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A BRIEF REVIEW ON PHYTOCHEMICAL AND BIOLOGICAL ACTIVITIES OF *CORCHORUS DEPRESSUS (LINN.)*

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ABSTRACT

In the current study, we are emphasizing our investigation on one of the commonly available plant in India i.e., *Corchorus depressus (Linn)* which belongs to Tiliaceae family. It plays an important role in the treatment of various diseases. Our study is focused on the biologically active ingredients and therapeutic activities of *Corchorus depressus (Linn)* extract. It aims to highlight the latest research on the different extracts of this plant. Many significant natural products like glycosides, flavonoids, steroids, terpenoids, etc. were isolated by different researchers. These natural products were prone for various therapeutic activities, such as antioxidant, anticancer, antidiabetic, anti-inflammatory, analgesics, wound healing and hepato protective actions, analgesic, diuretic, antifungal, antibacterial, antimalarial, cardiotonic activity, antipyretic and enzyme inhibition. All the information was gathered from global databases such as Elsevier, PubMed, Researchgate, and Web of Science. By considering the pharmacological profile of *Corchorus depressus (Linn)*, this plant might be utilized in various herbal formulations which can be reported in the future. The purpose of the present review is to provide an overview of the extremely diverse phytochemicals present in *Corchorus depressus*.

Keywords: *Corchorus depressus (Linn)*, Tiliaceae, Phytochemical constituents, Secondary metabolites, Pharmacological activity.

1. INTRODUCTION

Herbal products are a key source of health care and traditional medical practices for over 4 billion people living in poor nations. Therefore, the use of herbs is considered an important part of the culture of these communities. Traditional herbs are substances derived from plants that have undergone minimal industrial processing and have been used to treat diseases. As a result, traditional herbal medicines have received great attention in the global health debate [1].

Traditional medicine is seen by the World Health Organization (WHO) as a field of medical support, with a complete explanation of knowledge, skills, and exercise, taking into account the assumptions, beliefs, and experiences of other cultures, whether logical or not, and prevention, identification, improvement, or treatment of physical and mental instability [2]. India is famous for its Ayurveda, Siddha and Unani traditional medicine system. The concept of Ayurveda was developed in India between 2500 and 500BC [3]. The use of natural resources in routine life has become a daily Ayurvedic practice for Indians. The basic rule of Ayurvedic treatment consists of two parts. It is about perpetuating the cause of the disease and making the patient more aware of the cause of the disease [4-5].

Medicinal plants are used in traditional drugs aimed at treating various health conditions. The problem of promotion in the use of alternate medications in the developed countries has very little evidence of documentation. It is therefore necessary to document all research work related to traditional medicine and to ensure standardization of the parts of the plant that will be used. So we have planned to carry out the review of *Corchorus depressus (Linn)*. This type of work and research will help in authentication and ensure the reproducibility of herbal merchandise in marketing.

Corchorus is a genus of Tiliaceae family. There are 450 species and 50 genera in this family, distributed in

tropical and subtropical regions of southern Asia and South America. Out of these, nearly 100 species are found to have appreciable therapeutic importance. The species which contribute prominently toward the medicinal properties are:

1. *Corchorus depressus* 2. *Corchorus capsularis* 3.*Corchorus olitorius* 4.*Corchorus fascicularis* 5.*Corchorus pseudocapsularis* 6.*Corchorus aestuans* 7.*Corchorus humilis* 8.*Corchorus siliquosus* 9.*Corchorus tridens* 10.*Corchorus trilocularis* 11.*Corchorus acutangulus* 12.*Corchorus urticifolius.*

The species *Corchorus depressus (L.)* is attributed to several herbal and indigenous medicinal properties. According to the literature assessment, many phytochemicals isolated from various portions of the plants contribute to a variety of therapeutic qualities. As a result, the current review contains information on the chemical composition and biological properties of various plant parts.

1.1. Macroscopic characters of *Corchorus depressus (L)*

Corchorus depressus (L.) commonly known as 'Bhedani' (Sanskrit), 'Bauphali' (Hindi) and 'Malukh' (Arabic) is found in drier parts of India such as Odisha, Punjab, Gujarat, and Rajasthan. It grows up to 1000 m above sea level in arid and semi-arid regions of South Asia and South America. It is about 6-9 inches long and is a ground-creeping woody perennial. Branches radiating from the wooden canopy adhere to the ground. Leaves are 6-20 mm, round, generally wrinkled, glabrous and irregularly circular toothed. The toothing has no appendages; the base is round or wedge-shaped and petiole 1.2- 2.5 cm long, very slender, stipules subulate [6].

Botanical Classification

Kingdom	*Plantae*- Plants
Subkingdom	*Tracheobionta*-Vascular Plants
Super division	Spermatophyta -Seed plants
Division	*Magnoliophyta* -Flowering plants
Class	*Magnoliopsida*-Dicotyledons
Subclass	*Dilleniidae*-
Order	*Malvales*-
Family	*Tiliaceae*-Linden family
Genus	*Corchorus L.*
Species	*Corchorusdepressus (L.)*

Roots are diffusely branched. Flowers are yellowish, 1 mm long, occurring in 1-3 flowered axillary, orantiphyllous cymes. The growth of leaves and fruits is hindered in saline soil and stony soil [7]. The fruit is a capsule, 8-15 mm long, often curved upwards from the lower part of the branch, with a cylindrical beak, 4-petaled, with or without compartments between the seeds [8]. Seeds are angular, smooth, oblong with sharp edges, minute, dark brown colored, and 1-2 mm in length with an obliquely truncate base. The stem is mostly adpressed to the ground, glabrous to sparsely pubescent [9].

2. TRADITIONAL USES

Various parts of the plant *Corchorus depressus (L.)* like roots, stems, leaves, seeds are used as remedies for many ailments. The plant contains various phyto-chemicals such as triterpenoids, alkaloids, phenolics, sterols, ionones, flavonoids, saponins, carbohydrates, and cardiac glycosides [10]. The plant has been traditionally used in pain, fever, and sexual dysfunction [11]. The entire plant is employed in folk treatments for a variety of ailments such as tumors, pain, pile fever, and emollient [12]. A decoction of the plant has found numerous ethnomedicinal uses, such as curing dysentery, dyspepsia, and liver disorders [13]. It is also utilized in the indigenous systems of drugs as a tonic and its mucilage is prescribed for treating gonorrhea [14].

2.1. Leaves

Plant leaves are used to prevent urinary stagnation and warmth stroke. The leaves of plants are more efficient emollient and an honest cooling agent. Its mucilage is employed for treating gonorrhea and in curing the skin eruptions [15]. The leaves are used to increase the viscosity of the semen [16]. The infusion of leaves is employed as demulcent, tonic, laxative, expectorant, antipyretic, diuretic and useful in chronic cystitis, dysuria [17], to extend sexual ability in males [18].

2.2. Seeds

Seed decoction is used as an energy supplement [19]. Seed water extract is employed in the treatment of nocturnal emissions and premature ejaculation [20]. Decoction of seed with goat milk and jaggery is used to treat acute diarrhea [21].

2.3. Roots

Roots are rubbed on stone and applied on forehead to relieve migraines [22].

2.4. Stem bark

Powdered stem gives a cooling effect during heat [23].

2.5. Fruits
Powdered dried fruit with milk is used to cure leucorrhoea in females [24].

2.6. Whole plant
The whole plant has been used for disorders such as hepatitis, liver inflammation, itching of urine, long-term bleeding during menstruation, and erectile dysfunction in men [25]. It is also used as an aphrodisiac, to treat swelling and damage to internal organs, urinary tract infections, and fever and to nourish the body [26-28]. It is found useful in gonorrhea, diabetes, betrayal disorders, improved sexual vitality, and jaundice [29-32]. The whole plant is used as a popular medicine in the disease of spermatids, treating muscle stiffness, treating dysentery, in tumors, indigestion [33-35].

3. PHYTOCHEMICAL STUDIES
Various secondary metabolites such as alkaloids, flavonoids, carbohydrates, cardiac glycosides, triterpenoids, phenolics, sterols, ionones are reported from the species *C. depressus.*

3.1. Leaves
The leaves of *C. depressus* contain various secondary metabolites, such as steroids, alkaloids, saponins, glycosides and phenolic compounds [36]. Leaves are reported to have flavonoids such as quercetin **(1)** and kaempferol **(2)** [37].

3.2. Aerial Parts
Samina evaluated the pharmacological constituents of the aerial parts *C. depressus*. The plant showed secondary metabolites like alkaloids, cardiac glycosides, and saponins **(3)** [38].

3.3. Roots
Patel *et al*., investigated the phytochemical composition of *C. depressus* (L.) roots. The hydroalcoholic extract of the roots contained phytochemicals such as saponins, flavonoids, steroids, carbohydrates and tannins. Also, methanolic extract of the plant showed flavonoids and steroids. The water extract showed phytochemicals such as glycosides, saponins, flavonoids, and tannin [39].

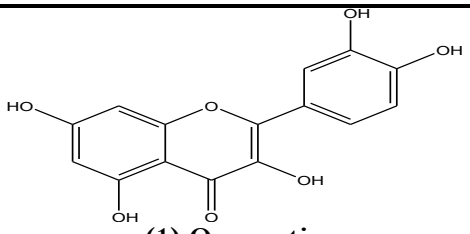
3.4. Flowers
Flavonoids like quercetin and kaempferol are isolated from the flowers of the plant.

3.5. Seeds
Shivhare *et al*., investigated the phytochemical activity of seeds of *C. depressus* and isolated depressogenin and glucopyranosides [40].

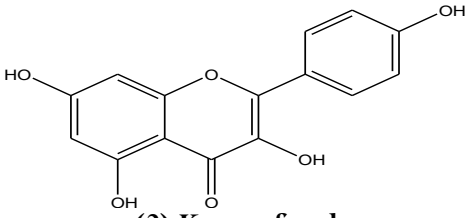
3.6. Fruits
Fruits and twigs of *C. depressus (Linn)* are crushed and eaten Nyman *et al.,* reported the cardiotonic activity of fruits [41].

3.7. Whole Plant
Corchorus depressus contain various phytochemicals such as β-sitosterol **(4)**, β-sitosterol-β-D -glucoside **(5)**, apigenin **(6)**, luteolin **(7)**, and α-amyrin derivatives. In 1991, Khan and coworkers isolated three α-amyrin derivatives which includes cordepressic acid **(8)** (2α,3β,20β-trihydroxy-urs-12-ene-24,28-di-oic acid), cordepressin **(9)** (2α,3β,20β-trihydroxy-urs-12-ene-24,28-di-oic acid 24 β-D-galactoside) and cordepressenic acid **(10)** (2α,3β- dihydroxy-urs-12-20-diene-24,28-dioic acid) [42]. In 1998, Viquar Uddin reported cycloartaneglucosides like depressoside**A (11)** (9,19-cyclolanosta- 22 (R),25 - epoxy - 3β, 16 β, 24 (S)-triol-3-O-β-D-glucopyranoside), depressoside **B (12)** (9,19-cyclolanosta-22(R),25-epoxy-24(S)acetoxy - 3β, 16β-diol-3-O-β-Dglucopyranoside) [43]. Viquar Uddin and coworkers in 2000 isolated two novel cycloartane-type glycosides such as depressoside **C (13)** ((22R) 16β,22-epoxy-3β,26-di-hydroxy-9,19-cyclolanost-24E-ene-3,26-di-O-β-D-glucopyranoside) and depressoside **D (14)**{(22(R),24(S)-22,25-epoxy-3β,16β,24-trihy-droxy-9,19-cyclolanostane 3,24-di-O-β- glucopyrano side} [44].

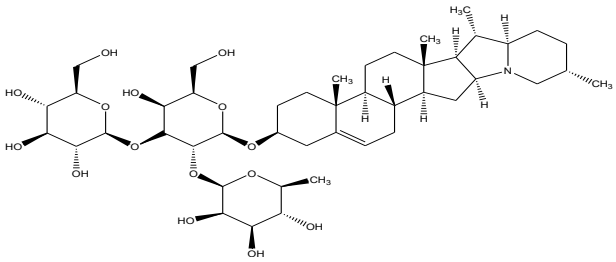
Zahid M and coworkers reported two new flavonol glycosides depressonol **A** (**15**){kaempferol-3-[β-D-glucopyranosyl-(1→4)-β-D-galactopyranoside]7-(α-L-arabino- furanoside) and depressonol **B**(**16**) [kaempferol-3-[β-D-glucopyranosyl-(1→6)-β-D-galactopyranoside] 7-(α-L-arabinofuranoside). In 2002, two new mono desmosidiccycloartanetriterpene glycosides, namely depressosides **E** (**17**) {(22R, 24S) -22,25-epoxy-9,19-cyclolanostane 3β, 16β, 24-triol-3-[α-L-rhamnopyranosyl-(1→4)-β-Dglucopyrano-side]} and depressoside **F** (**18**){(22R,24S)−22,25-epoxy-9,19-cyclolanostane-3β,16β,24-triol-3[α-D-glucopyranosyl-(1→3)-β-D-glucopyranoside]} were reported [45].



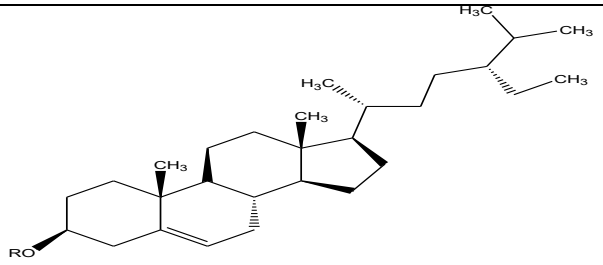
(1) Quercetin



(2) Kaempferol

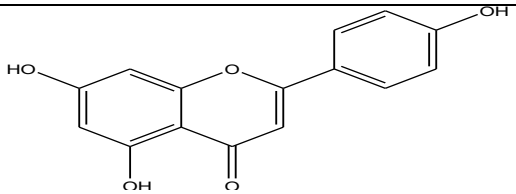


(3) Saponin

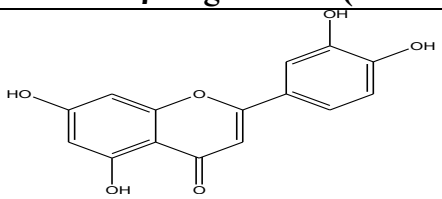


(4) β-sitosterol (R=H)

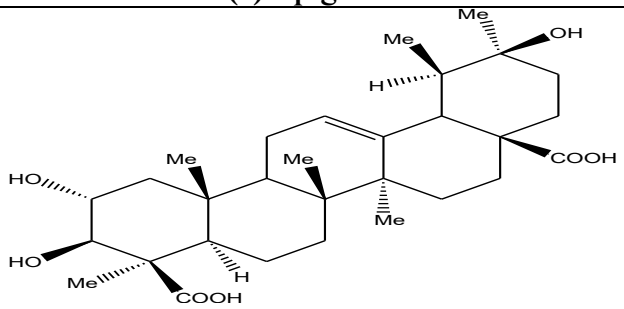
(5) β-sitosterol-β-D-glucoside (R=Glucose)



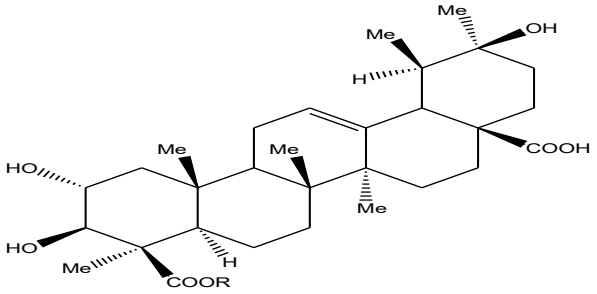
(6) Apigenin



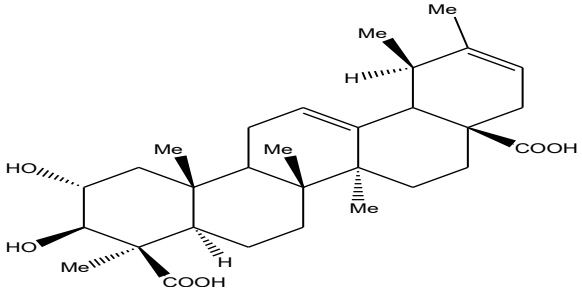
(7) Luteolin



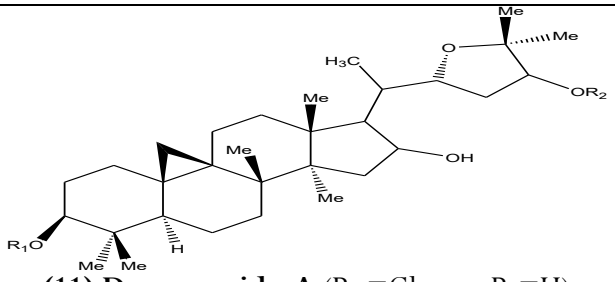
(8) Cordepressic Acid



(9) CordepressinR=β-D-Galactose

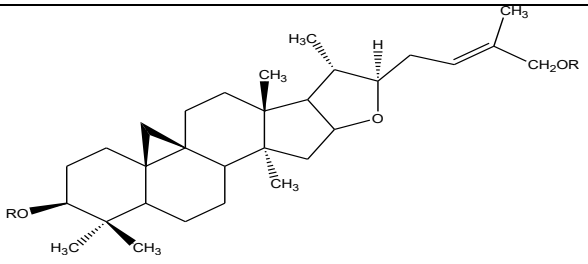


(10) Cordepressenic acid

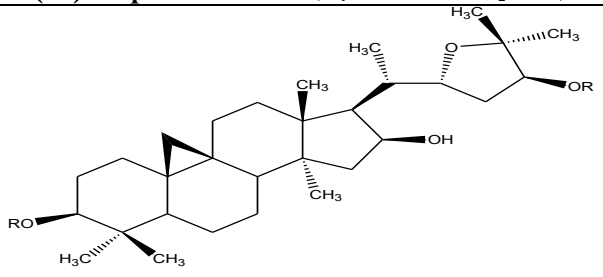


(11) Depressoside-A (R_1 =Glucose,R_2=H)

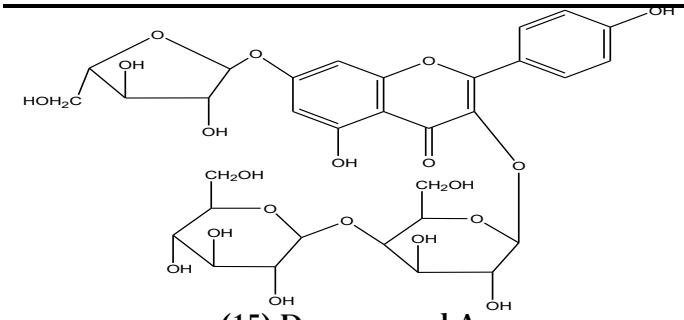
(12) Depressoside-B (R_1=Glucose, R_2=Ac)



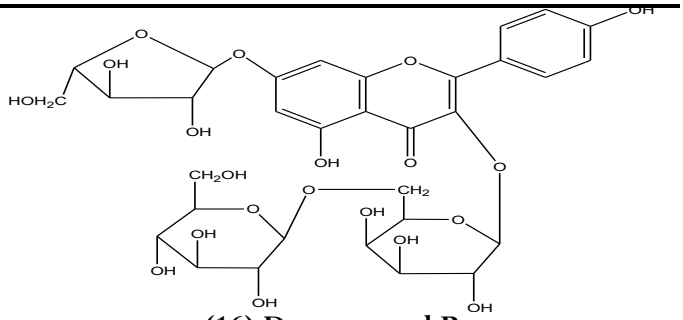
(13) Depressoside-C(R=β-D glucopyranosyl)



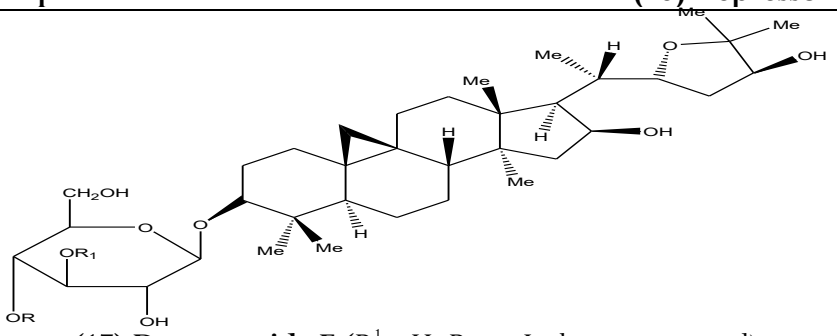
(14) Depressoside D (R= β-D-glucopyranosyl)



(15) Depressonol A



(16) Depressonol B



(17) Depressoside E (R^1= H, R= α-L-rhamnopyranosyl)

(18) Depressoside F (R^1 = α-D-glucopyranosyl, R = H)

4. PHARMACOLOGICAL ACTIVITIES

4.1. Anti-oxidant Activity

Jabeen *et al.*, investigated for antioxidant activity of *C. depressus (L.).* Ethanol, methanol, acetone, ether and hexane extracts were analyzed for antioxidant activity using five assays such as DPPH, total flavonoids, total phenols, percent inhibition of the linoleic acid system, reducing potency analysis. Methanolic extract showed considerable antioxidant activity [46].

4.2. Analgesic Activity

Khuntia *et al.*, investigated the analgesic activity of a *C. depressus* methanolic extract. It showed inhibition for the release of endogenous substances, which excites the pain nerve endings, incorporating the analgesic activity to the methanolic extract of the plant. The hot plate test method was used for the study of central analgesic effect [47].

4.3. Antipyretic Activity

Ikram *et al.*, studied the antipyretic activity of whole plant *C. depressus (L.)* in rabbits receiving yeast injections. Aspirin was selected as a standard antipyretic. At a dose of 150mg/kg orally, hexane and chloroform-soluble extracts of the plant find potential antipyretic properties [48].

4.4. Anti-inflammatory Activity

Khuntia *et al.*, investigated the anti-inflammatory activity of *C. depressus* methanolic extract (L.) It demonstrated potential anti-inflammatory activity in rat paw and cotton pellet induced granuloma models induced by carrageenan and egg-albumin. Methanolic extract contains a variety of secondary metabolites, such as flavonoids, which inhibit the release of inflammatory substances such as prostaglandins [49].

4.5. Diuretic Activity

M. A. Raza *et al.,* [50] studied the diuretic properties of the plants. The decoction of aerial parts of the plant exhibited diuretic properties in the dosage of 500 g LA and 200 g SA.

According to Kakrani and Saluja the whole plant can be used as a diuretic. Half a cup of the plant's aqueous decoction is consumed twice daily for 10-12 days [51].

4.6. Wound Healing Activity

Khan *et al.*, studied the pharmacological properties of *C. depressus.* Leaves mucilage were reported to have wound healing property [52].

4.7. Antifungal activity

Methanol and Dichloromethane extracts of the plant were examined for antifungal activity by Samina *et al.* The plant was tested against *A. niger, A. flavus, F. solani, A. fumigatus*, and *Mucor* fungal strains. A dichloromethane extract of the plant's aerial parts inhibited *A. niger* growth by 80% or more. Furthermore, the methanol extract of the arial part and the dichloromethane extract of the plant's root inhibited

A. flavus growth by more than 80%. The methanol extract of the root part inhibited the growth of fungus *F. solani* by 55%, and the dichloromethane extract of the plant inhibited growth by 64% [38].

4.8. Antibacterial activity

Kapoor *et al*., investigated the antibacterial activity of *C. depressus* against *S. aureus*, *E. coli*, and *C. albicans* pathogens. Various solvent extracts of leaves, such as ether and alcoholic extracts were studied. All of the extracts had strong antibacterial activity against these three bacteria types [53].

4.9. Anti-diabetic activity

Samina *et al*., assessed plant root extract's anti-diabetic activity. The dichloromethane extract of roots showed 79% inhibitory action against the α-glucosidase enzyme with IC_{50} 62.8±1.5 µg/ml [54]. Also, Patel *et al*., reported that methanol and water extract of the plant showed potential inhibitory action against α-amylase enzyme [39].

4.10. Anti-cancer activity

Kakrani studied the cytotoxic effect of arial parts of *C.depressus*. Methanol extract showed increased cytotoxicity in HepG2 and HLE human hepatocellular carcinoma cells at an inhibitory concentration of about 200µg IC_{50}. The highest cytotoxic effect has been recorded at 500µg/ml [55].

4.11. Hepatoprotective activity

Anil Pareek investigated the hepatoprotective activity of the plant. The ethanolic extract prevented the CCl_4 induced decay of antioxidant enzyme activities. This hepatoprotective effect was also evidenced by histological levels. *C. depressus* had a free radical scavenger that effectively protects the rat liver against oxidative damage induced by CCl_4 and avoids the oxidation of detoxifying enzymes such as CAT and SOD [56].

4.12. Aphrodisiac activity

Ramandeep [57] looked into how different solvents, such as petroleum ether, chloroform, ethyl acetate, n-butanol, and aqueous fractions, affected the response. The methanolic extract of the whole plant of *C. depressus* had aphrodisiac action in rabbits. At a dosage of 25 mg/ml, chloroform extract was found to have a stronger aphrodisiac effect, causing 71.4 percent relaxation.

5. CONCLUSION

Since human evolution, plants and herbs have been used to treat and prevent disease all over the earth. About 25% of the drugs prescribed around the globe are of plant origin. Previous literature and current research of *Corchorus depressus (L.)* showed that leaves and roots consist of secondary metabolites, such as steroids, alkaloids, saponins, glycosides, and phenolic compounds, which would be a wonderful in producing recent medicine to cure illness. This plant grows chiefly in wild areas.

An exhaustive literature search of phytochemicals in *Corchorus depressus(L.)* indicates the presence of several secondary metabolites such as β-sitosterol, β-sitosterol-β-D-glucoside, apigenin, luteolin, and α-amyrin derivatives. Also, cyclartane type glycosides and some α-amyrin derivatives have been isolated from various parts of the plant. These phytochemicals incorporated important pharmacological properties such as anti-malarial, antipyretics, aphrodisiac, diuretics, antifungal, wound-healing activity, and anti-diabetic properties.

This review reveals an important medicinal and indigenous significance of the plant and still a broad scope is left to investigate more of its properties in the field of phytochemistry. As a result, we hope that phytochemical research and pharmacological properties will aid and attract researchers in the discovery of new drugs as well as the isolation, identification, and characterization of the structures of various active compounds responsible for these activities. To rationally use the plant as an effective herbal medicine, the pharmaceutical industry must take innovative measures and gather the necessary evidence.

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Conflict of interest

The authors declare no conflict of interest.

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