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Phytochemical profile and Biological potentials of *Cordia myxa*: A review

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Abstract

Cordia myxa is called sebesten plum. It is a tree from family Boraginaceae. The phytochemical analysis on *Cordia myxa* fruit extract proved the presence of oil, glycosides, flavonoids, sterols, saponins, terpenoids, alkaloids, phenolic acids, coumarins, tannins, resins, gums and mucilage. Pharmacological studies indicated that it has analgesic, anti-inflammatory, immunomodulatory, antimicrobial, antiparasitic, insecticidal, cardiovascular, respiratory, gastrointestinal and protective effects. This review was done to highlight the chemical constituents and pharmacological effects of Cordia *myxa*.

Keywords: *Cordia myxa*, chemical compounds, plants, bioactivities.

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1. Introduction

Boraginaceae (borage) family comprises about 2740 species distributed in 148 genera [1]. Different chemical constituents isolated and characterized from *Boragina ceous plants*, including pyrrolizidine alkaloids, naphthaquinones, flavonoids, terpenoids, triterpenoids and phenols [2]. *Cordia* is an important and representative genus of this family that could grow as trees, shrubs or sometime essubscandents [1]. The generic name honours a sixteenth century botanist, Valerius Cordus [3]. The genus Cordia originates from tropical and subtropical regions. About3 00 species have been identified worldwide, mostly in the warmer regions. *Cordia myxa* (Syn. *Cordia obliqua*, *Cordia crenata*) is a medium sized deciduous tree about10.5m [4]. The chemical characteristics of this genus are the presence of quinones which are known as cordiaquinones [1]. Pyrrolizidine alkaloids are generally present as esters. More than 200 pyrrolizidine alkaloids have been isolated from these plants. Although these alkaloids are cytotoxic and cause poisoning, *Cordia myxa* was reported to contain the nontoxic alkaloid macrophylline [2]. *Cordia myxa* fruit locally known as Bumber. It's found growing primary in Asia as well as across the globe especially in tropical regions having the right type of geophysical environment. *Cordia myxa*. seeds are a good source of antioxidant agents available in everyday life [5]. *Cordia myxa* is a sweeter fruit because it contains the maximum amount sucrose, glucose, fructose and high total dietary fiber, which plays one important role in decreasing risk of many diseases [6]. Also, *Cordia myxa* fruit is a rich source of protein, fat, carbohydrates, ash, and essential minerals such as K, Na, Ca, Fe and Zn [7]. *Cordia myxa* have high levels of glycosides, flavonoids, sterols, saponins, trepenoids, alkaloida, phynolic acids, gum and mucilage [8]. So *Cordia myxa* fruit is popularly used for treatment of chest and urinary infections, Wound healing [9] and as an antihelminthic, diuretic, astringent, demulcent and expectorant agent, Moreover anti-inflammatory, and significant biological activities and anti-arthritic [10]. This review focuses on detection of the components of *Cordia myxa* and bioactivities.

2. Phytochemicals

The phytochemical analysis on *Cordia myxa* fruit extract revealed the presence of oil, glycosides, flavonoids, sterols, saponins, terpenoids, alkaloids, phenolic acids, coumarins, tannins, resins, gums and mucilage [11-15]. The fatty oil of the seeds of *Cordia myxa* was consisted of palmitic acid, stearic acid; oleic acid and linolenic acid were identified. β-sitosterol was also isolated. The flavonoids and phenolic derivative content of the five species of genus Cordia leaves (*C. francisci*, *C. martinicensis*, *C. myxa*, *C. serratifolia* and *C. ulmifolia*) was investigated. Four flavonoid glycosides, robinin, rutin, datiscoside and hesperidin, one flavonoid aglycone, dihydrorobinetin, two phenolic derivatives, chlorogenic and caffeic acid, were determined [16]. Phenolic content of *Cordia myxa* extracts was measured by Folin-Ciocalteu reagent and was calculated as gallic acid equivalents. The maximum fruit extract rich in phenolic content (11.1±1.47 mg/g gallic acid equivalent) can be obtained by hand-macerating of the peeled fruit [17]. The soluble phenolic acids of *Cordia myxa* were extracted with methanol. Total phenolic compound were 402 mg/100g [18].

3. Biological activities

3.1 Immunomodulatory activity

The immune-modulatory activity of aqueous extract of *Cordia myxa* fruit was studied in mice immunized by hydatid cyst fluid antigen HCFAg. Delayed type hypersensitivity (DTH), Mitotic index (MI) and histopathological change in spleen were studied. A higher increase of thickness of the spleen was showed in immunized mice treated with aqueous extract of *Cordia myxa* fruit after 10 days of treatment. The MI of bone marrow and spleen cells was significantly increased as a post immunized and treated mice in comparison with the other groups. Histopathological examination of spleen showed marked hyperplasia of lymphoid corpuscles and sometimes formed large follicle. Accordingly, aqueous extract was found to stimulate cell mediated and immune responses in mice [19].

3.2 Antioxidant activity

The total phenol contents of *Cordia myxa* fruits were 373.91 ± 13.93 mg/100g dry weight, and antioxidant activity (IC_{50}) was 132.53 ± 5.75 µg/ml. Plant extracts were evaluated for their phenolic content and antioxidant activity. Phenolic content was measured using Folin-Ciocalteu reagent and was calculated as gallic acid equivalents. Antiradical activity of *Cordia myxa* extracts was measured by DPPH assay and was compared to ascorbic acid. One milligram of the crude extract was found to be equivalent to 15µg of ascorbic acid [20].

3.3 Antimicrobial activity

The antimicrobial activity of *Cordia myxa* leaf extracts was studied against three bacterial strains (E. coli, *Staphylococcus aureus* and *Pseudomonas aeruginosa*), and three fungal strains (*Aspergillus niger*, *Penicillium* spp. and *Scytalidium* spp.). *Cordia myxa* proved the highest inhibition in case of *Staphylococcus aureus* and then E. coli. However, it showed no antifungal activity. Extracts of *Cordia myxa* were tested for their anti–HIV–1 activity using the syncytia formation assay. All the extracts showed a weak anti–HIV–1 activity [21].

3.4 Anti-ulcer activity

The protective effects of Cordia *myxa* fruit extract (CME) was investigated against indomethacin-induced gastric ulcer in rats. Gastric ulceration was induced by a single intraperitoneal injection of indomethacin (30 mg/kg b.w.). CME was administered orally at a dose of 125 mg/kg b.w., while ranitidine (RAN), which used as a reference drug, was given at a dose of 50 mg/kg b.w., two weeks prior to indomethacin injection. Pretreatment with CME produced significant reduction in gastric mucosal lesions, malondialdehyde (MDA), and serum tumor necrosis factor (TNFα) associated with significant increase in gastric juice mucin content and gastric mucosal catalase (CAT), nitric oxide (NO), and prostaglandin E_2 (PGE_2) levels. A similar increase in mucin content, NO and PGE_2 was not observed with RAN although it generated a preventive index of 75.9%. RAN significantly increased pH value and decreased pepcin activity, and gastric juice free and total acidity [22].

3.5 Analgesic and anti-inflammatory effects:

The analgesic and anti-inflammatory effect of the hydro-alcoholic extract of fruit of *Cordia myxa* was investigated in mice. Formalin test and acetic acid test were used for evaluation. Normal saline, oral indomethacin, intraperitoneal tramadol, 100 mg/ kg, oral hydro-alcoholic extract of fruit of *Cordia myxa*, 200 mg/ kg orally and 100 mg/ kg intraperitoneally were used for comparison. The duration of foot lickings were calculated in formalin-administered within 0 to 5 min (acute phase) and 15 to 25 (chronic phase). Acetic acid-induced writhings were counted within 10 min. The results showed that hydro-alcoholic extract of *Cordia myxa* fruit has analgesic and anti-inflammatory properties in both acute and chronic phases [23]. The anti-inflammatory effects of *Cordia myxa* fruit on experimentally induced colitis was investigated in rats. Colitis was induced by intrarectal administration of 4% acetic acid. All the animals were sacrificed 4 days after the fruit treatment. Colitis was monitored histologically and by activity of myeloperoxidase. Glutathione peroxidase, superoxide dismutase, as well as total antioxidant status and concentrations of zinc, copper, manganese, selenium, and

iron were assayed in plasma, liver, and colon. Histology of the colon of colitic rats showed acute colitis that was confirmed by a significant increase in the myeloperoxidase activity. Colitis was associated with significant decreases in the tissue activities of glutathione peroxidase and superoxide dismutase and lower concentrations of trace elements [24].

3.6 Protective effect

The hepatoprotective effect of *Cordia myxa*. (CM) extracts was studied in rats. Oxydative liver damage in rats was induced by two agents, carbon tetrachloride (CCl_4) and thioacetamide (TA). Oxydative damage was evaluated by a measurement of aspartate transaminase (AST), glutamate transaminase (ALT) and alkaline phosphatase (ALP) in sera of the rats. Several extracts of *Cordia myxa* were prepared and were fed to experimental animals over a period of two weeks. Liver recovery was assessed by re-measuring the hepatic enzymes and their comparison with the control group. CCl_4 and TA induced comparable oxidative liver damage as measured through hepatic enzymes. A significant (P=0.05) liver recovery was noticed when animals treated with CCl_4/TA were fed with CM extracts [25].

3.7 Effect on blood pressure and respiratory functions

The mechanism of broncho-relaxant effect of *Cordia myxa* was studied in sheep trachea. *Cordia myxa* extract inhibited contraction in both epithelium-intact and denuded sheep trachea rings induced by acetylcholine. The scale of relaxation with *Cordia myxa* extract was dose dependent and slightly more potent in epithelium denuded rings than epithelium-intact preparations. L-NAME (10 nM-100 µM) but not DNAME completely inhibited the relaxant effect in a concentration dependent manner. *Cordia myxa* extract-induced relaxation was inhibited by methylene blue (1-100 µM), and verapamil (100 nM), and removal of extracellular Ca^{2+}. In contrast, *Cordia myxa* extract -induced relaxation was potentiated by Nw-nitro-Larginine (L-NOARG) treatment. Accordingly, the *Cordia myxa* extract -induced relaxation may be due to nitric oxide from applied exogenously administered L-arginine as well as endogenous nitric oxide donors such as amino acid and arginine derivatives [26].

4. Conclusion

This review proved the chemical constituent, pharmacological and therapeutic effects of *Cordia myxa* as promising herbal drug because of its safety and effectiveness.

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