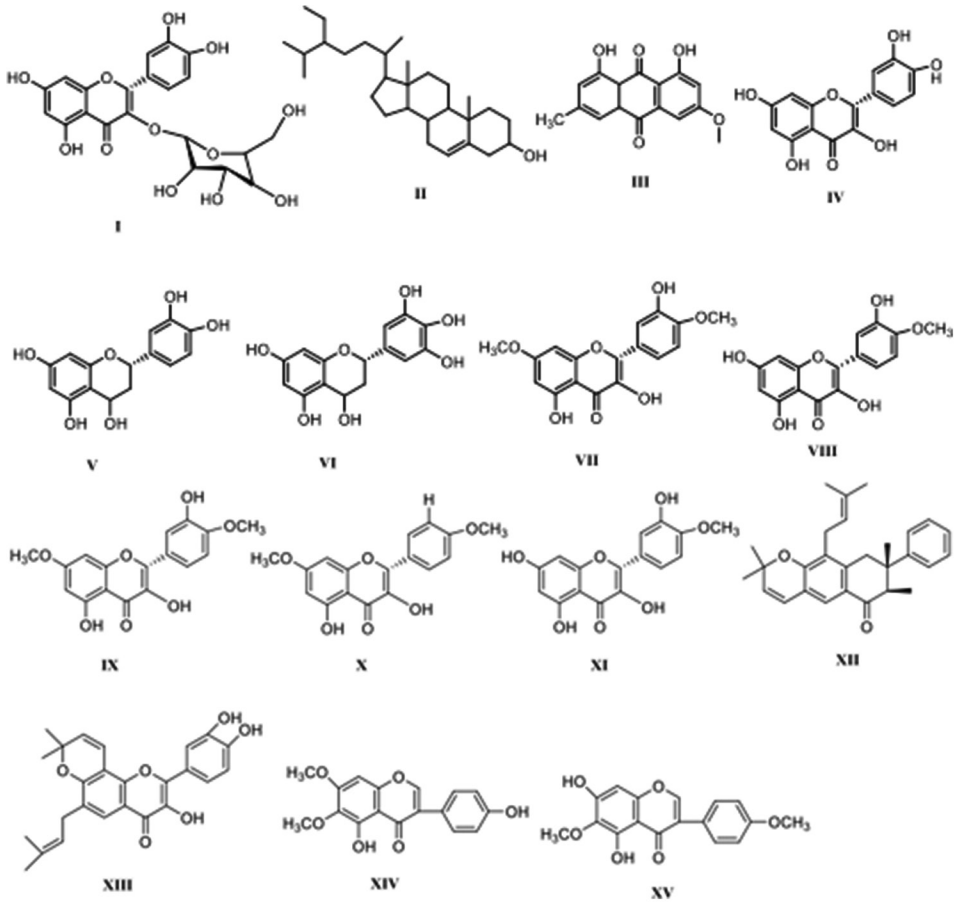

Fig. 1: Chemical structures of phytoconstituents isolated from Lannea species [54]

Table 1: Traditional and Medicinal uses of *L. coromandelica* [3,10,49-52]

Region	Local name	Plant part used	Medicinal uses
Khoraput district of Orissa	Kondh tribe-Kanbeli	Twigs	Tooth sticks
	Poraja tribe-paalkaara, pithmari	Bark	Skin diseases
	Gadaba tribe-pithmari	Leaves and roots	Stomach ache
Gadchiroli district of Maharashtra	Gond tribes- gopid	Fruits	Fish poison
Madhapur forest region of Bangladesh	Garo tribes-Jiga Bark	Bark	Seminal weakness and excessive seminal emissions.
Tingeing, Hainan Island, China.	Ziza	Decoction and macerations of leaves and bark	Injuries and Hematochezia
Mizoram, India	Tawitawsuak	Bark	Astringent, in ulcers and sore, leaf is used in swellings, sprains and Pain of the body
Srihari Kota island, Nellore dist., India	Gumphini	Leaf juice	Ulcers, applied to treat tooth ache
		Stem bark paste	Body pains
		Wood	To make agricultural implements
Goa, India	Moi	Bark	Tanning, as antidote for coma patient caused by narcotics, and to treat dyspepsia, general debility, gout, Dysentery, sore eyes, leprosy, sprains and bruises.
Nizamabad District, Andhra Pradesh, India	Lambada tribes- Dumpidi	Bark	Bandage to treat bone fracture, impotency
Rajasthan, India	Jingini	Gum- soaked in water, rubbed on stone and applied locally	Pain
		The inner bark of stem- crushed and make suspension juice is applied over cuts	Stops bleeding and to prevent tetanus

L. coromandelica: Lannea coromandelica

extracts were in a dosage-dependent manner. The elimination of Fe3+ is a crucial component of transferring electrons and a fundamental step in exerting antioxidant properties. In the extracts of *L. coromandelica*, the (Ferric Reducing Antioxidant Assay) test indicated a favorable connection between reducing power and the total concentration of phenols. The antioxidant capacity index for polyphenolic compounds, flavonoid, ascorbic acid, and tocopherol is frequently measured using chromogenic oxidizing agents. According to the findings, the cupric reducing power of the ethanolic fraction was the highest, while the aqueous fraction had the lowest concentration [62].

ANTIMICROBIAL ACTIVITY AND WOUND HEALING

Gouranga das and Durbadal Ojha examined the antimicrobial activity of various extracts of cassia toralinn plant leaves in 2010. The antibacterial and wound healing activities of the bark of *L. coromandelica* were determined by the disc diffusion method by [63-65]. On mice, it demonstrates substantial wound healing activity.

The isolates were evaluated for antibacterial activity (ABA) against 11 bacterial species (*Bacillus subtilis, Bacillus cereus, Sarcina lutea, Staphylococcus aureus, Shigella boydii, Vibrio mimicus, Shigella dysentery, Escherichia coli, Salmonella typhi, Salmonella paratyphi*, and *Pseudomonas aeruginosa*) and contrasted to the reference antibiotic cephradine disc by measuring the zone of inhibition (in mm). Antifungal activity was also evaluated against two fungi (*Candida albicans* and *Saccharomyces cerevisiae*) [45,66], and the results were comparable to nystatin. In comparison to the reference, dichloromethane portions of both bark and leaves demonstrated better ABA against both Gram +/– bacteria. Furthermore, leaf portions exerted stronger anti-bacterial properties than bark fractions. The dichloromethane soluble fractions of leaves demonstrated the highest ABA against *S. paratyphi*. Most of the other fractions exhibited minimal or no antifungal properties [67].

Table 2: List of the constituents and phytochemicals

Phytochemicals	References
4-O- (a-D-galactopyranosyluronic acid)-D-galactose	[20]
6-O- (ß-Dglucopyranosyluronic acid)-D-galactose	[20]
6-O-(4-O-methyl-Dglucopyranosyluronicacid)- D-galactose	
3-O-ß-L-arabinofuranosyl-L-arabinose	[53]
3-a-D-galactopyranosyl-L-arabinose	[53]
3-O-ß-D-galactopyranosyl-D-galactose	[53]
6-O-ß-Dgalactopyranosyl-D-galactose	[33]
4-O-methyl derivatives namely 2,3,4-tri-O-methyl-Lrhamnose	[33]
2,3,5- and 2,3,4- tri- and 2,5-di-O-methyl-L-arabinose	[54]

Aspergillus flavus, Aspergillus niger, Colletotrichum gloeosporioides, and A*lternaria alternata* were investigated for their effectiveness in the test dermatophytic fungus *C. albicans* and *Malassezia pachydermic* with ethyl ethanoate fractions of fungal endophytes derived from *L. coromandelica*. A. flavus has a maximal inhibitory region of 26.22 mm toward *C. albicans* and 16.72 mm toward *M. pachydermic*. *C. albicans* showed substantial suppression, while *A. niger* and *A. alternata* showed no significant inhibition. A considerable inhibitory zone was found in *M. pachydermic* and *C. gloeosporioides* [68-71].

ANTIDIABETIC AND ANALGESIC ACTIVITY

Past investigations have shown that an ethyl alcohol extract of *L. coromandelica* bark has an anti-hyperglycemic effect in mouse models and demonstrates significant analgesic properties in heat-induced animals. The ability of the methanolic isolates of *L. coromandelica* bark to tolerate hyperglycemia was investigated. The mice were orally fed with 2 g glucose/kg of body weight, blood samples were taken after 2 h to test blood glucose levels by glucose oxidase methodology. Glibenclamide, a standard antidiabetic medication, was given to the control groups at a concentration of 10 mg/body weight [72]. At a concentration of 200 and 400 mg/kg body weight, the glucose-loaded mice treated with the bark extracts of *L. coromandelica* displayed significant antidiabetic action [73].

On 3 weeks of oral ingestion of *L. coromandelica* at concentrations of 250 and 500 mg/kg, hyperglycemic mice showed a notable reduction in blood sugar levels both in acute and long-term - term studies, and a remarkable reduction in total cholesterol, total triglycerides, low-density lipoprotein cholesterol, and an insubstantial improvement in high-density lipoprotein cholesterol levels were noticed [74]. In comparison to the treated diabetic control group, oral consumption of *L. coromandelica* dramatically lowered creatinine levels, alanine aminotransferase, and aspartate transaminase. These findings revealed a significant enhancement from the detrimental impact of alloxan on the pancreatic islet cells [75].

The extracts have been reported to effectively block glucagon-assisted cAMP synthesis, and are ineffective in lowering forskolin-induced cAMP production. The availability of numerous bioactive elements such as flavonoids, glycosides, and alkaloids in the ethyl alcohol leaf fractions of *L. coromandelica* resulted in a substantial hypolipidemic impact at a concentration of 200 mg/kg body weight [76].

OTHER THERAPEUTIC PROPERTIES

Antinociceptive effects

Chemicals and temperature-induced pain paradigms, such as acetic acid-induced writhing, hot plate, tail immersion, formalin, and glutamate testing's, were used to assess the antinociceptive effect of an

Table 3: Bio-exertion of biological activities

Hepatoprotective	Ethanolic extract of *M. oleifera* leaves as well as alcoholic extract of seed in perspective of hepatoprotective *(in vivo)* was estimated contrary to the rifampicin and pyrazinamide evoked liver damage[5] and also hepatoprotective effect contrary to antitubercular medical pills and alloxan evoked liver damage noted in diabetic rats
Antifungal Activity	Antimicrobial activity of the ethanolic and aqueous extracts of *L. coromandelica* on three microbes (two bacteria and one fungus) by agar well diffusion method. On the basis of previous studies, we can conclude that *L. coromandelica* bark extract having antimicrobial property and antifungal property against the female RTI which caused by some pathogenic microorganism. Extracted material shows the relevant stronger activity against all tested bacterial stains. However, aqueous extract demonstrated higher antifungal activity [55]. Therefore, *L. coromandelica* has been used for further analysis.
CNS enterprise	Leaves extract of *M. oleifera* restores the capability of amine levels of the central nervous system which will be helpful in Alzheimer's sickness and *in vitro* anticonvulsant enterprise from the liquid extract of *Moringa oleifera* roots [8].
Antidiabetic activity	The study showed that Tropylpropanaltosylhydrazone could be used as a potential lead compound in the treatment of diabetes. Further exploration of the function of the compound will facilitate a better understanding towards development of Tropylpropanaltosylhydrazone[50] a s an antidiabetic agent.
Hypolipidemic Activity	In terms of hypolipidemic activities, the indigenous products can be inter-related with the secondary metabolites such as flavonoids, tannins, carbohydrates, and so on. It acts as inhibitor for biosynthesis and absorption of lipogenic and lipolytic enzymes due to lipid enzymes [56].

ethyl alcohol extract of *L. coromandelica* leaves. In the chemical/heat-induced nociception in murine models, the ethyl alcohol fractions of *L. coromandelica* showed strong dose-dependent antinociceptive action, confirming the leaf's longstanding usage in the healing of many painful disorders. Another scientific study found that the ethanolic extract of *L. coromandelica* produced a substantial dose-dependent increase in hot plate latencies and tail retraction duration. It also decreased the number of stomach constraints and paw lickings caused by acetic acid [77-79].

Anti-arthritic effects

In terms of ABA, preliminary phytochemical research, *in vitro* antioxidant, and anti-arthritic tests reveal that the ethanolic extract of *L. coromandelica* leaves has increased anti-arthritic potency [80].

HYPERTENSIVE REACTIVITY

It showed a reduction in arterial blood pressure so can be used as a hypotensive agent. It was found no effect in vagotomy and eviscerated dogs, but spinal preparation showed a slight increase in hypotension [81].

WOUND HEALING ACTIVITY

Ethyl alcohol and propanone fractions of *L. coromandelica* (Houtt) Merr bark hinder remediation activity in excision and incision form when treated to male rats in conventional ointments. For both procedures, framycetin sulfate was used as a standard. In the excision approach, ethanolic and acetone extracts showed 97.11%and 95.95% activity, respectively, and showed long-term effects in the incision method [82].

CONCLUSION

The main objective of this review was to resolve the pharmacological and medicinal activities of *L. coromandelica* that exposed plant possesses analgesic medication, anti-inflammatory, antipyretic, and antioxidant. These activities are commenced in its root, stem, leaf, and seeds. It states that any of the solvent either ethanolic or methanolic extracts is widely used for examination and identification purposes and in the future, principally *in vivo* studies based on animal models may be considered for higher effective results.

CONFLICT OF INTEREST

Nil.

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