Review Article

A Review on Botanical, Phytochemical and Pharmacological Reports of *Conocarpus Erectus*

Sabi-ur-rehman[1], Farooq Azam[1], Shaheed Ur Rehman[2], Tasbeeh Ur Rahman[3], Ayeza Mehmood[4], Afshan Gohar[5] and Abdul Samad[5]*

[1]Institute of Pharmacy, Physiology and Pharmacology, University of Agriculture Faisalabad, Pakistan; [2]Department of Pharmacy, COMSATS University Islamabad, Lahore Campus. Pakistan; [3]Department of Medicine, Shalamar Hospital, Lahore, Pakistan; [4]Hamdard Institute of Pharmaceutical Sciences, Islamabad Campus, Pakistan; [5]Ecotoxicology Research Program, National Agricultural Research Centre Islamabad, Pakistan.

Abstract | *Conocarpus erectus* is an evergreen shrub found on the shorelines in tropical and subtropical regions of the world, throughout the America, tropical Africa, and West Indies. The main objective of this review was to highlight the relevant documented knowledge published about its botanical aspects, phytochemistry, traditional uses as well as therapeutic potential of *Conocarpus erectus*. This plant was selected due to its great medicinal importance like its leaves and fruits have been using traditionally as antipyretic, anti diabetic, anti malarial and for the treatment of conjunctivitis, syphilis, gonorrhea, orchitis, diarrhea, anemia, prickly heat and swellings etc. The plant has also reported to have pharmacological active phytochemicals i.e. conocarpan, conocarpol, gallic acid, ellagic acid, ellagitannin, castalagin, quercetin, myricetin and syringetin etc. The review expresses the ethanomedicinal potential of this plant specie as well as its importance in modern medicines.

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***Correspondence** | Abdul Samad, Ecotoxicology Research Program, National Agricultural Research Centre Islamabad, Pakistan; **Email:** samadbiochemist@gmail.com
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Introduction

Being an important natural source medicinal plants (MPs) play key role for benefits of mankind both for food as well as for medicinal purpose in the treatment of various disorders in rural areas throughout the world (Aziz et al., 2018). Plant is a central part of all the alternative treatment system i.e. traditional Chinese Medicines (TCM), Homeopathy, Naturopathy, Native American Medicines, Ayurvedic, Sidha and Eastern Medicines. Because natural preparations are regarded as one of the safe and economic source of traditional medicines as compared to synthetic medicines. Despite of its safety some medicinal plants also exhibit toxic effects so substantial precautions must be taken while using such plants for medicinal purpose also latest pharmaceutical precautions must be brought in practice for the preparation of natural formulations at a same safety standard as that of allopathic medicines. The economic and medicinal importance of plants and its knowledge were transferred from generation to generation by people without knowing their authenticity, but at present medicines from plants include a complete knowledge of botany, chemistry, pharmacology, toxicology and quality control (standardization). Out of 4,22,127 MPs worldwide only 35-70k plants are considered as medicinally active (Hasan et al., 2007) and among these only 20k plants are in use in 3rd world countries. In Pakistan out of six thousand MPs only

700 plants are known for its therapeutic importance (Stewart, 1982, Shinwari et al., 2006) and according to (Shinwari et al., 2009) about 250-300 plant species are available in Pakistani market in different forms for medicinal uses. It is very surprising that in this modern era and latest technology still 5% of MPs are analyzed worldwide for medicinal purposes while remaining MPs are still need to be examined as there is no documented knowledge available for it (Mukherjee, 2004). Pakistan is a developing country and its local population mainly relay on traditional medicines system for ailments of various disorders (Ahmad, 2004). There is almost 50k registered herbal practitioners available in Pakistan which are helping local community, in various treatments using plants or parts of plants in one way or another (Gill, 2003). Almost 60% of anticancer drugs as well as 75% of other drugs used against infectious diseases are plant origin (Wang et al., 2005). Plants medicinal potential are due to the presence of different phytochemicals, which plants synthesize for their own needs, e.g. alkaloids are synthesized by plants in order to protect from predators, similarly each and every phytochemical has its own importance in treatment against diseases (Rosenthal and Berenbaum, 2012). The use of traditional medicines or crude drugs has long been documented but still there is need to scientifically analyze medicinal plants and justify its local uses hence making it possible to enhance the use of medicinal plants in an appropriate way (Bouzeraa-Bessila, 2013).

Botanical description and habitat of Conocarpus erectus

Conocarpus erectus, commonly known as buttonwood/ button mangrove (fruits being button like), belongs to genus *Conocarpus* (having 2 species of flowering plants) and family Combretaceae. *Conocarpus erectus* can withstand elevated temperatures, air pollution, poor drainage, trampled soil and salty soil etc (Gilman and Watson, 1993). It has two verities i.e. silver with pubescent leaves and the other green having glabrous leaves. The species of this genus are native to shorelines in tropical and subtropical region of the earth (Abdel-Hameed et al., 2012, Rosa Galdino Bandeira, 2003, Schoener, 1988). The tree grows up to 30-40 ft height whereas it can spread up to 20-30 ft (Gilman and Watson, 1993). It is an evergreen tree. It may have dull grayish green leaves (2-7 cm long and 1-3 cm wide) which are arranged alternatively. Each leaf has two small glands attached at the base. It has an unremarkable petite greenish blossoms and reddish brown small scaly button like fruits (5 to 8 mm in diameter). The bark (rich in tannins) is brown, scaly and ridged in appearance, give very attractive look. It is located on southern and mid Atlantic states from Florida to North and South America throughout the West Indies and from Mexico to Brazil and Ecuador (Stearn, 1958, Semple, 1970, Bailey and Ethel Zoe 1976). This specie is also found in western Africa and was introduced in Arab countries including Kuwait, Saudi Arabia and emirates because they can tolerate excessive heat and brackish water (Abdel-Hameed et al., 2012). This specie can grow almost in every type of soil as it can withstand air pollution, poor drainage, trampled soil and salt containing soil etc. (Gilman and Watson, 1993). It has been successfully grown in different metropolitan cities despite of the air pollution and deficiency of water. Buttonwood found in Florida is suitable specie to be grown on sea side because this specie can tolerate heat and sun shine as well as salty, alkaline, sandy and wet soils (Gilman and Watson, 1993). This specie is considered very strong and tough and is suitable for urban conditions therefore it is used to make long lasting durable streets and parking lots (Al-Wabel et al., 2015).

Traditional Uses

Conocarpus wood might have been in the past utilized for fire, furniture, charcoal, as it is very hard and strong wood (Al-Wabel et al., 2015). It burns slowly and because of this reason its wood along with bark is considered suitable for smoking fish and red meat. For the treatment of many disorders traditionally local people is using this specie in the management of orchitis, preekly heat, headache, anemia, bleeding, catarrh, diabetes, diarrhea, conjunctivitis, tumors, gonorrhea, syphilis, and as anti pyretic and anti inflammatory in the treatment of fever (Decoction of leaves) and swellings (Nascimento et al., 2016, Raza et al., 2016, Raza et al., 2018). Its bark as well as fruits are used in the management of diabetes, haemorrhoids, wounds (Santos et al., 2018). To best of our knowledge little documented data is available in literature regarding its phytochemicals and pharmacological studies as well as it toxicological studies.

Phytochemical screening

Phytochemicals isolated from *C. erectus* includes Gallic acid, Ellagic acid, 3,3′-Dimethoxyellagic acid (Nawwar et al., 1982), Brevifolin carboxylic acid (Nawwar et al., 1994) Quercetin 3-*O*-glucuronide (Nawwar et al., 1984), Myricetin 3-*O*-glucuronide (Nakanishi et al., 2007), Syringetin 3-*O*-glucuronide

(Bohm and Collins, 1975), Ellagitannin, castalagin (Ayoub, 2010), Quercetin (Nawwar et al., 1984), Myricetin (Nakanishi et al., 2007), Syringetin (Yasukawa et al., 1990) and 3,4,3′-Trimethoxyellagic acid (Alam and Tsuboi, 2007). The new trimethoxy-ellagic glycoside, 3,3,4-tri-*O*-methylellagic acid 4-*O*-β-glucupyranuronide, an amorphous yellow powder (methoxy-ellagic acid-*O*-glycosides) as well as 12 others previously known phenolic compounds are isolated from its leaves (Ayoub, 2010). From the stem wood of *C. erectus* conocarpan, dehydrodi-isoeugenol (lignan), conocarpol, 1,4-diarylbutane (lignan) and 2'-methoxyconocarpol has been isolated as pure compounds (Hayashi and Thomson, 1975). Tannins, saponins, flavonoids, tri-terpenoids were identified in the aqueous, n-hexane, meOH extracts of *C. erectus* respectively while coumarins, alkaloids and saponins were absent. (Nascimento et al., 2016).

Evidence-based pharmacology

Locally, *C. erectus* has been using to treat many disorders like anemia, malaria, fever, swelling, diabetes, syphilis, gonorrhea, catarrh, conjunctivitis, diarrhea, orchitis and preekly heat (Nascimento et al., 2016, Abdel-Hameed et al., 2012, Ayoub, 2010, Abdel-Hameed et al., 2013). Keeping in view its local uses scientists tried to justify its different extracts as well as bioactive constituents by performing various biological assays which are discussed below.

Acute toxicity

Aqueous extract of *C. erectus* Linn leaves was examined for acute toxicity using female albino mice and results justified low acute toxicity. LD_{50} calculated was 2gm/kg body weight. In another toxicity experiment by (Abdel-Hameed et al., 2013) who examined different parts of this specie i.e. leaf, stem, flower and fruit showed that MeOH extracts being administered intraperitonally, was safe and there was no mortality noticed in mice at a dose up to 5gm/kg of body weight during 24 hours of observation. Its LD_{50} was calculated i.e. > than 5000 mg/kg B.W. (Nascimento et al., 2016).

Antioxidant activity

The defatted me OH extracts of several parts of *C. erectus* and its organic fractions were examined for their free radical scavenging properties. MeOH extracts of fruit showed significant anti-oxidant activity, using phosphomolybdenum method i.e. 630.1±5.79 mg than the methanol extracts of other tested parts of *C. erectus* i.e. flowers, stem as well as leaves (579.5±7.58, 570.7±4.37 and 376.3±2.19 respectively. All results were compared to that of ascorbic acid equivalent /g extract as standard.

DPPH assay

Defatted MeOH extracts of Leaves, fruits, flowers as well as stem of *C. erectus* showed significant free radical scavenging activities against DPPH in a range of IC_{50} between 6.47-9.4ug/ml (Abdel-Hameed et al., 2013). In another assay of DPPH free radical scavenging activity n-butanol fraction of *C. erectus* were investigated in comparison with the results of standard drug ascorbic acid and results shown that this plant specie has considerable antioxidant potential (Hussein, 2016).

Hepatoprotective activity

management of intoxicated albino mice using methanol extracts (defatted with n-hexane) of fruit, flowers, leaves as well as stem of *C. erectus* using dose of 500 mg/kg for duration of two weeks significantly lowered the levels of ALT in blood (p<0.5 and P<0.01) whereas blood urea level was not decreased significantly (Bashir et al., 2014).

Anticancer activity

Cytotoxicity studies were carried out on ethyl acetate as well as *n*-butanol extracts of leaves, flowers, fruit and stem using SRB assay method. HepG2 which are (liver cancer) and MCF-7 (breast cancer) cancer cell lines were used at NCI (National cancer institute) in Egypt. The max. Inhibition was shown by stem and leaves fractions. IC_{50} of ethyl acetate ext. of stem was 8.97µg/ml against HepG2 cell line while that of leaves was 8.99µg/ml. The IC_{50} values were also calculated for MCF-7 cell lines against all the tested extracts of *C. erectus*. The highest inhibition was recorded for n-butanol fractions of flowers and its IC_{50} is 7.60 µg/ml. IC_{50} of ethyl acetate fraction of fruit was also significant i.e. 10.82 µg/ml. Among all the tested extracts of *C. erectus* most of these samples gave significant results as their IC_{50} values were < 20 which is the standard range for herbal crude extracts by NCI (American Cancer Institute) (NCI).

Antimicrobial activity

Purified tannins as well as crude extracts of different parts of *C. erectus* were studied against gram positive and gram negative bacterial strains as well as fungal strains using agar disc diffusion method. In case of

tannins max. xone of inhibition (ZOI) was recorded against *S. cerevisiae* (fungal specie) i.e. 14.3±0.58 mm. Crude ext. of flowers, fruits, leaves as well as stem shown moderate activity only against *S. cerevisiae* (fungal specie) with ZOI 11.3±0.5 mm, 13.3±0.5 mm, 10.3 ±0.5 mm and 11.0 ±1 mm respectively. In antibacterial study most sensitive bacterial strains were gram positive as compared to gram negative and acid fast bacteria. In results calculations max. ZOI were recorded against gram positive bacterial strains i.e. *S. aureus* and *B. subtilis* which is 21.00 mm and 23.00 mm respectively (Bashir et al., 2014).

In another antibectrial assay of n-butanol extract of *C. erectus* max. ZOI was recorded against *Streptococcus pneumonia* i.e. 22 mm, against E. coli its ZOI was 21mm which was also the same in a previous experiment conducted by (M. Akinpelu et al., 2016) results were compared to standard control Ciprodar (ZOI = 25 mm and 23 mm respectively) (Hussein, 2016).

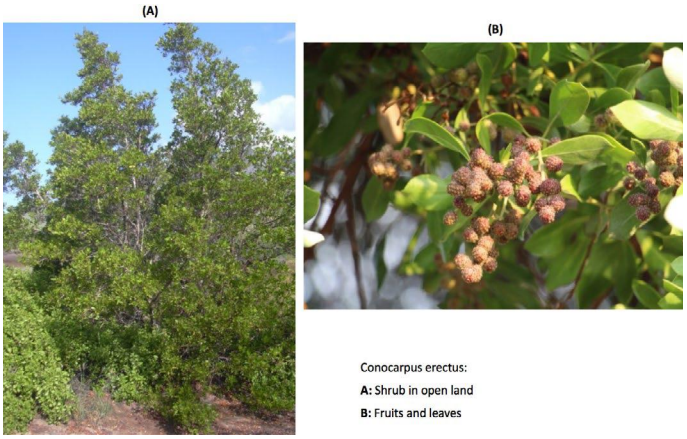

Figure1: *Conocarpus erectus (Picture is taken at COMSATS University Islamabad, Lahore Campus on 20th of June 2018).*

Conclusion and Recommendations

Conocarpus erectus is an evergreen tree, successfully grown in different metropolitan cities despite of the air pollution and deficiency of water. In the polluted environment of Karachi (Pakistan), it was successfully grown in green belts on road sides in different countries of the world. In Saudi Arabia, United Arab Emirates and Kuwait deserts, mangroves are grown to increase natural greenery and remediation of oil-polluted soil after Gulf war in 1911 (severe environmental pollution due to damage of 600 oil wells) because Conocarpus tree can absorb heavy metals and brackish water (Al-Surrayai et al., 2009). Despite this, *Conocarpus erectus* exhibits strong therapeutic potential against vast types of diseases. The rural people of Pakistan using *Conocarpus erectus* to combat infectious diseases, but still scientific approaches are required for the rational use of this medicinally important plant species.

Author's Contribution

Sabi-ur-rehman: Conception and Data collection.
Farooq Azam: Data collection.
Shaheed Ur Rehman and Tasbeeh Ur Rahman: Critical revision of the article.
Ayeza Mehmood: Data analysis and interpretation.
Afshan Gohar: Drafting and proof reading the article
Abdul Samad: Conception, interpretation and drafting of the work.

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