

A critical review of phytoconstituents and pharmacological activities of an ethnomedicinal plant *Cordia dichotoma* G. Frost.

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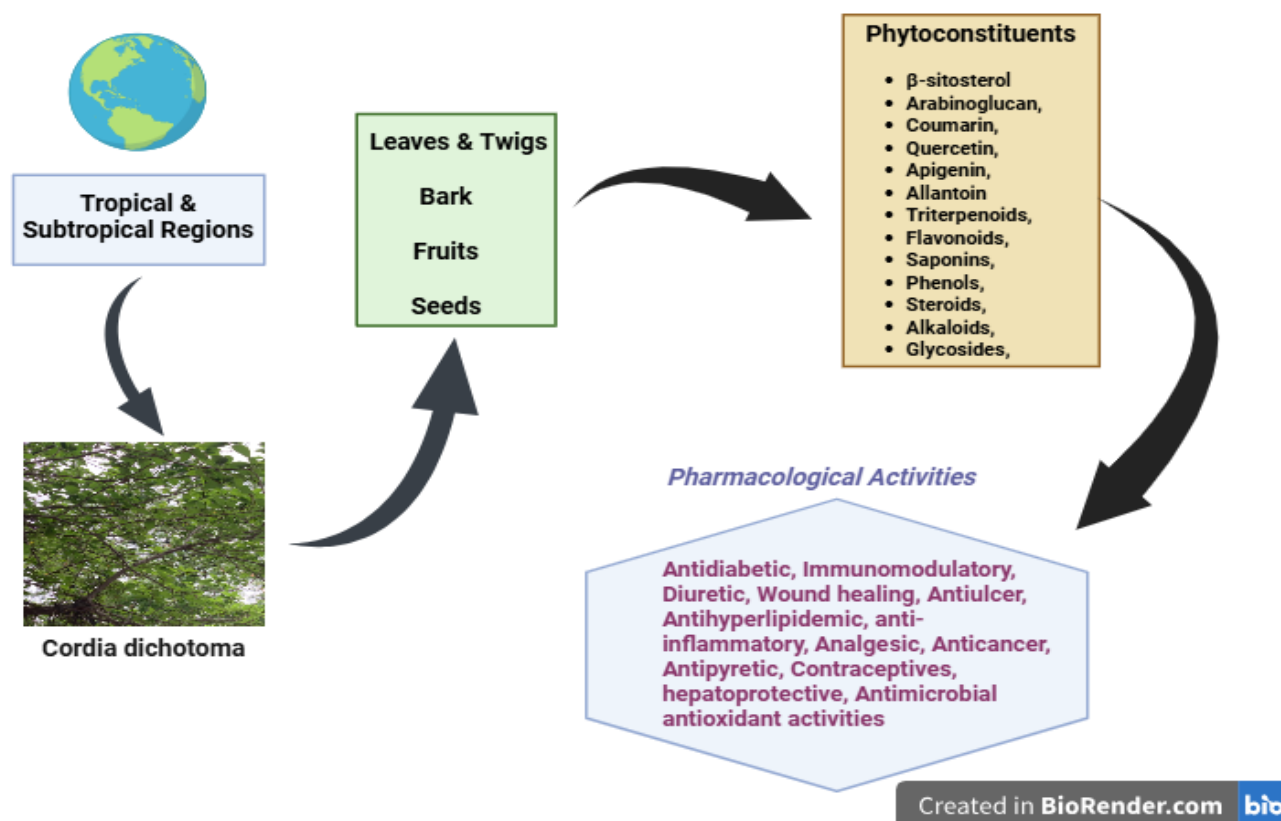
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ABSTRACT

Introduction: *Cordia dichotoma* G. Frost. is a deciduous plant found with semitropical to torrid zone. The several constituents of this plant are utilized as Traditional Chinese Medicine (TCM) and herbal preparations. These herbal formulations utilized in many disorders/ illness for hepatoprotectant, antidiabetic, immunomodulatory, antioxidant, antimicrobial, wound healing, antiulcer, antifertility and anticancer activities. Phytochemicals like such as allantoin, beta sitosterol and glyceride were screened from *C. dichotoma* plant. The review further highlights the pharmacological and therapeutic activity, which can be helpful to evaluate the future studies on the plant's usability in treatment of many disease & disorders. **Methodology:** The primary objectives of the study is to do information gathering from prior publications pertaining to keywords including “*Cordia dichotoma*,” “pharmacological activities,” “phytochemical constituents,” “traditional Chinese medicine,” “utilization of *C. dichotoma*,” and related terms. Duplicate articles were removed prior to screening. The titles and abstracts were screened for relevancy. Further full text articles were assessed for appropriateness and eligibility. These data obtained through various databases (Google Scholar, Scopus, Web of Science and PubMed). Therefore, ethical committee approval is not required. We collected, finalized, and applied 58 publications from 2004 to 2026 for our review. **Results:** This review emphasizes on phytochemical constituents and reported pharmacological effectiveness of *C. dichotoma* plant. **Conclusion:** The research included in this review suggests that *C. dichotoma* offer various therapeutic benefits for several diseases. However, extensive evaluation is necessary to clearly understand the mechanisms pertaining to *C. dichotoma* potential in treating several disease conditions.



Keywords: *Cordia dichotoma*, Pharmacological activities, Phytochemical constituents, Hepatoprotective activity, Traditional Chinese Medicine

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INTRODUCTION

Medicines obtained from plants are thought to be the front line of defense for restoring wellness and safeguarding from illness and the herbal medicines continue to be the main source of newer drugs with promising therapeutic qualities [[1], [2]]. The *Cordia dichotoma* (*C. dichotoma*) fruits are utilized for medicinal preparation in Traditional Chinese Medicine (TCM) from ancient time [3]. The species are widely grown & cultivated in India, Philippines, China, Malaysia, Australia and Polynesia [4]. The seeds are used for propagation. The family Boraginaceae includes the genus *Cordia*, which has about 300 species spread across the globe primarily in the warmer climates. Several *Cordia* species have been used in traditional medicine, according to a review of the literature. Because of the genus *Cordia*'s ethnopharmacological and chemotaxonomic significance, we looked at one of its species named *Cordia dichotoma* G. Forst., a medicinal plant that grows widely from northern India to southern China [5]. The *Cordia dichotoma* G.Frost fruit is known as phoa-po-chi in Taiwan, Republic of China. This fruit is consumed as picked in Taiwan [13]. A common Uighur therapeutic herbal mixture in China's Xinjiang area is called Abnormal Savda Munziq (ASMq). The herbal ASMq is consumed for the treatment of hyperglycemia, cardiovascular disorders, cancer and respiratory conditions like asthma. For cancer treatment, 500 ml of ASMq oral decoction should be administered thrice in a day [14]. *C. Dichotoma* fruits with other herbs are used to treat various types of asthma conditions like Gejsiman belghem-like asthma, excessive amount of Sewda (black bile)-type asthma and Nezla-type asthma in TCM [15]

From *C. dichotoma*, a variety of phytoconstituents with distinct pharmacological actions were screened and isolated. The isolated compounds found to be tannins, glycerides, flavonoids, terpenes and alkaloids [6].

Throughout history, medicinal plants have been used to produce important plant products that are used as medical aids treating a variety of ailments and conditions worldwide. It has been well established that folk drugs made from plant products throughout history [7]. Similarly different parts of *Cordia dichotoma*, plant is employed to treat several disorders and ailments in folklore medicines. *C. dichotoma* is quite popular for its medicinal effectiveness against a variety of pathogenic disorders [8]. The leaves and bark of plants are frequently used as a hepatic stimulant and to treat fever, diarrhea, and burning sensations. *C. dichotoma* leaves are utilized in the treatment of kidney issues, hepatic abnormalities, stomach issues, and gastrointestinal distress. There is additional evidence of the plant's antifertility properties [9]. The *C. dichotoma* leaf extract, which is known to have important contraceptive qualities. The entire plant is frequently used as antidote in snake bites and its fruits are used for diuresis, astringent, destroying parasitic worms, purgative, cough remedy and hypoglycemic agent. Additionally, jaundice is historically treated with the leaves [10].

The Ayurvedic and Unani medical systems also recommend the use of *C. dichotoma* for therapeutic purposes. In Unani Tibb traditional medicine system, *C. dichotoma* G. Frost. Is one of the main ingredient in "Joshanda Kadha". "Joshanda Kadha" is an unique polyherbal mixture that is used extensively in India for treating pulmonary conditions, such as congestion, soar throat and other severe breathing difficulties. It has been shown that various ayurvedic preparations of *C. dichotoma* have restorative properties in the Ayurvedic medical system [[6], [11]]. *Cordia dichotoma* is a deciduous shrub that has been used for centuries as a medicinal herb in India. The fruit is said to contain a lot of carbohydrates. When *C. dichotoma* fruit ripens, it turns into a sticky, jelly-like material [[4], [6], [12]]. Since ancient times, leaves and stem bark have utilized for the treatment of gonorrhea. Plant leaves have been traditionally used as anthelmintics [13].

It has many medicinal properties, including antifertility, juvenomimetic, and antioxidant effects [16]. Their leaves are the primary source of 2-4 carotenoids, which have strong antioxidant

properties [17]. Due to busy schedules, people's eating habits are changing these days, which impacts our bodily systems and causes a number of health problems like migraines, diabetes, obesity, and hypertension. We are now concentrating on Ayurveda rather than homeopathic and allopathic medicine to address these issues [18]. A common medicinal tree in arid and semiarid regions of our nation, such as northwest and central India, is *Cordia dichotoma* [19]. This plant is also found in Egypt, where it is known as makhate [20]. Lasora and Gonda are the local names for the fruits of *Cordia dichotoma*, which are often referred to as Indian cherries and sebesten [[4], [21]]. There are about 3000 species in the *Cordia* genus, many of which are utilized as herbal medicines [8].

Cordia dichotoma G. Frost. Plant is average sized, characterized by diminutive, fragmented branches and an outer bark layer that is typically wrinkled. The entire plant parts are consumable and replete with advantages, demonstrating multiple medicinal applications, including its usage as an astringent, expectorant, hepatoprotective agent, and its benefits for digestion and skin health [9]. Herbal remedies derived from traditional or folklore are important in the treatment of many human illnesses, such as cancer, neurological conditions, diabetes, and inflammatory and pain conditions, to mention a few. Given its significance in traditional and ethnopharmacological medicine, herbal remedies may be useful in the treatment of inflammation and pain [22].

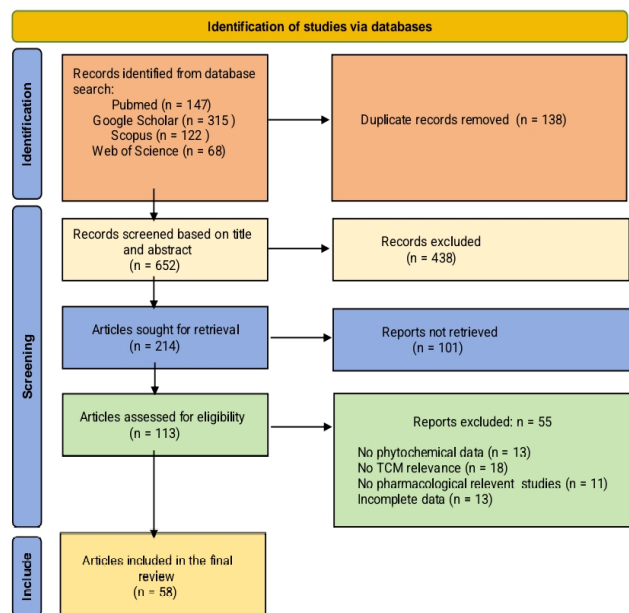
Cordia dichotoma is a tropical and subtropical tree of average size. Additionally, it is a significant plant species used in Ayurveda, Unani, and Siddha, among other traditional Indian medical systems [[4], [24]]. Fruits have laxative, astringent, expectorant, and anthelmintic properties. Antidiabetic, immunomodulatory, hepatoprotective, and free radical scavenging properties are some prominent ethnomedical uses of *C. dichotoma*. Numerous phytoconstituents, including α -amyrin, beta-sitosterol, Allantoin are identified from *C. dichotoma* bark [21].

The utilization of plant extracts and their active ingredients is a key component of traditional medicine [4]. *C. dichotoma* is medium length deciduous plant with a small bole, spreading crown, and curved trunk. Simple, whole, and somewhat dentate, the leaves have a circular, cordate base with a shape of elliptical-lanceolate to broadly oval. Plant bark is either lengthwise crumpled or smooth with grayish brown colour. The flowers emerge in loose corymbose cymes have short stalks, are bisexual, and range in color from white to pink. Fruits having gummy pulp can be eaten [22]. *Cordia dichotoma* has been used extensively in traditional medicine due to its therapeutic qualities, which include treatments for skin, gastrointestinal, and respiratory conditions [23]. Current studies demonstrates its rich phytochemical profile and promise in medicines, cosmetics and nutraceutical, proving these claims [17]. Additionally the tree is essential to rural life since it provides local communities with food, medicine, and revenue. Only a small number of thorough evaluations covering the medicinal applications of *Cordia dichotoma* have been assembled so far. Therefore, the goals of this review are to give a summary of the most recent findings about the ethnopharmacological aspects, phytoconstituents and pharmaceutical applications of plants *C. dichotoma* [24].

2. METHODOLOGY

Search strategies: The primary objectives of the study is to do information gathering from prior publications pertaining to keywords including "*Cordia dichotoma*," "pharmacological activities," "phytochemical constituents," "traditional Chinese medicine," "utilization of *C. dichotoma*." and related terms. Duplicate articles were removed prior to screening. The titles and abstracts were screened for relevancy. Further full text articles were assessed for appropriateness and eligibility. These data obtained through various databases (Google Scholar, Scopus, Web of Science and PubMed). Therefore, ethical committee approval is not required. We collected, finalized, and applied 58 publications from 2004 to 2026 for our review (Fig. 1).

Fig. 1: Search result from different sources (Pubmed, Google scholar, Scopus and Web of Science)



Source: Page MJ, et al. BMJ 2021;372:n71. doi: 10.1136/bmj.n71.

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3. SYSTEMATIC DESCRIPTION

3.1 Taxonomic Identification

- Taxonomically *Cordia dichotoma* plant belongs to *Plantae* kingdom. It belongs to *Streptophyta* phylum of *Equisetopsida* class of *Magnoliidae* subclass. It belongs to *Boraginales* order. It is a member of *Boraginaceae* family of *Cordia* genus and *dichotoma* species [6].

3.2 Vernacular Names

- *C. dichotoma* is referred to by a variety of vernacular names in different languages. Here are few examples. Sanskrit's Bahuvarah; Hindi's Lasora; Assamese's Goborhut, bahubara; Bengali's Bahubara, Boch; Marathi's Bhokar, Shelu; Gujarati's Vad gundo; Telugu's Bankanakkera, Chinna-Nakkeru, Botgiri; Tamil's Naruvili, Citam, Naruvali; Malayalam's Naruvari; Kannada's Challe, Haadige, Doddachallu, Kaaduchalle, Mannadike, Kendal; Nepalese's Lasura; Punjabi's Lasuda, English's Sebesten, Glue Berry, Pink Pearl Tree, Bird Lime Tree, Fragrant Manjack, Snotty Gobbles, Indian Cherry [25].

3.3 Area and Habitat

- There are between 228 and 300 plant species of the world that belong to the genus *Cordia*. Trees and shrubs in this genus are mostly grow in humid to warm temperature climates. In India, *C. dichotoma* is grown in a variety of geographical

areas. *Cordia dichotoma* is grown across countries like Taiwan, China, Malaysia, Australia, and Polynesia [26].

- The deciduous tree has a spreading canopy and a slender trunk. Its simple, somewhat dentate leaves vary in shape from wide oval to elliptic-lanceolate. Bark might have longitudinal furrows or be smooth. Budding leaves and immature fruits are frequently eaten as vegetables [27]. Additionally, raw fruits are pickled. It normally found as a wild tree. It is also grown on the road sides or along the fields however it is less often cultivated for commercial benefit. It also thrives in the wet monsoon forest of Maharashtra. Because of its extreme adaptability, *Cordia dichotoma* thrives in temperatures between 20°C and 35°C. It thrives on sandy, loamy, or somewhat saline soils and can withstand drought[4], [13], [28]].
- It is appropriate for regeneration and desertification mitigation initiatives because of its ability to endure in arid environments [29].

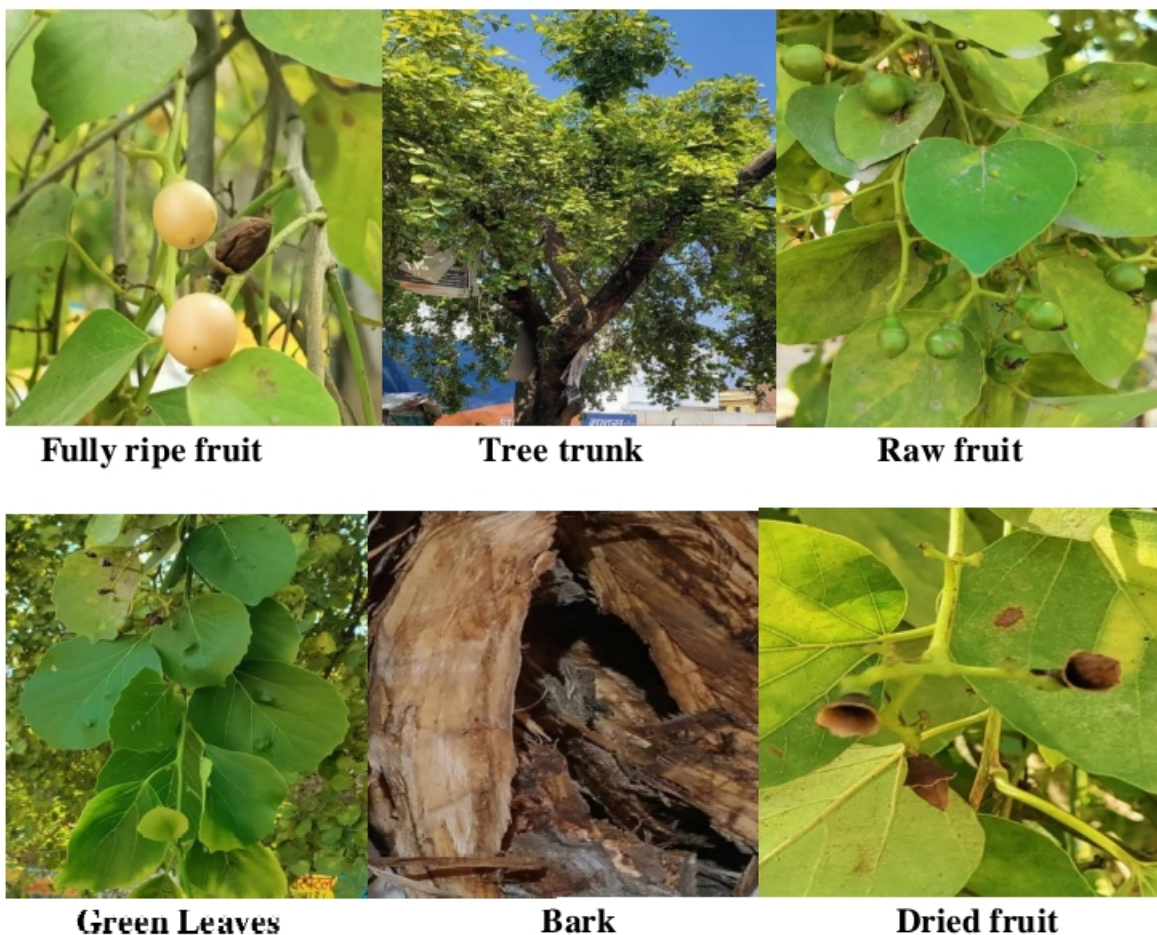
3.4 Cultivation

- The fruit size, yield, and phytochemical composition of the tree show notable regional variation. While varieties from more fertile places have improved nutritional quality, those from drier regions typically have a larger mucilage content. These variations highlight the necessity of regional research to determine the best cultivars for particular uses. It thrives on sandy, loamy, or somewhat saline soils and can withstand drought [30]. The tree is suited for regeneration and desertification mitigation initiatives because, despite its preference for moderate rainfall, its deep-root structure allows it to thrive in arid environments. When the fruits ripen between March and June, they are manually harvested. A mature tree can produce between 10 and 20 kilogram of fruit a year, depending on the environment and soil quality [31]. Because of the fruit's high moisture content, post-harvest management is essential as it's susceptible to microbial deterioration. To maintain quality and increase shelf life, cold storage and quick processing are required [32].

3.5 Morphology and Organoleptic Characteristics

- *Cordia dichotoma* are shrub to moderately large trees have small branches and , a short, curled trunk, and a short bole. The bark of this plant has longitudinal wrinkles or is smooth and grayish brown. It has simple leaves that are dentate. The flowers are short-stalked, ambisexual, white emerging as loose corymbose cymes. They are followed by 1 inch 25 mm lengthy, faded, pink fruits which feels gummy while eating [13]. The fruit is oval or spherical stone fruit with a yellowish or yellow with a hint of pink shining that is placed on an expanded calyx which appears like a saucer. Once the fruit is ripened, the pulp becomes gummy and turn out to be black. The gritty stone is seeded 1-4. Dry, small, greyish brown pieces of bark looks rough on outer surface with longitudinal and transverse cracks and fissures; short, light brown, fibrous interior surface with fibrous fractures [33].
- The stem bark's transverse section reveals a broad area of rhytidoma made up of tangential bands of cork tissues that alternate with dead elements of phloem secondary. Phellem or cork cells are square to rectangular, thin-walled, few-layered cells in breadth. Phellogen remains unclear. Phelloderm is parenchymatous and multilayered. A collection of phloem fibers that alternate with the ceratenchyma bands in tangential bands [34]. The images of parts of the tree mentioned in **Fig.2**

Fig. 2: The images of different parts of *Cordia dichotoma* G.Frost. tree (Images are captured from real *Cordia dichotoma* plant)



4. PHYTOCHEMICAL CONSTITUENTS

- Several preliminary phytochemical tests have shown a numerous phytochemicals presence in *C.dichotoma*, including pyrrolizidine alkaloid, coumarin, fats and gums, glycosides, proteins, glycosides [35].
- **Leaves & twigs:** The leaves of *C. dichotoma* G. Frost. Have ample amount of flavonoids and polyphenol compounds. Flavonoids reported in the leaves of *C. dichotoma* are apigenin, rutin, quercetin, quercitrin, luteolin. Phenol compounds found in leaves of this plant are methyl rosmarinate and rosmarinic acid [25]. Phytochemical investigations of the leaves have identified the presence of amino acids, pyrrolizidine alkaloids, β sitosterol, α -amyrin. However β amyrin and saponins have also evaluated in *C. dichotoma* leaves [[21], [30]].
- **Bark:** The bark of *C. dichotoma* have reported phytosterol like β sitostreol and allantoin which is a naturally occurring nitrogenous heterocyclic compound. Bark of *C. dichotoma* G. Frost. have characterized a significant amount of flavonoids which include 3',5-dihydroxy-4'-methoxyflavanone-7-O- α -L-rhamnopyranoside and apigenin [27].
- **Fruit:** The Fruits of *C. dichotoma* G. Frost. have abundant amount of flavonoids. These flavonoids are kaempferol, quercetin, and isorhamnetin. The fruits have also characterized the presence of aminoglucan. These aminoglycan are made up of levo-arabinose and dextro-glucose [19].
- **Seeds:** A variety of fatty acids, including as palmitic, stearic, arachidic, behenic, oleic, and linoleic acids, are present in *C dichotoma* seeds. They also contain bioactive components such betulin, octacosanol, β -sitosterol, hentriacontanol, hentriacontane and α -amyrins. Caffeic acid and chlorogenic acid are two phenolic derivatives that were evaluated in the seeds. Additionally seed extract reported presence of four flavonoid glycoside like robinin, rutoside, datiscoside, and hesperidin [[4], [16]].

Phytochemical composition in *C. dichotoma*

Plant Parts	Phytochemical Compounds	References
Leaves & twigs	Flavonoids- apigenin, rutin, quercetin, quercitrin, luteolin	Prajapati and Kar et al., 2017
	Phenols- methyl rosmarinate and rosmarinic acid	
	Amino acids, pyrrolizidine alkaloids, β sitosterol, α -amyrin, β amyryl and saponins	Hussain and Kakoti et al. 2020 Ganjare and Anjali et al., 2019
Bark	Phytosterol- β sitostreol and allantoin	Nariya and Bhalodia et al., 2011
	Flavonoids- 3',5-dihydroxy-4'-methoxyflavanone-7-O- α -L-rhamnopyranoside, apigenin	
Fruit	Flavonoids- kaempferol, quercetin, and isorhamnetin	Patel and Lambole et al., 2019
	Aminoglycan	
Seeds	Fatty acids- palmitic, stearic, arachidic, behenic, oleic, and linoleic acids	Jamkhande and Barde et al., 2013 Abdel Monem, 2023
	Phenolic derivatives- Caffeic acid and chlorogenic acid	
	Flavonoid glycoside- robinin, rutoside, datiscoside, and hesperidin	
	Betulin, octacosanol, β -sitosterol, hentriacontanol, hentriacontane and α -amyryns	

5. PHARMACOLOGICAL ACTIVITIES

- Since ancient times, various pharmacological characteristics have been documented in *C. dichotoma* [6].

Pharmacological potential of major phytochemicals of *Cordia dichotoma*

Number	Class	Phytochemicals	Pharmacological effect	Reference
1	Flavanoid	Apigenin	Anti-inflammatory, Anti-ulcerogenic activity	[36], [56]
		Rutin	Antioxidant, anti inflammatory, Antiulcer activity	[6], [23]
		Quercetin	Anticancer, Anti-inflammatory, antioxidant and Antiulcer activity	[4], [6], [23], [36]
		Quercitrin	Anticancer, Anti-inflammatory, antioxidant and Antiulcer activity	[6], [23], [36]
		Luteolin	Anti-ulcerogenic, Antioxidant and antiinflammatory, Anti-fertility activity	[6], [21], [36], [39]
		Isorhamnetin	anti-atherosclerotic and antihypertensive activity	[42], [58]
		Kaempferol	Anticancer, Anti-inflammatory, hepatoprotective, antioxidant and Anti-ulcer activity	[4], [36], [41]
2	Flavanoid glycoside	3',5-dihydroxy-4'-methoxyflavanone-7-O- α -L-rhamnopyranoside	Anticancer, Anti-inflammatory, hepatoprotective, antioxidant and Anti-ulcer activity	[4], [36], [41]
		Robinin	Antioxidant, anti-inflammatory, and antimicrobial properties	[37], [43]
		Hesperidin	Hepatoprotective and antioxidant activity	[4], [6]
		Datiscoside	Antidiabetic and lipid-lowering activity	[6]
		Rutoside	anti-inflammatory, analgesic, hepatoprotective, antiviral, antiulcer, anthelmintic, antioxidant, and wound-healing activity	[4], [6]
3	Triterpene	Betulin	Anti-inflammatory, Antioxidant, and Anti-diabetic activity	[4], [25]
		β -amyryl	Anti-inflammatory and Antioxidant	[4]
		α -amyryns	Anti-inflammatory activity	[4]
4	Fatty alcohol	Octacosanol	Anthelmintic activity	[4]
5	Alkane hydrocarbon	Hentriacontane	Anti-inflammatory activity	[25]
6	Phytosterol	β -sitosterol	Anti-hypercholesterolemia, Anti-inflammatory and hepatoprotective activity	[4], [20]
		Allantoin	Wound Healing and Antiinflammatory	[4], [6]
7	Phenol	Methyl rosmarinate	Antioxidant, Anti-inflammatory, and Antimicrobial activity	[4]
		Rosmarinic acid	antioxidant, anti-inflammatory, and antimicrobial agent	[22]

Number	Class	Phytochemicals	Pharmacological effect	Reference
8	Phenolic acid	Caffeic acid	Anticancer, Anti-inflammatory, Antioxidant and Anti-ulcer activity	[6], [9]
		Chlorogenic acid	Antioxidant, Anti-inflammatory, and hepatoprotective activity	[23]

5.1 Antiulcer Activity

- The antiulcer activity evaluated on ethanolic fruit extract of *C. dichotoma* by using animal models like Pyloric ligation, aspirin induced, and indomethacin-induced rat model. The extract fractionated with different solvents like petroleum ether, ether, ethyl acetate, butyl alcohol, and butanone. Wistar rats were exposed to a dose of 300 mg/kg body weight. The findings show that, in comparison to the control, extracts of ethyl acetate, butane, and butanone have significantly lower the amount of gastric acid secretions, free acidity, total acidity, and ulcer index score. The study's findings suggest that fruit extracts of *C. dichotoma* G.Frost. have strong antiulcer efficacy [36].

5.2 Antimicrobial Activity

- Numerous phytochemical agents from *C. dichotoma* have been shown in experiments to have antimicrobial effects against various microbes. A variety of bacterium like *Escherichia coli* bacterium, *Pseudomonas aeruginosa* strain, *Streptococcus pyogenes* strain, and *Streptococcus aureus* bacterial strain were tested against bark extracts of *C. dichotoma*. Moreover fungal strain like *Aspergillus niger* fungal strain, *Candida albicans* strain and *Aspergillus clavatus* fungal strains were evaluated against *C. dichotoma* bark extracts. Significant antimicrobial properties towards all microorganism were discovered in the plant extract [37].
- Silver nanoparticles (AgNPs) of leaf extract from *C. dichotoma* were investigated to find possible involvement in photocatalytic degradation of azo dyes including Congo red and methylene blue as well as antibacterial properties. The findings demonstrated that AgNPs have strong antibacterial and high catalytic activity when exposed to sunshine. These had the ability to break down dyes like Congo red and methylene blue [38].

5.3 Ethnocontraceptive Activity

- Herbs have historically been the primary choice for controlling fertility because they include a variety of phytoconstituents which are likely to have contraceptive properties. The phytoconstituents coumarin, flavonoid, and sitosterol have a strong antifertility effect since they have been linked to some negative effects on the reproductive system. The active components of this plant include flavonoids including quercetin, apigenin, luteolin, and β -sitosterol, which may have antifertility effects in female rats [10].
- The ethnocontraceptive effect of leaf extract of *C. dichotoma* (LCD) in after coitus feminine rats was assessed in light of the safety/hazard ratio of steroidal contraceptive agent. At 800 mg/kg dose administration, the leaf extract demonstrated 100% antiimplantation efficacy. The LCD-BCD complex was created using (2-hydroxypropyl)- β -cyclodextrin (BCD) as a bioavailability improving agent. At 250 mg/kg dose, the LCD-BCD complex demonstrated 100% pregnancy prohibition. Two contraceptive phytoconstituents, luteolin and apigenin, were extracted from the LCD extract using a proven HPTLC technique. Following withdrawal, the reversible contraceptive potential was identified by histological and biochemical assessments. Strong contraceptive ability was demonstrated by leaf extract of *C. dichotoma* herbal formulation [39].
- The methanolic bark extract of *C. dichotoma* have shown a strong anti-implantation activity. Extract pretreated group with a dose of 100 mg/kg of body weight has considerably lower the count of implant sites. The anti-implantation action seen with current trial with BCD can be primarily connected to its suppression in the number of implants because there

was no alteration in the process of ovulation. The ethnocontraceptive effect of BCD might have caused by chemical components like flavonoids, glycosides, and saponins. According to the current experimental results, BCD has anti-implantation activity, which is what causes its contraceptive activity [40].

5.4 Hepatoprotective Activity

- Liver problems can be treated with a limited number of medications. Therefore, many herbal drugs have been investigated to evaluate the liver protective activity by using various preclinical methods. Male Wistar rats were used to investigate the liver protective effects of a methanolic extract of *C. dichotoma* leaves. The two doses of 300 mg/kg and 500 mg/kg were administered to test the efficacy. Carbon tetrachloride (CCl₄) were used to causes liver damage. In this investigation silymarin was given as standard medication. The findings demonstrated that the liver protective activity of *C. dicotoma* leaf extract was as efficacious as that of silymarin [40].

5.5 Antineoplastic Activity

- The anticancer potential and programmed cell death-mediated efficacy of the methanolic leaf extract of *C. dichotoma* (MECD) in a culture the human cervical carcinoma cell line (HeLa) were pharmacologically evaluated using the MTT colorimetric assay and DAPI fluorescent staining test. As comparison to normal tamoxifen, which had an IC₅₀ of 48 μ g/mL, the results demonstrated that MECD test group had an IC₅₀ of 202 μ g/mL, suppressed HeLa cells under in vitro proliferation and programmed cell death-mediated mechanism, demonstrating its reliable antineoplastic ability. Therefore, *C. dichotoma* leaf methanolic extract may be an effective chemotherapeutic treat cancer in humans [41].

5.6 Antihyperlipidemic Activity

- The antihyperlipidemic investigation were performed on albino species of male rats. Hyperlipidemia was induced by high fat fed diet (HFD). Animals were fed HFD over a period of ten weeks in this study. Animals were assigned to three groups: the HFD normal control which was fed only HFD, HFD-CDP10% and HFD-CDP20% groups, which were fed HFD with 10% and 20% of *C. dichotoma* pulp (CDP), respectively. In comparison to ND-control, NDCDP20% considerably reduced the risk ratio in normal rats by roughly 57.9%. Two doses of CDP supplementation improved the hepatic and renal functions in hyperlipidemic rats. However pathological results showed that raising CDP to 20% reduced fatty alterations in rats' livers. The study's findings indicated that CDP has a potent hypolipidemic effect and that more research is necessary to assess the nutritional value of various extracts and identify their active ingredients [42].

5.7 Antioxidant Activity

- The literature has numerous in vitro and in vivo evaluation studies of *C. dichotoma*'s antioxidant activities. A phytochemical with strong antioxidant activity, quercetin from *C. dichotoma* demonstrated to optimize blood pressure levels [43].
- Nariya et al (2013)* assessed the phenolic content and free radical scavenging activity in methanolic and butanolic bark extract of *C. dichotoma*. Three in vitro models were employed in the current investigation to assess antioxidant activity. One of the method assessed the reducing power, whereas other two used direct measurement of antioxidant activity. When compared to normal l-ascorbic acid, *C. dichotoma* demonstrated substantial antioxidant activity by

lowering power activities and blocking DPPH activity. Furthermore, it was shown that both extracts had a discernible quantity of total phenols, which are essential for regulating oxidation [44].

- The study conducted by *Shuge et al (2014)* ascertained the phytoconstituents and antioxidant potential of *C. dichotoma* seed. The experimental findings showed that the seeds of *C. dichotoma* contain enough amount of amino acids and polyphenol compounds that can be utilized for its antioxidant potential [45].

5.8 Antidiabetic Activity

- Plant species have been utilized to heal a variety of illnesses since ancient times. The medical system still faces difficulties in managing diabetes with drugs that have no negative side effects. These factors have led to an increase in interest in herbal medicines [46].
- In this study the antidiabetic effect was tested on wistar rats. Alloxan was used to induce hyperglycemia in animals. The extract was administered in 250, 500 and 1000 mg/kg. After the time period of 4 hour, 8 hour and 24 hours of dose administration, effect was evaluated. The *C. dichotoma* 500 and 1000 mg/kg extracts have shown a significant level of reduction in blood sugar levels and shown to have satisfactory antihyperglycemic effect [47].

5.9 Analgesic, Anti-inflammatory & Antipyretic Activity

- *Shahpurkar et al. (2011)* used a natural polymer derived from *C. dichotoma* fruit gum to create transdermal films. The films' anti-inflammatory properties were evaluated using carrageenan induced raw paw oedema model. Diclofenac sodium, a common medication, was used to compare the outcomes. The percentage of oedema reduction was found to be maximum in rats administered with 0.20% (w/v) glycerin, specifying significant anti-inflammatory activity [48].
- The analgesic, anti-inflammatory, and antipyretic properties of methanolic extract *C. dichotoma* were assessed by *Gupta et al. (2015)* The SD female rats were given dichotoma leaf extract. When compared to a normal medication, 400 mg/kg dose of methanol leaf extract *C. dichotoma* found to be more significant. As a result, findings from numerous published studies validate and support the conventional application of *C. dichotoma* extract for the treatment of fever, inflammatory and painful related illness [49].

5.10 Wound Healing Activity

- Because plant based medications are safer and more tolerated than allopathic ones, their use is growing daily. Many plants have been investigated for their traditional application in wound care. Diverse research groups have documented diverse pharmacological activities of *C. dichotoma* throughout the last 20 years. However, just a few researchers have examined this plant's ability to cure wounds [[9], [50], [51]].
- The fruit extract was fractionated by solvent like petroleum ether, solvent ether, ethyl acetate, butanol, and butanone. The incision, excision, and dead space wound models applied for evaluation of these fractions for their wound healing effect in albino wistar rats. Flavonoids found in *C. dichotoma* fruits may be responsible of all the fractions substantial wound healing activity [52].

5.11 Antidepressant Activity

- Aqueous, ethanol, and chloroform extract (referred to as CdAe, CdEe, and CdCe respectively) were made from *Cordia dichotoma* leaves. The study used behavioral models in experimental animals to examine the antidepressant effects of these compounds. As part of the assessment procedure, locomotor activity was also measured. After administration of 200 and 400 mg/kg doses, the CdEe *Cordia dichotoma* was found to reduce mobility time in rat forced swim test (rFST) and modified tail suspension test (mTST). In the repeated

rFST, CdAe reduced immobility duration at 400 mg/kg; in the mTST, substantial effects were seen at 200 and 400 mg/kg. Only at 200 mg/kg dosage of the chloroform extract significantly shortened the immobility period in the mTST. Notably, at the same dosage level, the *Cordia dichotoma* chloroform extract (CdCe) did cause a considerable reduction in locomotor activity. When combined, these results imply that leaf extracts from *Cordia dichotoma* may have antidepressant activity [53].

6. TRADITIONAL USAGE

- Medicinal plants have been essential to human health since ancient times, serving as the basis of traditional medical systems all over the world and a significant source of therapeutic compounds [54]. These plants have been utilized to cure common ailments, infections, and even life-threatening problems since they are often packed with wonderful bioactive compounds. They are becoming a crucial part of traditional healthcare systems worldwide as a result [55].

6.1 Decoction in Infection

- The quantity 50 ml to 100 ml of bark decoction is frequently used to cure various infections by tribal population [6].

6.2 Animal Fodder

- The leaves of *C. dichotoma* were utilized as nutritious cattle fodder [23].

6.3 Natural Glue

- Traditionally, the fruit's sticky white substance has been utilized as natural glue [56].

6.4 Vegetable & Pickles

- They are cooked with other vegetables or used as a vegetable (commonly referred to as Gunda ki Sabzi). The young green fruits are mostly used to make pickles, a delicacy in Rajasthan and Northern India that are acidic and spicy [57].

6.5 Buccal Health

- Bark decoction were utilized as a gargle to treat pharyngitis and inflammation in mouth, and powdered bark is applied directly on mouth ulcers [58].

7. CONCLUSION AND FUTURE PERSPECTIVE

- The review highlights the high potential applications of this under utilized *C. dichotoma* plant as a novel therapeutic beneficial for a variety of TCM formulations. The phytochemical substances and pharmacology of *C. dichotoma* have been the subject of extensive scientific research from decades. Nevertheless, this knowledge has not been explored holistically, which is crucial to comprehending this plant's therapeutic potential. The medicinal potential of leaves, bark, fruits, and seeds can be utilized in a variety of extracts to create different pharmaceutical dosage forms.
- Numerous substances with distinct biological activities, including flavonoids, β -Sitosterol, allantoin extracted from *C. dichotoma*. The herbal Abnormal Savda Munziq has already well proven for its effectiveness in TCM for the treatment of hyperglycemia, cardiovascular disorders, cancer and respiratory conditions like asthma. There have been various scientific studies in which *C. dichotoma* has proved its pharmacological efficacy for antipyretic, antiulcer, hepatoprotective, anticancer, antioxidant, antihyperlipidemic, antidepressant, antidiabetic, and antifertility properties. Experimental research has demonstrated the intrinsic anti-inflammatory and anticancer properties of several Traditional Chinese Medicine (TCM) substances, including flavonoids, phenols, and phytosterol found in *C. dichotoma*. It appears worthwhile to investigate this plant further because of the long history of sino traditional utilization *C. dichotoma* as well as current understanding its phytochemical components potential and biological activities.

- The identification and characterization of bioactive chemicals from *Cordia dichotoma* for new pharmacological activity should be the main focus of future study. This knowledge may be applied to further research on *C. dichotoma* in Chinese traditional medicine systems. The plant's metabolic processes could be further clarified by genomic research.

8. STUDY LIMITATIONS

- There are still few clinical investigations available, therefore it needs more investigation into long-term safety profiles and ideal dosage. In addition to provide pharmacological credibility to contemporary research and formulation development in the approaching future studies, this long historical safe use among people supports the foundation of ongoing therapeutic inquiry about this plant.

Abbreviations

- *C. dichotoma* (*Cordia dichotoma*), Traditional Chinese Medicine (TCM), Silver nanoparticles (AgNPs), Leaf extract of *Cordia dichotoma* (LCD), β -cyclodextrin (BCD), Carbon tetrachloride (CCl₄), Methanolic leaf extract of *C. dichotoma* (MECD), High Fat Diet (HFD), *C. dichotoma* pulp (CDP), *Cordia dichotoma* chloroform extract (CdCe), rat Forced Swim Test (rFST), modified Tail Suspension Test (mTST)

Data Availability

- No data were generated in this article.

Ethics Statements

- This is a review article and not applicable.

CRediT authorship contribution statement

- Alok Kumar Srivastava: Writing – original draft, Methodology, Investigation, review & editing, Formal analysis. Dr. Siraj Anwar: Supervision, Resources, Conceptualization.

Conflict of Interest Statement

- All authors read the manuscript and we declare no conflict of interest.

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- Graphical abstract schematic diagrams were created in <https://BioRender.com>

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