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PHYTOCHEMICAL AND PHARMACOLOGICAL INVESTIGATION OF *CORDIA MACLEODII* HOOK

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ABSTRACT
Cordia macleodii Hook. an important medicinal plant of family Boraginaceae categorized as endangered taxa has immense economical and ethno medicinal uses. Several bioactive compounds like alkaloids, tannins, saponins, phenolics, phytosterols has been isolated from tree bark, stem, leaves, flower, crude and solvent extracts. In general the plant is anti-microbial, hepato-protective, antioxidant, anti-venom, wound-healer, antihypertensive in nature with great significance in pharmaceutical industries. This systematic review focuses on screening main chemical constituents of all the valuable parts and their pharmacological activities so as to be successfully employed in pharma industries for preparing new drug formulations.

KEYWORDS: Cordia macleodii, chemical composition, pharmaceutical activities.

INTRODUCTION

Plants containing bioactive compounds have been beneficial for human health since time immoral. According to an estimate nearly 50 to 80,000 plant species either native or pharmaceutical derivatives are used in human healthcare system globally.[1] Drug discovery from plant products include its chemical composition, analysis and pharmacological investigation. The development of new scientific technologies like GC–MS, IR, NMR, HPLC, HPTLC has helped in identifying and elucidating natural products and new drug discovery.[2] Moreover, in recent years tissue culture techniques has revolutionized the development of commercially important species and their secondary metabolites like alkaloids, flavonoids and phytosterols with pharmacological applications.[3] The continuous growing economic importance of plant-based pharmaceuticals is increasing rapidly and shown positive impact on human healthcare system.[4] In recent years, various studies have been done on chemical constituents and pharmacological properties of medicinal plants.[5-10]

Cordia macleodii (Griff) Hook. F. & Thomas., a medium sized tree belonging to family Boraginaceae is an important medicinal tree (Figure 1). The tree mainly occurs in moist and deciduous forests in Central India, Deccan, Southern and Western region with common names 'Dadhiman', 'Dahipalas' or 'Dahiman'. It contains various bioactive compounds with significant pharmaceutical uses. According to available literature HPTLC, GC/MS, FTIR, UV-Vis scientific techniques has been applied to isolate many secondary metabolites like alkaloids, tannins, glycosides, flavonoids from the leaves, bark, stem and flowers of the plant. These bioactive compounds have immense potentiality against various diseases and thus an important candidate in drug industries for developing new medicines.

Figure 1. *Cordia macleodii.*

PHYTOCHEMICAL CONSTITUENTS

The phytochemical composition of any plant is key factor in determining its pharmaceutical potentiality. Earlier the author has conducted vast studies on phytochemical composition of various important medicinal plants.[11-15] The screening of literatures based on phytochemical constituents of *C. macleodii* comes out

with significant outcomes suggesting that plant parts are enriched with several bioactive compounds. The systematic research study reveals that tree bark followed by leaves and stem are the important parts with essential secondary metabolites of pharmaceutical importance.

Chemical composition of stem bark

Physico-chemical studies of bark reveal that it contains total ash, acid insoluble ash, hexane soluble extractive, alcohol soluble extractive, water soluble extractive, sugar, starch and tannins. The hexane and chloroform bark extract mainly contain triterpenoids, acetone, methanol and aqueous bark extract contains reducing sugar and aqueous bark extract also contain saponins, tannins, glycosides, alkaloids.[16, 17] Beside this acetone, ethyl alcohol, petroleum ether and water extract also contains carbohydrate, flavanoid, and resin.[17] Moreover, the physico-chemical analysis of powdered stem bark using HPTLC reveals foreign matters, loss on drying, alcohol soluble extractive, water soluble extractive, total ash and acid in soluble ash in 2.18, 8.40, 7.01, 24.93, 17.07, 5.86 % respectively.[17]

The unsaponifiable fraction of petrol-ether bark extract using GC/MS analysis and IR and UV characterization yielded three compounds Stigmasterol, Camphesterol and Cholest-5-EN -3OL (3 Beta)-Carbonyl chlorinated[18,19] in addition with p-hydroxyphenylacetic acid and β-sitosterol.[19] The UV spectrum studies of bark fraction shows presence of flavonoids whereas and ethanolic[19, 20] and methanolic bark extract shows presence of Quercetin.[21] Beside this two other flavonoids apigenin and kaempferol were isolated from methanolic bark extract.[21] The granular activated charcoal prepared from the bark at pH 11.5, 330 minute contact time, 6 mg/l initial metal concentration, 1.4 gm adsorbent dose, and 650c temperature, has potentiality in adsorbing toxic element manganese from wastewater.[22]

Chemical composition of stem

The UV-Vis spectrophotometry of silver nitrate colloidal solution of stem extracts with maximum absorption spectrum at 424 and 437.4 nm confirms presence of silver nanoparticles.[23]

Chemical composition of Leaf

Physicochemical studies suggest that the drug moisture minimizes on drying of leaves, inorganic materials in total ash content, acid insoluble ash, along with extractive values that are water and alcohol soluble.[24] The qualitative analysis of powered, methanolic, petroleum ether and water extract of leaf shows presence of glycosides, alkaloids, flavonoids, tannin, fats and fixed oils, terpenoids, steroids, phenolics compound and resin.[17,24,25] Physico-chemical analysis of powdered leaf applying HPTLC technique shows foreign matters, loss on drying, alcohol soluble extractive, water soluble extractive, total ash and acid in soluble ash in the range 2.93, 5.22, 4.17, 12.56, 13.68 and 3.12%, respectively.[17] UV spectrum analysis of pure fraction of leaf shows presence of Phenolics and ethanolic leaf extract yielded Gallic acid (3, 4-dihydroxy-5-methoxybenzoic acid) [20]. UV-Visible and FTIR spectra of Choloformic extract of leaf confirms the presence of β-carotene, showing potentiality as a dye sensitized solar cell.[26]

PHARMACOLOGICAL ACTIVITIES

The pharmacological activities of *Cordia macleodii* has been studied since many years. The scientific information suggests that the plant generally possesses antimicrobial, antioxidant, anti-inflammatory, analgesic, hepatoprotective, antivenom activities.[27] The plant parts mainly stem, bark and leave in form of extracts, powder, and decoction either internal or external applicability, shows wider pharmacological activities.

Anti-microbial activities

Plant leaf powder shows moderate effect on gram positive bacteria *Streptococcus* and *Staphylococcus aureus.*[24] The mixture of plant leave and its ghrita base in different concentration shows antibacterial activity against gram negative- *P. aeruginosa* and *E. coli*, and gram positive- *S. pyogenes* and *S. aureus* bacteria.[28] Water and n-hexane extract of leaf exhibited effective action against gram-positive bacteria *Bacillus subtilis* and fungi *Aspergilus niger* after 12 hrs.[29] Dhal et al.[23] observed that silver nanoparticles synthesized from plant stem extract showed high degree of antibacterial activity against *S. aureus, Citrobacter* sp. and *Klebsiella* sp. with 15.1 mm, 14.0 mm and 11.9mm zone of inhibition, respectively.

The ethanolic bark extract at 100 mg/ml shows significant antibacterial activity against *Comamonas testosteroni* and *Pseudomonas plecoglossicida* with 7 and 9mm zone of inhibition. Petroleum ether bark extract of the plant shows significant inhibition of two gram-positive bacteria *Streptococcus pyogenes* and *Staphylococcus aureus*, and two gram-negative bacteria *Pseudomonas aeruginosa* and *Escherichia coli.*[30] The chloroform leaf extract exhibit significant anti-fungal activity against *Aspergillus niger, Candida albicans* and *Aspergillus clavatus* compared to standard drugs. Moreover, chloroform leaf extract and ethyl acetate leaf extract shows better anti-malarial activity against *Plasmoduim falciparum.*[31]

Anti-oxidant activities

Qureshi *et al.*[32] reported leaf ethanolic extract at 800 lg/ml dose exhibit maximum inhibition of DPPH and nitric oxide radicals 81.20 and 72.70%, respectively. Further, ethanolic extract in the same dose was found effective in inhibiting reducing power and iron chelation with absorbance mean of 1.53 and 0.433, respectively in animal models. The ligand cordia-1, an important phytochemicals of the plant binds with anti-oxidant enzymes Catalase (CAT), Super oxide dismutase (SOD) and Glutathione peroxidase (GPx) showing scavenging action, and have wider impact on anti-oxidant activities.[33]

Antihypertensive activities

Dikshit and Jaishwal[34] investigated that dadhimanth powder obtained from leaves, administered 3-6 gm twice daily in plain water for one month, reduces hypertension and also found significant in controlling blood urea.

Wound-healing activities

The plant leaves exhibit low degree of wound healing capacity. The external application of 100 g dose of plant leaf powder shows wound healing in wistar rats after 29 days with 88% healing capacity. Moreover, the incision wound shows nearly 318 g/100g body weight tensile strength along with neo- vascularization in the dead space wounds, presenting weak recovery in tested animal model.[35] However, Sharma *et al*.[36] observed that formulation of fresh leaf powder and Cow's ghrita shows high percentage of relief from wound healing after third week of application. The unhealthy granules, discharge and wound margin were effectively controlled whereas wound floor, wound size and swelling exhibit promising reduction. The wound colour, pain and tenderness show significant changes in the tested patient after 21 days.

Anti-venom activities

Ethanolic bark extract with a dose of 400 and 800 mg/kg has potentiality in inhibiting Naja venom induced hemorrhagic lesion, lethality, edema and necrotizing lesion in male Wistar albino rats.[37]

Hepatoprotective activities

The plants like C. macleodii and others, with effective chemical constituents show better efficacies against liver diseases.[38] Qureshi *et al*.[32] reported the efficacy of leaf ethanolic extract against CCl4 induced hepatotoxicity in rats and observed that the dose of 400 mg/kg minimize the elevation of glutamic pyruvic transaminase (GPT), glutamic oxaloacetic transaminase (GOT), alkaline phosphatase (ALP) and Bilirubin up to 23.2 U/I, 25 U/I, 81 U/I and 0.43 mg/dl, along with reducing liver weight to 6.38 g, respectively. The hepatoprotective action of stem bark and leaf was also confirmed by other research works.[39] Shukla *et al*.[40] reported hepatoprotective activity of aqueous and ethanolic bark extract in ethanol and CCl4 induced hepatotoxicity in male wistar rats. In both the cases, the extract reduces level of Serum glutamic Pyruvate transaminase (SGPT) enzyme activity in liver. Further, these extract shows significant reduction in the level of mitochondrial enzyme serum Glutamic Oxaloacetic Transaminase (SGOT) and Alkaline phosphatase (ALP) an enzyme obtained from hepatic parenchyma, along with maintaining liver weight.

Chronic diseases

Khan[41] reported that cordia-1((4 5)-1formy 1-4-dihydroxy-3oxo 3-4 dihydro-2H-pyran-1-ium) molecular formula C6H7O5, a bioactive molecule obtained from C. macleodii has potential in binding and blocking mitogen-activated protein kinases (MAPKs) thus used to develop drug against chronic diseases like Alzheimer's, Cancer, Parkinson's, amyotrophic lateral sclerosis, neurological, diabetes, cardiovascular, pulmonary and inflammatory bowel diseases.

CONCLUSION

In conclusion *Cordia macleodii* although a threatened species, is an important medicinal plant with highly significant bioactive compounds. The continuous exploitation of this species for various economic uses by human civilization has created a great havoc to this valuable taxa, thus there is a need to preserve this species for its sustainable socio-economic uses. The global scientific communities should take special responsibility to carry detailed study on its internal composition for developing new drugs formulation used to combat various chronic diseases and to prepare medicine to fight common stresses like hypertension, cardiac and neural disorders. However, the first and foremost things to be applied is, proper identification, nomenclature and increasing species population through tissue culture or mother nursery techniques and above all the conservation of mother species throughout the globe.

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