

## Plant profile, phytochemistry, and pharmacological properties of *Cardiospermum corindum* L: An overview

Bharjil Bingari<sup>1</sup>, Innocent Sutnga<sup>2</sup>, Phaibiang Lapasam<sup>3</sup>

<sup>1,2</sup>Department of Pharmaceutical Sciences, Dibrugarh University, Dibrugarh, Assam, India

<sup>3</sup>Department of Pharmacy, RIPANS, Aizawl, Mizoram, India

### Abstract

All over the world, people are very much concentrating on utilizing an herbal product for their treatment of different diseases since it has less effects and low cost instead of synthetic drugs. The *Cardiospermum corindum* L. is known as the Love in a puff or Balloon vine plant which is a climber plant which belongs to the family Sapindaceae. The *C. corindum* L. is broadly developed in the Pantropics regions of Africa, South America and Asia. In north-eastern Brazil, infusion of all parts of *C. corindum* is used by traditional people to treat liver disease and memory tonic, diuretic, emmenagogue, and rheumatism. In India, the indigenous people of the Karnataka zone are typically utilized the leaf paste of this *C. corindum* as conventional medicine for the treatment of rheumatoid arthritis, nervous diseases, stiffness of the limbs, and snakebite. This review paper describes the pharmacognostical, geographical, phytochemistry, and pharmacological activity of the *C. corindum* L. (Sapindaceae). Plants possess phytochemicals constituents such as Tannin, Sterol, Terpenes, Flavonoids, Carbohydrates, Amino acids, Proteins, Saponins, and Alkaloids. Based on various literatures, *C. corindum* extracts possess various potential pharmacological activities proved by many experimental studies such as Anti-cancer activity, Anti-inflammatory activity, Antioxidant activity, Hepatoprotectivity, Antibacterial Activity and Antispasmodic effect. Henceforth, this plant can be developed as a drug by pharmaceutical industries, based on a numerous study. An overview of *C. corindum* plant is well described in the present paper.

**Keywords:** plant profile, phytochemistry, pharmacological, *Cardiospermum corindum* L.

### Introduction

Nowadays, everywhere on over the globe, around 80% of the total population is yet concentrating on utilizing the natural plants for their underlying medicines, in case synthetic drugs are not available<sup>[1-2]</sup>. Herbal drugs have been utilized broadly in various traditional systems of medicine to treat different disease by indigenous individuals. Besides, the ethnic individuals of different regions of India have acquired the information from their ancestors to practice their conventional treatment system for regular diseases<sup>[3]</sup>. Because of their less side effects and low cost, people are very much interested in utilizing the herbal products than manufactured drugs<sup>[4]</sup>. Eco-accommodating natural plant-based commodities need to consider for the therapy and treatment of human illness, inflammations, liver sickness, malignancy, and numerous different diseases<sup>[5]</sup>.

The *Cardiospermum corindum* L. known as the Love in a puff or Balloon vine plant which is a climber plant, the words 'cardio' means heart, and 'spermum' means seed which comes from the Greek words<sup>[6]</sup>. The *cardiospermum* genus represents around 14 species around the world which belong to the family Sapindaceae<sup>[7]</sup>. Globally, this plant species is broadly developed in the Pantropics regions of Africa, South America and Asia. It is reported that *Cardiospermum corindum* L. (Sapindaceae) occurs in the Northeast, Southeast and Southern regions of Brazil where the plant is known by the popular name "balãozinho".<sup>[29]</sup> In India, this plant is normally reported all through the tropical and subtropical zones of the Himalayan regions inside the height of 1300 m. The *Cardiospermum corindum* L. (synonyms: *C. canescens* Wall) and *Cardiospermum*

*halicacabum* L are two mainly occur in India. *Cardiospermum halicacabum* L. is highly distributed across India, whereas *Cardiospermum corindum* L. is known to occur abundantly in wastelands at some parts of Andhra Pradesh, Karnataka, and Tamil Nadu<sup>[8]</sup>. In northeastern Brazil, infusion of all parts of *C. corindum* is used by traditional people to treat liver disease and memory tonic, diuretic, emmenagogue, and rheumatism<sup>[29]</sup>. The indigenous individuals of the Karnataka areas are typically utilized the leaf paste of this *C. corindum* as traditional medicine for the treatment of rheumatoid arthritis, nervous diseases, stiffness of the limbs, and snakebite. The leaf juice is utilized for the treatment of asthma. The roots are diuretic and utilized in treating liver issues and diarrhea. The aerial plant has therapeutic properties like diaphoretic, diuretic, emetic, emmenagogue, purgative, refrigerant, rubefacient, and stomachic<sup>[9]</sup>. The plants parts used of *C. corindum* were Fruits, Leaves, Roots and Seeds. However, the accepted scientific name of this plant is *Cardiospermum corindum* L. although it has numerous synonyms in which various researcher have worked on it that indicate the same plant<sup>[12]</sup>. Hence, adequate information in review paper is described for this plant both generally and scientifically.

### Plant description

The plant is a twinner, pubescent or almost glabrous yearly or lasting with slim branches, liming using spiral snares. Leaves are biternate; flyers praise lanceolate, 1.5-5×1-3 cm, pubescent, base intense or weaken zenith taper, petiolute to 1mm. Climbing ringlet bearing spice up to 6m, with wiry stem and branches, stems profoundly wrinkled. Blossoms

white, in long peduncled umbellate cymes on ringlets. Male blossoms: sepals suborbicular, 1.5 mm. petals 4, white, 6×4 mm; Capsules enlarged not winged, 3.5×3 Cm; seeds globose, to 5mm. <sup>[10, 11]</sup>

### Taxonomical Classification <sup>[12]</sup>

Kingdom: Plantae – Plants  
 Subkingdom: Tracheobionta – Vascular plants  
 Superdivision: Spermatophyta – Seed plants  
 Division: Magnoliophyta – Flowering plants  
 Class: Magnoliopsida – Dicotyledons  
 Subclass: Rosidae  
 Order: Sapindales  
 Family: Sapindaceae – Soapberry family  
 Genus: *Cardiospermum* L. – balloon vine  
 Botanical name: *Cardiospermum corindum* L.,

### Synonyms: <sup>[12]</sup>

*Cardiospermum alatum* Bremek. & Oberm.,  
*Cardiospermum canescens* wall., *Cardiospermum clematideum* A. Rich., *Cardiospermum corundum* var. *angustisectum* (Griseb.), *Cardiospermum corundum* f. *angustisectum* (Griseb.) Radlk. *Cardiospermum ferrugineum* A. Rich. *Cardiospermum galapageium* Robinson & Greenm. *Cardiospermum giganteum* Rodr. *Cardiospermum hexagonum* Wight ex Radlk. *Cardiospermum keyense* Small, *Cardiospermum loureiroi* K. Koch, *Cardiospermum loxense* Kunth *Cardiospermum molle* Kunth. *Cardiospermum oblongum* A. Rich. *Cardiospermum ovatum* Wall. *Cardiospermum palmeri* Vasey & Rose *Cardiospermum pechuelii* Kuntze, *Cardiospermum pubescens* Lag.

**Vernacular Name:** Balãozinho (Brazil), Periya mudakathan (Tamil language), Chumattukodi, Uzhinja (Malayalam), dodda bekkina (Kannada), boodahcacarathega (Telugu).

### Phytochemistry

#### Phytochemical constituents

As reported, the phytochemical screening of ethanolic and water extracts of *Cardiospermum corindum* L. revealed may be the presence of Saponin, Tannin, Sterol, Terpenes, Flavonoids, Carbohydrates, Amino acids, Proteins, Saponins, and Alkaloids <sup>[7]</sup>. Likewise, GC-MS characterization revealed the presence of 33 compounds, the primary compounds revealed maximum area percentages,

for example, Methanamine, n-Hexadecanoic acid, Oleic acid, 5, 5, 8a-trimethyl-3,5,6,8,8a-hexahydro-2H-Chromene, and Hexadecanal. Atomic absorption spectroscopy revealed the presence of various components, for example, Phosphorous, Potash, Iron, Manganese, Zinc, Nitrogen, Copper, and Lead <sup>[10, 11]</sup>.

### Chemistry

Based on the phytochemical constituents that were reported in a CH<sub>2</sub>Cl<sub>2</sub> extracts on the aerial parts of *Cardiospermum corindum* L. resulted to the isolation and identification as two triterpenes [friedelin (1), friedelinol (2)], two coumarins [umbelliferone (4), scopoletin (5)], three methoxylated flavones [umuhengerin (3), luteolin 30,40-dimethyl ether (6), chrysoeriol (7)], one non-cyanogenic glucoside [epidermin (8)] and one cyclitol [(L)-quebrachitol (9)]. Although, the presence of this chemical compounds (1–8) has been reported in other *Cardiospermum* species as well as in Sapindaceae family (2, 3, 6 and 8). Compound 9 is found only in *C. corindum* and all their structure is shown in figure 1. These phytochemical studies of *C. corindum* of different extracts also revealed the presence of 30, 0-di-O-methyl luteolin-7-b-D-glucuronide, myo-inositol, 1-methyl 4-[[2-(4-nitrophenyl) ethenyl] sulfonyl] benzene, 1-[[2-methoxy-2 (4-nitrophenyl) ethyl] sulfonyl] 4-methylbenzene, b-sitosterol and stigmasterol <sup>[13]</sup>.

As reported, six known compounds (A-F) were isolated and recognized from the methanolic extracts of entire plants *C. corindum* based on chromatographic strategies and investigations of spectral datas, such as <sup>1</sup>H NMR, MS, IR, and <sup>13</sup>C NMR. These are the compound metabolites isolated and identified as follows: Compound A {[1R, 9S, Z)-4, 11, 11-trimethyl-8-methylenebicyclo [7.2.0] undec-4-ene] obtained as a yellowish solid. Compound B {[1S, 5R, 9R) 10, 10-dimethyl-2, 6-dimethylenebicyclo [7.2.0] undecan-5-ol] obtained as a pale yellow solid. Compound C {[1R, 4R, 10S)-4, 12, 12-trimethyl-9-methylene-5-oxatricyclo [8.2.0.0.4, 6] dodecane] obtained as a white powder. Compound D {[3S, 3aS, 6R, 8aS)-3, 7, 7-trimethyl-8-methyleneoctahydro-1H-3a, 6-methanoazulene] obtained as a grayish solid. Compound E [(1R, 2S, 6S, 7S, 8S)-8-isopropyl-1, 3-dimethyltricyclo [4.4.0.0.2, 7] dec-3-ene] obtained as a greenish semi-solid. Compound F {[3aR, 6R, 7S, 8aS)-6, 8, 8-trimethyl-3-methyleneoctahydro-1H-3a, 7-methanoazulene] obtained as a pale brownish solid and their structure is shown in figure 2. <sup>[14]</sup>

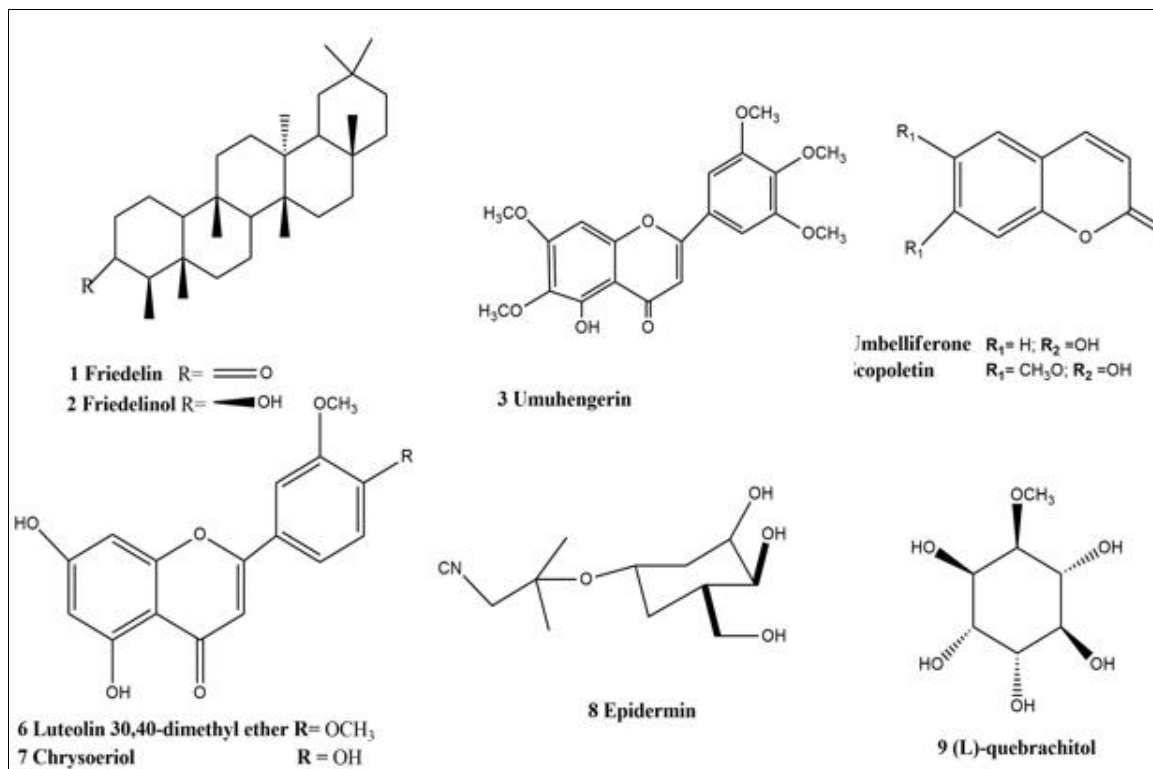


Fig 1: Compound metabolites distinguished from  $\text{CH}_2\text{Cl}_2$  extract of *Cardiospermum corindum* L.

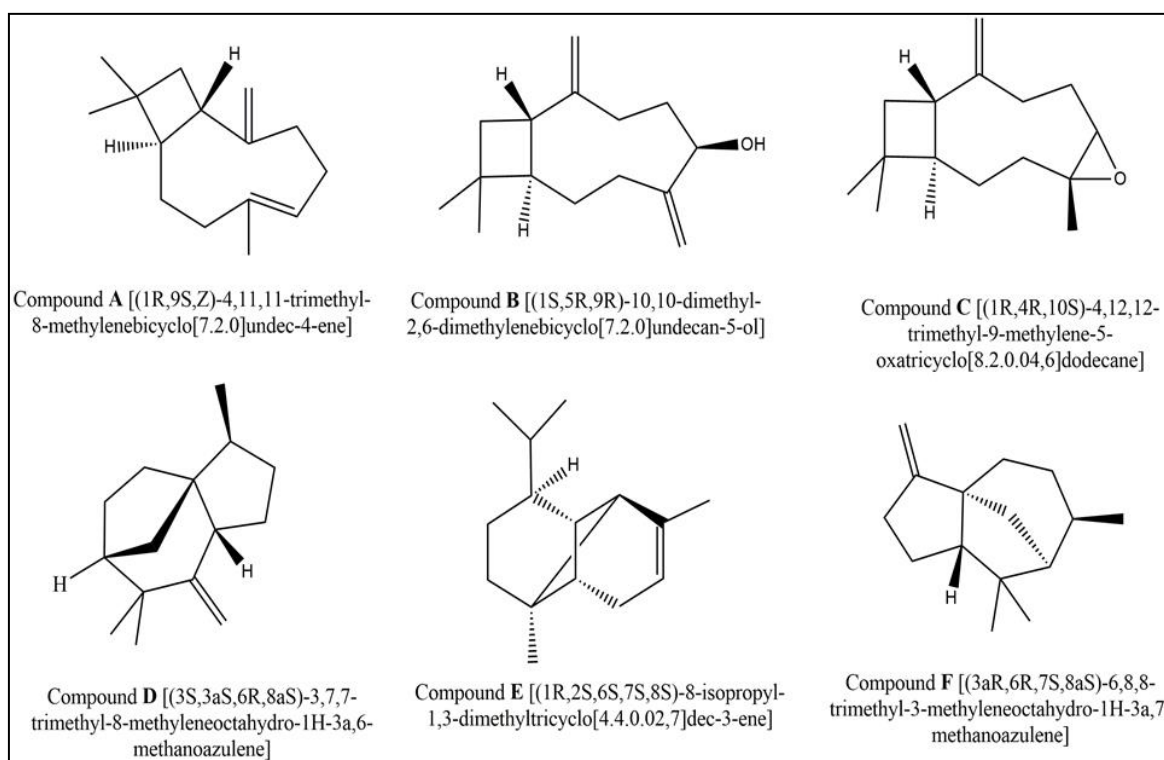


Fig 2: Compound metabolites distinguished from methanolic extract of *Cardiospermum corindum* L

### Pharmacological properties of *C. corindum* L.

#### Anticancer activity

Udhayasankar M.R. *et al.* 2013 evaluated the invitro anticancer activity of methanolic extract of *Cardiospermum corindum* L. (MECC) which shows a potential effect on a cancer cell. The human ductal breast cancer cell line (T-47) and Colon cancer cell line (HT-29) were utilized to determine their effects on cell viability (MTT assay), growth inhibition, and cell morphology (DAPI staining technique). It was reported that the significant decrease in cell viability

was observed for 100 $\mu\text{g/ml}$  in human ductal breast cancer cell line and 150 $\mu\text{g/ml}$  in colon cancer cell line. The cell viability of MECC shows a significant decrease in human ductal breast cancer cell line than the colon cancer cell lines. Also, the increased growth inhibition shows significantly reduce in human ductal breast cancer cell line than the colon cancer cell lines. Based on various literature indicates that this family Sapindaceae has potent cytotoxicity activity. However, further studies for cytotoxicity activity are required based upon the potential effect of different doses of

MECC which possess a significant decrease in cell viability, increase growth inhibition, and morphological changes.<sup>[8]</sup>

Ketha A *et al.* 2020 evaluate the in-vitro anticancer activity of MECC and their metabolites compound (A-F) as mentioned using Sulforhodamine B (SRB) assay with four cancer cell line MCF-7 (Breast), DLD- 1 (Colon), HeLa (Cervical), and A549 (Lung) and one normal human cell line (normal human mammary epithelial). The MECC and metabolites compound (A-F) were tested across all cell lines and reported to have a potential activity with specificity at 100µg/mL and below. The MECC shows good growth inhibition against DLD-1 and A549 than the standard drug (doxorubicin). The compound metabolites B reported significantly great inhibition specifically across all cell lines panel, while compound C against only DLD-1 and A549 and compound A against only A549 and cell death at different concentrations for all cell lines. The anticancer activity of MECC and compound (A-F) have potently inhibited the growth mechanism of cancer cell lines and also, reported that the samples are non-toxic to normal human cells since it shows less degree of specificity against normal human mammary epithelial (NHME)<sup>[14]</sup>.

#### Anti-inflammatory activity

Ketha A *et al.* 2020 stated that synthetic anti-inflammatory drugs lead to many side effects, numerous scientists are attempting to discover novel normal anti-inflammatory drugs which have the least side effects that are vital for current days. Generally, inflammation is caused by the human body due to the increased level of prostaglandins and leukotrienes. In this way, the two fundamental enzymes, Cyclooxygenase (COX-1 and 2) and 5-lipoxygenase (5-LOX) are responsible for the secretion of prostaglandins and leukotrienes, respectively. MECC and compound isolated metabolites (A-F) were reported utilized in the estimation of inhibitory of COX, LOX, and XO enzyme. Also reported that plant extract acted as a dual inhibitor on both COX and 5-LOX enzymes whereas compound B significantly inhibit only COX-1 enzyme. This enzymatic analysis showed that the methanolic extract has a great potential of anti-inflammation activity by possessing a significant IC<sub>50</sub> value towards COX-1 and 2, 5-LOX, and XO enzymes<sup>[14]</sup>.

Sreedevi K. *et al.* 2017 carried out the in-vivo anti-inflammatory activity of ethanolic extract of *Cardiospermum halicacabum* (EECH) and *Cardiospermum corindum* (EECC) with regards to their effects on inhibition of acute and chronic anti-inflammatory studies. It was reported for that *C. halicacabum* and *C. corindum* L. has potential anti-inflammatory activity and it could significantly inhibit the first stage and the late period of carrageenan-initiated paw edema model. It was accounted that this is due of the capability of the extracts to inhibit the release of a mediator, such as a histamine, serotonin, bradykinin, Prostaglandins, Platelet-enacting variable, and substance P. *Cardiospermum* reduce the intensity of afferent nervous stimulation in the acetic acid-induced writhing model with the extract significantly ( $P<0.001$ ) reduced leakage of protamine sky blue dye into the peritoneal cavity. The alcoholic extracts significantly ( $P<0.001$ ) reduced xylene and PMA (phorbol 12-myristate 13-acetate) which induce ear edema by inhibiting neuropeptides, substance P, and leukotriene B<sub>4</sub>. Likewise, the extracts significantly ( $P<0.001$ ) inhibit the activation of macrophage and neutrophil and suppressed the granuloma formation induced

by cotton pellets<sup>[15]</sup>.

Udhayasankar M. R. *et al.* 2013 assessed the anti-inflammatory activity of MECC was performed in carrageenan-induced rat paw edema model. It was reported that the plant extract possesses a potential anti-inflammatory activity by either inhibits of cyclooxygenase pathway and by inhibiting the release of vasoactive substances (histamine, serotonin and kinins). Similarly, results were reported in the entire plant EECH altogether inhibits the advancement of Carrageenan induced paw edema after 3 hrs ( $P<0.001$ ) of treatment. Carrageenan induced edema test (*In vivo* anti-inflammatory activity) is profoundly active to NSAIDs, furthermore, it has been acknowledged as a valuable phlogistic technique for researching a new anti-inflammatory drug<sup>[16]</sup>. The MECC may have inhibits the release of pro-inflammatory mediators of acute inflammation, such as histamine and prostaglandin. The presence of phytochemicals such as flavonoids, phenols, and sterols may liable for this action<sup>[17]</sup>.

#### Antioxidant activity

Ketha A *et al.* 2020 followed the two methods, DPPH assay, and Superoxide radical scavenging assay to investigate the antioxidant property. The MECC were subjected to DPPH assay (1,1-diphenyl-2-picrylhydrazyl) and Scavenging assay (Superoxide) in triplicate and its IC<sub>50</sub> values were found to be 60.0 and 62.5 µg/mL, respectively whereas standard (ascorbic acid) value was 27.8 and 32.1 µg/mL, respectively. From all compound metabolites, only compound B and C showed IC<sub>50</sub> of DPPH and scavenging assay with values of 169.0 and 180.0 µg/mL, respectively for compound B, while C with 285.0 and 230.0 µg/mL, respectively. Thus, the plant extract showed significantly effect of antioxidant activity by inhibiting DPPH and Superoxide free radicals<sup>[14]</sup>.

Udhayasankar M. R. *et al.*, 2013 investigated using these three methods such as DPPH assay, ABTS radical cation scavenging activity and Hydroxyl radical scavenging assay. DPPH radical scavenging has been generally used to find out the free radical-scavenging capacity of different extracts and is viewed as acceptable *in vitro* model broadly used to evaluate the antioxidant activity in a short period of time<sup>[18]</sup>. ABTS test is an amazing technique for investigating the antioxidant agent containing of hydrogen atom that give antioxidant properties and of chain-breaking antioxidant. The •OH scavenging activity of plant extracts was determine by its capability to rival salicylic acid for •OH radicals in the •OH producing/identifying system<sup>[19]</sup>. Similarly, the extracts of *C. halicacabum* was reported to go about as radical scavengers against free radicals under the states of oxidative stress<sup>[20]</sup>. In Sapindaceae family, the extracts of various members in the comparative pattern of results were shown as *Dimocarpus longan*<sup>[21]</sup>, *Magonia glabrata*<sup>[22]</sup>, *Litchi chinensis*<sup>[23]</sup>, *Dodonaea viscosa*<sup>[24]</sup> and *Melicoccus bijugatus*.<sup>[25]</sup> As reported that the MECC that have proton-donating capacity, could fill in as free radical inhibitors or scavengers, acting potentially as essential antioxidants<sup>[26]</sup>.

#### Hepatoprotectivity

Manda R M *et al.*, 2013 investigated *C. corindum* which showed that it has hepatoprotective potential against CCl<sub>4</sub> induced hepatotoxicity in albino rats. Among different root extracts like petroleum ether, methanol, acetone, and

chloroform were used, as it was reported out that MECC was given the maximum significant hepato-protective activity as compared to control drug (Silymarin). Moreover, petroleum ether and acetone extract also exhibit hepatoprotective property. The biochemical parameter likes SGOT (Serum glutamic oxaloacetic transaminase), SGPT (Serum glutamic pyruvic transaminase), and SALP (Alkaline phosphatase) and increased the level of TP (Total Protein) and TA (Total albumin) were measured for the degree of protection. As reported that the use of root extract in administering the rats in which liver damage was initially induced by CCl<sub>4</sub> was observed as a reversible change in liver injury. Hence, this exhibited property validates the traditional use of *C. corindum* L. in a scientific way<sup>[9]</sup>.

### Antibacterial activity

Udhayasankar M. R. *et al.*, 2013 explored six bacterial strains such as *Streptococcus pyogenes*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Streptococcus faecalis*, *Salmonella typhi*, and *Escherichia coli* were used to determine the antibacterial activity by MECC and Tetracycline as a standard. The MECC reported that it has more active towards gram-positive bacteria. Although, the extract has inhibited all type of tested bacterial species in various manner. The *C. corindum* L. extracts at a concentration of 100 mg/ml exhibited the most significant inhibition against all the bacterial strains as compared to standard. *B. subtilis* and *S. faecalis* are two strains that were effectively inhibited in the least concentrations of plant extract. However, gram-negative bacteria *E. Coli* was reported to be highly inhibited among the six bacterial species with a MIC value of 7.86µg/ml at concentrations of 75 mg/ml of MECC. Thus, different concentrations of the extracts reported to have potentially good inhibition for each test organism with determination of MIC value according to their bacterial strains. This plant extract could have a potential source for the antibacterial activity among the herbal drugs<sup>[27]</sup>.

Pratap GP *et al.*, 2014 investigated the effect of Chloroform, ethanolic, water, Benzene, petroleum ethers and methanolic extracts from the leaves of *C. corindum* L. against human pathogenic bacterial strains of *Escherichia coli*, *Salmonella typhi* and *Klebsiella pneumoniae*. The results indicated that only ethanolic, petroleum ethers and methanolic extracts showed significant activity whereas chloroform, water, and benzene extracts showed negligible results. From the above three significant extracts, they reported that ethanolic extract have more significant antibacterial activity as compared to petroleum ether and methanolic extracts. Also, the antibacterial activity was reported examined for sensitivity tests of bacterial strains by utilizing Bauer–Kirby technique with some antibiotics such as Ampicillin(A), Amoxicillin (Am), Chloramphenicol(C), Erythromycin(E), Penicillin(P), Kanamycin(K), Tetracycline(T), Cephalexin (Cp), Norfloxacin (Nx), and Ciprofloxacin (Cf.) at a concentration of 30µg. Thus, the results revealed that all the antibiotics exhibited higher antibacterial activity and comparatively the leaf extracts of *Cardiospermum corindum* L. were also exhibited higher antibacterial activity against *Salmonella typhi*. In this way, the plant extracts at finally revealed to have a potential source of antibacterial activity<sup>[10]</sup>.

Uma G *et al.*, 2013 assessed two solvent extracts (methanol, petroleum ether) of *C. helicacabum* and *C. corindum* leaves against *Staphylococcus aureus*, *Streptococcus faecalis*,

*Streptococcus pyogenes*, *Salmonella paratyphi*, *Escherichia coli*, *Bacillus subtilis* and *Klebsiella pneumoniae*, by utilizing agar well diffusion technique. The plant extracts tested against Gram positive and Gram-negative organisms in which methanolic reported for dominant inhibition than petroleum ether in all microorganism. Therefore, MECC reported to be preferred action over *C. helicacabum*. The discoveries will be useful for traditional healers as well as engaged with bioprospecting of herbal plants<sup>[28]</sup>.

### Antispasmodic activity

Veiga da Silva J L *et al.* 2018 investigated the effects of an ethanol extract obtained from the aerial parts *Cardiospermum corindum* (Cc-EtOH) in rats with ethanol induced gastric ulcer assay, its antispasmodic potential on isolated rat ileum along with its acute toxicity test. The Cc-EtOH of different concentrations (50, 150 and 500 mg/kg) has significantly protected the inner gastric mucosa layer of rat (Ulcer index, UI = 210.0 ± 55.8; 119.2 ± 39.3 and 47.7 ± 13.2 mm<sup>2</sup>, respectively) on dependent doses manner from depletion induced by ethanol (UI = 367.5 ± 89.3mm<sup>2</sup>) comparatively with standard drug (Omeprazole). The histological analyses also show its protective effect. The toxicity test was reportedly performed for 14 days, as a result without any acute toxicity. Also, they reported that for antispasmodic activity of Cc-EtOH extract shows significant effects on isolated rat ileum contractile responses by CCh and KCl (IC<sub>50</sub> = 236 ± 59 and 201 ± 43mg/ml, respectively). Hence, the plant extract possesses an evidence that whole plants of *C. corindum* has gastric protection as well as *in vitro* antispasmodic effects in rats without possessing any acute toxicity and therefore validates the use in traditional medicine.<sup>[29]</sup>

### Conclusion

An imperiled plant *C. corindum* L., is utilized to treat ailments in traditional medicine, moreover *C. halicacabum* Linn, without knowing the contrast between the two species. The review outcomes give proof the various available literature that supports of traditional uses of the entire plant of *C. corindum* L. It possesses Anti-inflammatory, Anti-cancer, Anti-inflammatory, Antioxidant, Hepatoprotectivity, Antibacterial and Antispasmodic properties. Likewise, with respect to the critical consequences, continuous investigations, are important to approve its numerous other traditional uses, such as assessment of in-vivo anticancer activity of *C. corindum* L., which is suggested and may prompt finding new powerful anti-tumor compound(s). With time, we can hope to see a more prominent collection of scientific research supporting the advantages of *C. corindum* L, in general to improve the wellbeing and assurance from diseases.

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