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Review

Cordia Dichotoma (Bhokar): Phytochemical and Pharmacological Interpretation- A Review

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ABSTRACT:
Cordia dichotoma, an Indian cherry, is well-known for its ability to treat a wide range of illnesses, most notably hepatocellular problems. The aim of this study is to validate the scientific value of C. dichotoma's and strengthening the traditional knowledge, specifically, we will focus on phytochemical and pharmacological studies along with hepatocurative assessments. The literature search was done by us scientific databases such as PubMed, Google Scholar, Embase and Elseviers.
The main chemical constituent's structures of secondary metabolites, including flavonoids, tannins, alkaloids, proteins, carbohydrates, and phenolic compounds were represented using the Chem-Draw chemical structure editor software. The most notable phytoconstituents found in C. dichotoma are flavonoids and phenolic compounds, which are well-known for their numerous pharmacological and therapeutic efficaciousness against a variety of chronic diseases in addition to their remarkable potential as antioxidants. Overall, the research covered in this review suggests that the plant and its extracts offer important medicinal advantages for a number of different disorders, including hepatic.

KEYWORDS: Cordia Dichotoma, Indian cherry, antioxidants, chronic diseases, flavonoids and phenolic compounds.

INTRODUCTION:

The Himalayas and other high regions are a rich source of amazing medicinal plants that have been used for decades in conventional medical systems and practices around the globe. The scientific community became interested in the medicinal plants that were found in large quantities in the various Himalayan regions of India [10], [12]. Due to poverty and a lack of access to sophisticated medications, the World Health Organization (WHO) estimated that 80% of the world's population receives primary care from conventional doctors [13]. Conventional knowledge has been documented and has produced many modern, successful medications [14, 15]. Numerous plants are good for your health, both for self-medication and for use by the government. India has a wealth of naturally occurring plant medicines with potential uses in medicine [26].

Traditional medicinal herbs are an important source of medicine in India and are used for the prognosis, stimulation, and treatment of a wide range of ailments [27]. Throughout history, medicinal plants have been used to produce important plant products that are used as medical aids to cure a wide range of illnesses and disorders worldwide [13], there is a wealth of historical documentation regarding the application of traditional medicine made from plant products in addition to a range of alternative therapies [29]. Thousands of species of medicinal plants have been used by traditional healers worldwide to cure a wide range of illnesses, including a variety of liver diseases that our forefathers treated [1].

The administration of a variety of chronic disorders is greatly influenced by medicinal herbs, despite notable advancements in allopathic medical procedures [1], [3], [2]. India's traditional medical system makes extensive use of medicinal plant-based remedies for various illnesses, including hepatotoxicity prevention, which are generally safe to use over an extended period of time [4].

The majority of medicinal plants have been found in India's Himalayan regions. Of these, Himachal Pradesh is the most botanically diverse, with 1500 known species of aromatic and medicinal plants. The region spans 30°22'44–33°12'44N latitude and 75°45'44–79°04'20E latitude [9], [25],[20]. Many medicinal plants are used by people in Himachal Pradesh's rural and tribal areas to treat a variety of illnesses, including liver problems. Alkaloids, flavonoids, steroids, terpenoids, polysaccharides, and a variety of phenolic compounds are among the chemical constituents found in medicinal plants that help explain their therapeutic benefits. Additionally, these phytochemicals are crucial to the morphogenesis of plants.

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Aiming to make medicinal plants a possible source of medication for the management and prophylaxis of a variety of psychological diseases, the therapeutic effects of phytoconstituents demonstrate their approach to ethnopharmacological knowledge and new drug development. [4], [8]. The natural plant-based antioxidants found in phytoconstituents may be the reason for their effectiveness; these compounds are thought to play a major and long-lasting role in maintaining human health. Rich antioxidant medicinal plants are thought to be an important tool in reducing the consequences of oxidative stress, including diabetic, inflammatory, hepatic, cancer, and neurological illnesses [5], [6], [7]. Oxidative stress is a potent oxidizing and damaging sequence of events that results in the production of oxygen species, which in turn stimulates lipid peroxidation and gives rise to many diseases

Mostly found in temperate regions of the world, including South America, Ghana, Central America, West Africa, Southern China, East Africa, Nigeria, Australia, Philippines, Pakistan, Mexico, and widely dispersed in Sri Lanka and India, the genus Cordia is part of the family Boraginaceae. It has 300 species [29], [11], [15], [16], [17], [18]. One of the long-used traditional medicinal herbs is C. dichotoma, also referred to as Indian cheerful [24]. In the sub-Himalayan tract, C. dichotoma can reach elevations of up to 1500 meters above sea level. [27]

The medicinal properties of C. dichotoma are well-known for their ability to treat a wide range of pathogenic diseases, such as dyspepsia, fever, ulcer, bronchitis, leprosy, arthralgia, burning sensation, and diarrhoea[16],[36]. They also have antidiabetic, anthelmintic, diuretic, analgesic, antiviral, antiulcer, gastroprotective, and hepatoprotective qualities. It is a crucial herb in traditional medicine and Ayurveda, with a range of therapeutic benefits [33]. Historically, this plant's stem, bark, fruit, roots, leaves, flowers, and frequently the entire plant have all been used to treat a range of illnesses. Similar to how fruit mucilage is used to treat coughs and conditions relating to the chest. The plant's kernel is used to cure tinea in combination with oil, in the form of powder.

Phytochemistry or phytochemical profile of C. dichotoma:

The chemical compounds of the genus Cordia have been extensively studied and 290 compounds from various chemical classes are identified from several species [29]. Many investigations have already shown that C. dichotoma comprises a huge spectrum of bioactive compounds, and preliminary phytochemical screening has revealed the existence of several phytoconstituents inside the C. dichotoma including alkaloids, glycosides, proteins, amino acids, carbohydrates, triterpenoids, tannins, flavonoids, saponins, phenols, and steroids, arabinoglucan, pyrrolizidine alkaloid, coumarin, fats and gums, fatty acids and sugars (D-glucose and L-arabinose), arabinoglucan, pyrrolizidine alkaloid, coumarin, fats and gums [19],[46].

Characteristics:

Characteristics	Cordia sinensis	Cordia dichotoma
Hight	5.8m Hight	5 to10 m hight
Bark	Brown in Colour	White in colour
Leaves	Simple	Simple
Flower	White in Colour	White in colour
Inflorance	Axillary cymes	Cymose
Fruit	Raddish brown, pulpy, edible, single seeded.	Fruit yellow or pink, edible, single seeded.

Bark:

Bark of C. dichotoma also shows the abundance of flavonoid compounds which includes allantoin, β-sitostreol and 3′5-dihydroxy-4′methoxyflavanone-7-O-alpha-L-rhamnopyranoside and apigenin [11], [15], [21], [46].

Leaves and twigs:

Flavonoid and polyphenolic compounds are abundantly detected in the leaves of C. dichotoma. Flavonoids such as apigenin, rutin, quercetin, quercitrin, (quercetin-3-O-rutinoside, quercetin-3-O-2G-rhamnosylrutinoside), isorhamnetin-3-O-rutinoside, kaempferol-3-O-robinoside, kaempferol-3-O-rutinoside, kaempferol-3-O-2G-rhamnosylrutinoside, flavone (luteolin) and phenols such as methyl rosmarinate, rosmarinic acid are reported in leaves of C. dichotoma. Moreover, rosmarinic acid (0.0028 %) is the most significant phytoconstituent predominantly found in the leaves of C. dichotoma [46], [29]. In addition, β-sitosteryl-3β-glucopyranoside-6′-O-palmitate, chlorophyll a, octacosanol, pyrrolizidine alkaloids, saponins, terpenes (betulin), and sterols like β-sitosterol, α-amyrin, 4-hydroxy-transcinnamate ester triterpenoids (0.075%) and amino acids (1.39%) are also extracted from the leaves [34], [23], [36], [29], [37]. The phytoconstituents that were extracted from the twigs of C. dichotoma include1, 2-dilinoleoyl-3-linolenoylglycerol, β-sitosterol, and β-sitostreol-3-glycoside. [46]

Kernels:

The kernels of C. dichotoma are rich in fatty acids, including palmitic and behenic acid [6]. It also has a high concentration of tannic acid and other inorganic substances, such as protein (cysteine and methionine) [7].

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Fruits:

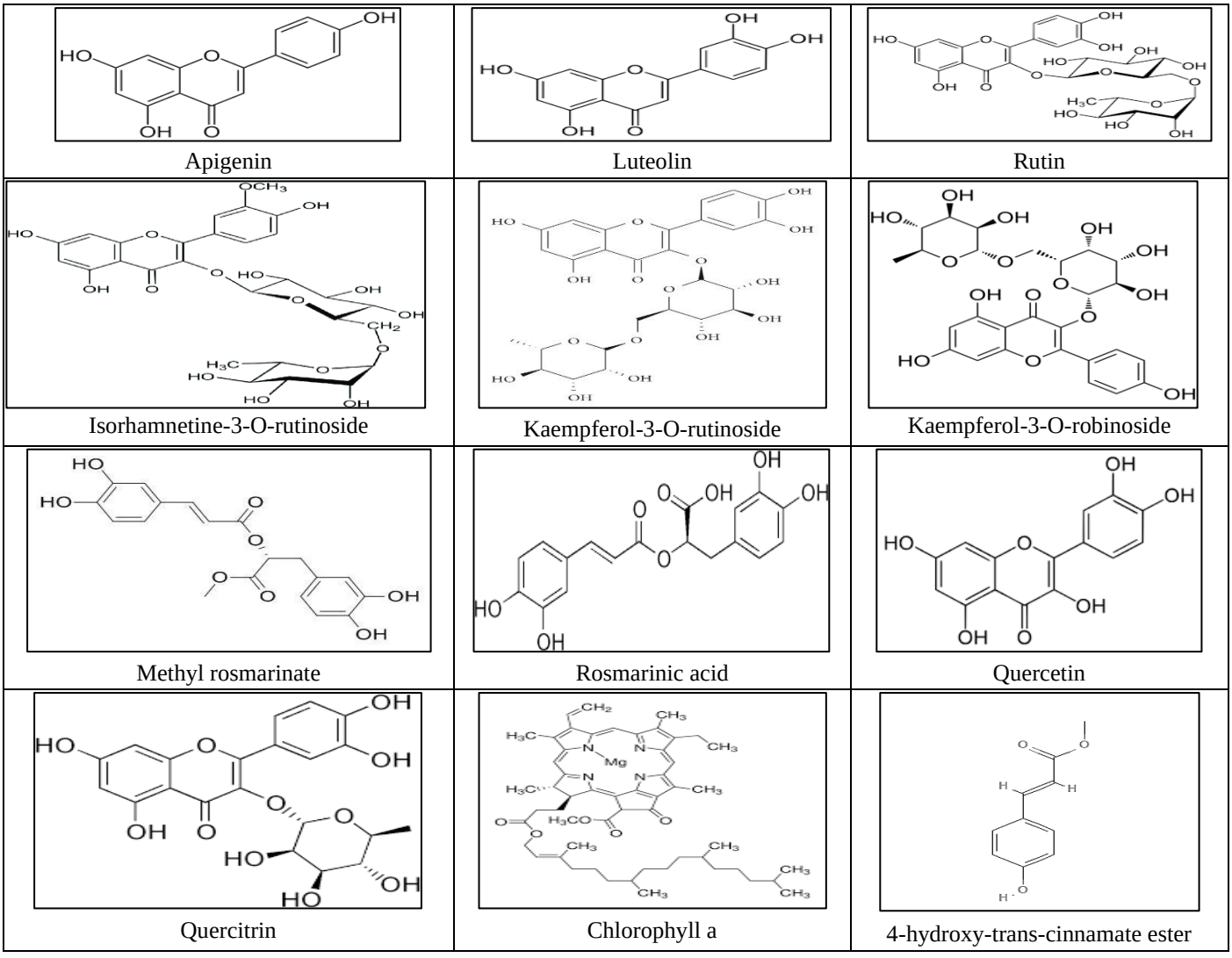
The fruit of C. dichotoma has the highest concentration of flavonoids, primarily flavonol (kaempferol, quercetin, and isorhamnetin). [46] Moreover, it has been discovered to produce aminoglucan, which is composed of L-arabinose and D-glucose (67.6%). Alpha and beta glucose (α- and β-glucose) as well as 1→2-linked L-arabinofuranosyl residues are among the other various substances it includes [46], [21], [11], [38], [15], [29], [39].

Seeds:

Flavonoids were found in abundance in C. dichotoma seeds, and certain fatty acids were also detected in trace levels. Plant seeds were found to contain flavonol subclasses such as β-sitosterol, β-sitosterol-3-glucoside, hentricontanol, hentriacontane, taxifolin (taxifolin-3-5-dirhamnoside), hesperitin (hesperitin-7-rhamnoside), α-amyrin, betulin, octacosanol, lupeol (lupeol-3-rhamnoside), flavonoid glycoside (rutoside, robinin, rutin, datiscoside) and flavonoid aglycone (dihydrorobinetin).[46] Furthermore, latifolicinin C, 4-hydroxybenzoic acid, p-hydroxyacetophenone, p-hydroxypropiophenone, [46] and p-hydroxybenzaldehyde. Furthermore, two of the most prevalent phenolic chemicals identified in C. dichotoma seeds are caffeic acid and chlorogenic acid [61]. Additional bioactive substances found in C. dichotoma seeds include α-amyrin (71.4 %) and taxifolin-3-5-dirhamnoside (67.8 %), as well as certain fatty acids such as arachidic, behenic, oleic and linoleic, palmitic, and stearic acid. [23], [24], [29], [38], [46].

The composition of the main secondary metabolites found in C. dichotoma's leaves, fruit, bark, kernel, and seeds as was previously indicated, these unique structures are produced utilizing diverse chemical structure-making tools and are drawn from multiple sources. Moreover, methanol, ethanol, petroleum ether, and chloroform extracts prepared from various sections of C. dichotoma show its important therapeutic activity. The strong chemical contained in C. dichotoma or other medicinal plants is also identified and quantified using a variety of techniques, such as soxhlet extractor, rotary shaker, and HPTLC. This review emphasizes the health benefits of C. dichotoma in addition to its range of phytoconstituents. This is because of the exceptional qualities of these phytoconstituents.

CHEMICAL STRUCTURES OF CONSTITUENTS:



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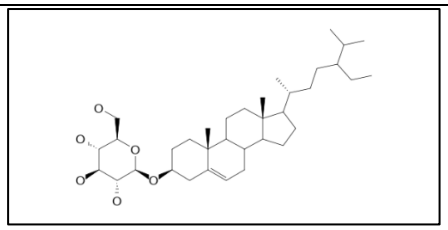
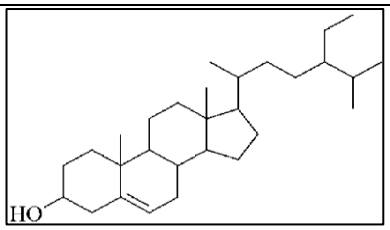
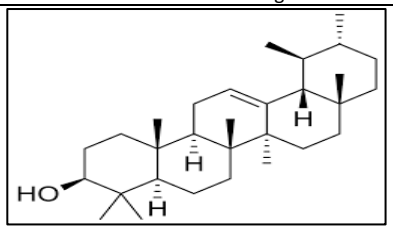


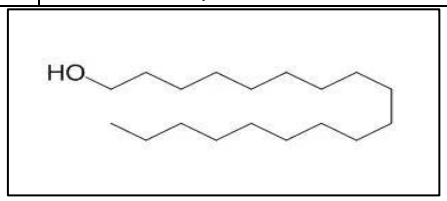
β- sitosterol-3-glycoside



β- sitosterol

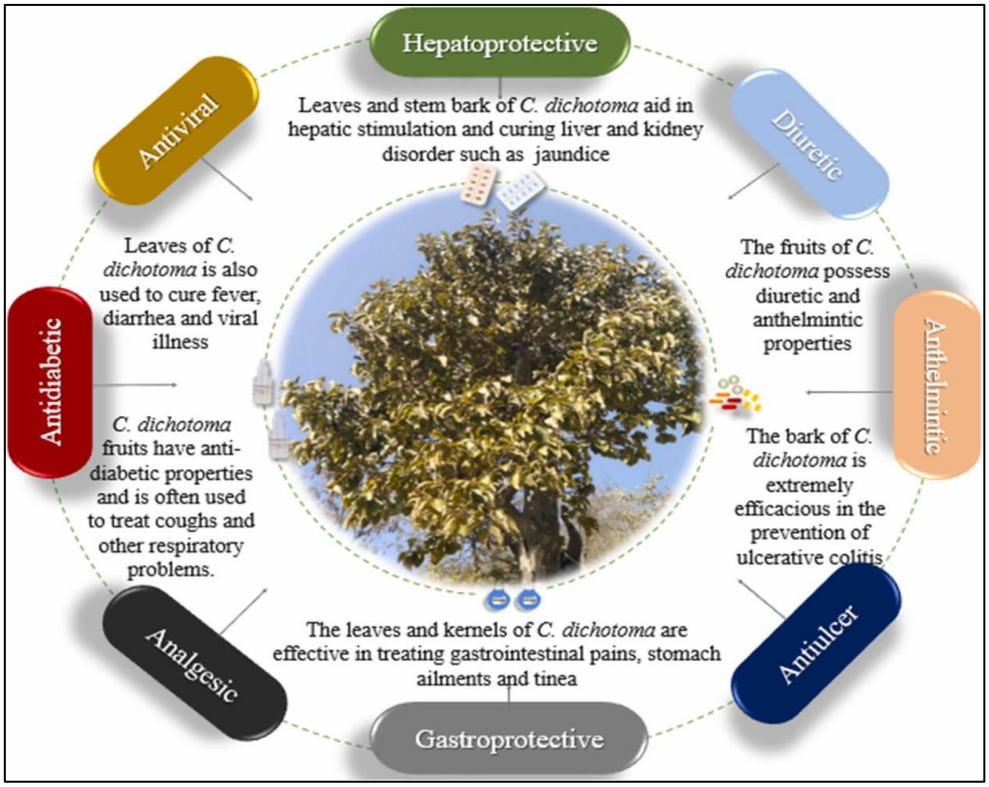


α- Amyrin



Octacosanol

MEDICINAL USES OF CORDIA DICHOTOMA:



Hepatoprotective:

Liver diseases can present with jaundice, hepatosis, acute or chronic hepatitis, and degenerative disorders leading to fibrosis of the liver. [46] Hepatic disease is a major cause of death worldwide and a major issue in emerging nations [42]. Recent studies have shown that hepatic diseases, including cirrhosis of the liver, hepatitis, fibrosis, alcoholic steatosis, and cancer (hepatocellular carcinoma), [46] affect 10% of the world's population [41]. Liver issues can be treated with just a few drugs. Thus, in several experimental animal models, a variety of traditional medicines derived from plants are being assessed for their antioxidant and hepatoprotective effects [46], [11].

A wide variety of medicinal plants and mixtures are employed in ayurvedic ethnomedicinal or other medical systems and are known to have significant hepatoprotective efficacy. [46] Hepatoprotective medications made from naturally occurring substances have drawn a lot more attention recently [2], [40], [46]. Medicinal plants that affect liver function are being researched and evaluated for their [46] potential to improve general health as traditional medicine approaches liver disease treatment in a more comprehensive manner [43].

In addition, ethnomedical documentation combined with screening of various plant biochemical components extreme persuasive ways to find new treatments against drug-resistant infections in the current era, especially for oxidative stress-related illnesses.

Antipyretic and Anti -inflammatory:

Oxidative stress is a major factor in the pathophysiology of many diseases. The biological matrix's free radical activity can lead to oxidative stress, which can develop out of control and throw off the body's antioxidant system and cellular metabolism. Oxidative stress generates a number of inflammatory processes that harm cellular components and thus result in inflammation [44]. The World Health Organization (WHO) lists inflammatory disorders as the main danger to public health and notes that they continue to be among the most prevalent medical conditions globally. Plants having the ability to reduce inflammation can be studied for new bioactive secondary metabolites or phytoconstituents that could be employed as safe, effective anti-inflammatory medicines [46], [44].

It revealed that the anti-inflammatory activity of C. dichotoma is due to the presence of phenolic phytoconstituents or plant flavonoids in the methanolic bark extract. The highest suppression of inflammation was seen after 4 h of the testing period in anti-inflammatory action. The percentage inhibition of paw oedoema at a lower test dose (250 mg/kg b.w.) was 29.7 %, while at a higher dose (500 mg/kg b.w.) the percentage inhibition was 48.6 %. In a carrageenan-induced paw oedoema model in rats, the MECD displayed anti-inflammatory action. The extract has an anti-inflammatory action that was dose dependent. When compared to the control group, MECD showed a significant ($p < 0.01$) reduction in paw oedoema and the conventional indomethacin group showed a sufficient level of anti-inflammatory action, with 56% suppression of paw oedoema at 5 mg/kg dose [46].

The anti-inflammatory properties of C. dichotoma (MECD) bark were discovered in a rat ema model using methanolic extract extraction [44]. Different C. dichotoma seed extracts (ethanol and aqueous) were assessed orally at doses of 250 mg and 500 mg. The dried powdered seeds contained alkaloids, glycosides, saponins, tannins, and carbohydrates [46]. The aqueous fraction and ethanol extract of this plant have been found to have an instant anti-inflammatory effect as a consequence of the screening methods employed. [19] When compared to the standard medication, the high dose of methanol extract (400 mg/kg) [46] in this study was found to be significant. The study's observations of the methanol extract of leaves [46] analgesic, anti-inflammatory, and antipyretic properties support their traditional use.

Anti-Ulcerative and Gastroprotective:

Anti-ulcerative and gastroprotective properties are exhibited by plant flavonoids such apigenin and quercetin. Numerous phytochemicals, including flavonoids, glycosides, and steroids, have been shown to have anti-ulcerative or gastroprotective properties by Hatware et al. [44]. However, by inducing a detrimental effect on ROS that produce oxidative stress, quercetin is primarily responsible for the inhibitory effect against stomach damage [46], [44]. Furthermore, there was a positive reduction in ulcerative colitis caused by acetic acid in the bark of C. dichotoma when apigenin was isolated from it. Because it is a rich source of apigenin [46] and has been used for generations, C. dichotoma bark is a useful supplemental and alternative treatment for ulcerative colitis. A gastric ulcerative condition is defined histologically as a disruption of the mucous membrane affecting the superficial or deeper muscular is mucosa of the stomach. The most common causes of stomach ulcers are either high pepsin activity or excessive stomach acid output. [44] Consequently, it has been demonstrated that MECD possesses anti-inflammatory properties against stomach ulcers caused by indomethacin. The study also shows that among its many other pharmacological activities, MECD has proven to have significant antioxidant and anti-inflammatory potential.

Quercetin and other bioflavonoids have been shown to have a gastroprotective effect in a rat model of indomethacin-induced stomach ulcers. [44] The gastroprotective effectiveness of several extracts from the ripe, fresh fruit of C. dichotoma was investigated by Darshan et al. in a rat model of stomach ulcers and pylorus ligation caused by aspirin. Alcoholic extract and water both exhibited antiulcer properties. When compared to regular ranitidine, water extract was found to be more effective than alcoholic extract in the case of aspirin-induced stomach ulcers and pylorus ligation [46], [43]. Furthermore, Wassel and colleagues discovered that the ethyl acetate, butane, and butanone extracts considerably ($p < 0.001$) lower the ulcer index, total acidity, free acidity, and gastric secretion volume in comparison to dose.

Comparably the bark of C. dichotoma has long been used to treat ulcerative colitis. An area of inflammatory bowel illness called ulcerative colitis (UC) (IBD). Colic and rectum colitis typically affects primarily the mucosa, or innermost lining, leaving a continuous area of inflammation and ulceration devoid of normal tissue sections. In the presence of chloride ions, myeloperoxidase (MPO) interacts with hydrogen peroxide to create hypochlorous acid, which is important for the inflammatory response in colitis. A different approach to regulating the inflammatory process associated with UC is provided by the methanol fraction of the crude methanol extract of C. dichotoma bark, which may prove useful as an adjunctive medication.

Anti-Oxidant:

Antioxidants neutralize and shield the body from a range of illnesses brought on by the generation of free radicals by acting as scavengers of free radicals. By preventing free radical damage, they offer defense against radical toxicity [19]. Due to their numerous pharmacological effects, which include antioxidant and anticancer properties, plant-derived flavonoids and terpenoids have drawn a lot of interest lately

[44]. Among the well-known properties of flavonoids, a class of polyphenolic molecule, are their ability to scavenge free radicals and inhibit both hydrolytic and oxidative enzymes. The presence of lignans, isocatechin, isoflavones, coumarins, flavones, flavonoids, anthocyanin, and catechin may be the cause of the antioxidant activity. [45], [44].Since terpenoids are composed of isoprene units, they are also referred to as isoprenoids. In the never-ending quest for novel bioactive natural compounds to combat oxidation, terpenoids are recognized to be a rich source of antioxidants. Furthermore, terpenoids' function as an antioxidant to prevent excessive generation of reactive oxygen species suggests that they may be involved in a number of cancer and liver diseases. Total phenols, which are important in regulating oxidation, were discovered to be present in significant amounts in C. dichotoma. Strong chain-breaking antioxidants, phenolic chemicals are thought to have a direct antioxidant impact. A study found that the phenolic content of plants is directly related to their antioxidant qualities. Furthermore, taxifolin is a flavanonol subclass of flavonoids possessing potent antioxidant properties.

Anti- Diabetes Properties:

Diabetes, often known as diabetes mellitus, is a chronic metabolic disease characterized by hyperglycemia brought on by either the action or synthesis of insulin [37]. Plant antidiabetic action has been linked to betulin, α-amyrins, octacosanol, β-sitosterol, lupeol-3-rhamnoside, β-sitosterol-3-glucoside, hentricontanol, taxifolin-3, 5-dirhmnoside, α-amyrin, hentricontane, and hesperitin-7-rhamnoside, which have been identified in the bark of C. dichotoma. [46], [37] In rats with alloxan-induced diabetes, Hussain et al. [37] also discovered that the metabolic extract of C. dichotoma (MECD) bark has an antidiabetic effect [46]. As a result, several extract dosages had significant ($p < 0.05$) antihyperglycemic and hypoglycemic effects in Wistar rats. [26]

The antioxidant activity of an aqueous extract from C. dichotoma fruits was assessed in vitro by Newary et al. along with its impact on nutritional parameters in rats given a high-fat diet. Ascorbic acid and butylated hydroxytoluene were the two reference materials that were evaluated and compared with the C. dichotoma extract. It was established what the lipid composition of the diet and excrement was, together with the lipid profile of the serum and liver. The extract reduced both the overall growth in body weight and the total amount of feed consumed. A low dosage was preferable to a high dosage, and C. dichotoma significantly decreased fat and cholesterol intake while increasing those in fecal excretions when compared to hyperlipidemic control values. A modest dosage was preferable to a large dosage. Extracts from C. dichotoma thereby offer protection against hyperlipidemia, which could potentially impact.

Anti-Microbial Properties:

Antimicrobial property of medicinal plant is rapidly being reported from all over the world. Plant extracts or active ingredients are estimated to be utilized as folk medicine in traditional therapies by the World Health Organization (WHO). Methanolic and butanol extracts produced from bark of C. dichotoma showed outstanding efficacy against most of the investigated bacterial and fungal strains ,C. dichotoma bark's butanol and methanolic extracts showed the remarkable inhibition of the zone of bacterial and fungal growth . Consequently, one study revealed inhibitory effects against all the examined bacterial, fungal, and yeast species. C. dichotoma extracts had moderate antimicrobial efficacy against the tested pathogens [46], [17].

Reports of medicinal plants' antimicrobial properties are coming in quickly from all over the world. The World Health Organization (WHO) estimates that plant extracts or active components are used in traditional therapies as folk medicine. The bark of C. dichotoma was used to make methanolic and butanol extracts, which were exceptionally effective against the majority of the bacterial and fungal strains that were studied. Butanol and methanolic extracts of C. dichotoma bark demonstrated a notable suppression of the zone of bacterial and fungal development. As a result, one study found inhibitory effects against every species of bacteria, fungus, and yeast that were investigated. The pathogens studied were susceptible to the modest antibacterial activity of C. dichotoma extracts [17].

Water extracts of the C. dichotoma plants did not show any antimicrobial activity against all the tested microorganisms [17]. Caffeic acid, hentricontanol, and lupeol, among the phytoconstituents responsible for C. dichotoma antimicrobial action, showed the greatest significant values for antibacterial activity, whereas -sitosterol glycol and lupeol showed the highest significant values for antifungal activity [16]. Caffeic acid is a physiologically active polyphenol found in most plants having antibacterial and antioxidant properties [16]. Also, Wintola and Afolayan and Lagnika et al. demonstrated that phenolics, triterpenoids, and other antimicrobial phytochemicals are directly associated with the significant antibacterial effect of methanol extract of C. dichotoma [46], [16].

Wound Healing Activity:

Wound healing activity study of ethanolic fruit extracts of by Kuppast and C. dichotoma Nayak (2006) showed significant wound healing activity. Ethanolic fruit extract was further fractionated using petroleum ether (40-60%), solvent ether, ethyl acetate, butanol and butanone in succession. These fractions were tested for wound healing activity using three different models, viz. incision, excision and dead space wound models on either sex of albino rats of Wistar strain. All the fractions showed significant ($P<0.001$) activity may

be due to the presence of flavonoids in fruits. A significant increase in the tensile strength of test as compared to control was also reported (Kuppast and Nayak, 2006). Results of excision, incision and granuloma wound vatathealing models showed significant would healing property of the fruit extract of . C dichotoma. [47]

Anti- Cancer Activity:

Cancer is one of the leading causes of death globally. Chemotherapy is a vital alternative for the treatment of cancer in clinical settings, in addition to surgery and radiation. Around the world, medicinal plants constitute a major source of chemotherapeutic drugs for both conventional and modern medicine. Its leaves are primarily rich in phenolics and carotenoids, which have potent anti-oxidant and anti-cancer qualities. In a range of cancer cell lines, phenolics have been demonstrated to suppress cancer cell proliferation and induce apoptosis. Apoptosis is frequently induced by chemotherapy, especially when using natural chemicals produced from plants. Its induction is essential for the effectiveness of plant-based natural medications as anti-cancer treatments.

In vitro antioxidant activity and its impact on nutritional parameters in rats given a high-fat diet were assessed by Newary et al. using an aqueous extract from C. dichotoma fruits. Butylated hydroxytoluene and ascorbic acid were used as reference materials in the testing and comparison of C. dichotoma extract. Additionally, the lipid composition of the diet and excrement was ascertained, along with the lipid profile of the serum and liver. The extract reduced the overall rise in body weight as well as the overall amount of feed consumed. The consumption of fat and cholesterol was significantly decreased while fecal excretions increased when compared to hyperlipidemic control values. A modest dosage was preferable to a large dosage.

C. dichotoma is the source of several phytochemicals, including zeaxanthin, lutein, lycopene, resveratrol, ellagic acid, diallyl sulfide, glutathione-S-transferase, genistein, curcumin, indole-3-carbinol, isothiocyanates, carotenoids, beta-cryptoxanthin, inositol, squalene, and terpenes. [15] The majority of phytoconstituents found in seeds are α-amyrins, otulin, octacosanol, lupeol-3-rhamnoside, β-sitosterol, β-sitosterol-3-glucoside, hesperetin-7-rhamnoside, hentricontanol, hentricontane, and taxifolin-3, 5-dirhmnoside. These phytoconstituents are believed to have a variety of medicinal qualities, including anticancer ability [15] etc.

After MECD therapy (in-vitro preclinical study), an increase in apoptotic cells was detected, along with apoptotic cell features and visible DNA fragmentation, which are essential hallmarks of apoptosis [17], [23]. MECD induced apoptosis in HeLa cancer cells through a variety of mechanisms, including DNA fragmentation, mitochondrial depolarization, and the accumulation of reactive oxygen species (ROS). This clearly indicates that the methanolic extract of C. dichotoma leaves could be a novel potent cancer chemo preventive or chemotherapeutic agent for human cancer and it may be considered for further clinical studies in drug development [48],[17]. An increase in apoptotic cells, as well as apoptotic cell characteristics and apparent DNA fragmentation—both crucial indicators of apoptosis—were found following MECD therapy (in-vitro preclinical investigation) Through many mechanisms, such as mitochondrial depolarization, reactive oxygen species (ROS) buildup, and DNA fragmentation, MECD caused death in HeLa cancer cells. This unequivocally shows that the C. dichotoma leaf methanolic extract may be a novel, potent cancer chemopreventive or chemotherapeutic agent for human cancer, and it may be taken into consideration for additional clinical trials in drug development [48].

CONCLUSION:

Highly effective plant C dichotoma has long been used to treat a variety of human illnesses. Many different chemicals that have been identified from this plant, such as apigenin, cordioic acid, quercitin, linolenic acid, rutin, hesperidin, a rabinose, caffeic acid, robinin, and arabinoglucan, may be the cause of its therapeutic qualities [48]. Moreover, quercetin is the most significant phytoconstituent that is responsible for the antioxidant efficacy of C. dichotoma. This plant has phenlolic substances, amino acids, steroids, glycosides, tannins, sugars, and saponins. C. dichotoma has many various medical applications. These plant is also rich in antioxidants has been regarded as a key tool for mitigating diseases related to oxidative stress such as antiinflammatory, antiulcerative, antifungal, antimicrobial, anticancerous, gastroprotective, antidiabetic, antifertility, hypolipidemic and mostly hepatic liver disease [46] and is highly valued due to the existence of several beneficial chemicals.

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