



Review Article

ANTIMICROBIAL ACTIVITY OF MEDICINAL PLANT EXTRACTS

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Abstract- Antimicrobial agents are mostly found in medicinal plants. Most population in the developing countries use plant-derived medicine. Plants are rich in a variety of phytochemicals including tannins, terpenoids, alkaloids, and flavonoids which have been found in vitro to have antimicrobial properties against the pathogens and are used for the formation of drugs and traditionally to cure the various diseases. Medicinal plants are the important substances for the study of their traditional uses through the verification of pharmacological effects and can be natural composite sources that act as new anti-infectious agents. Some plants have been reported for their antimicrobial activity from around the world. The present study investigated the antimicrobial activity of ethanol, methanol and aqueous extract of *Calotropis procera*, *Eichhornia crassipes*, and *Datura innoxia* plants are determined on four bacteria's i.e. *Escherichia coli* (MTCC-40), *Staphylococcus epidermis* (MTCC-435), *Pseudomonas aeruginosa* (MTCC- 424), and *Bacillus subtilis* (MTCC- 736) by using well diffusion method.

Keywords- Medicinal plants, Antimicrobial activity, Phytochemicals

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Introduction

India is Medicinal plants have been effective source of both traditional and modern medicines which are used for primary health care. The plant extracts and phytochemicals have antimicrobial properties so that they can be used in therapeutic treatments [1]. All plants contain different compounds (flavonoids, alkaloids, Tannins, phenols etc.,) which have biological significance and these are more complex and specific. The plant extracts of aqueous, methanol and ethanol used in allopathic medicine are good source of antiviral, antitumor and antibacterial agents (alcohols, chlorine) [2]. Depending on the natural characteristics, aquatic plants such as *Eichhornia crassipes* have economic and environmental uses are as:

1. In drainage canal, it reduces flow of water which can result in flooding.
2. It can interfere with navigation of commercial craft.
3. It reduces the dissolved oxygen level and increase sedimentation.

Some species have medicinal value while other are consumed in human diet and other species are good resource of minerals and vitamins. Depending upon species, season and location, aquatic weeds is differing in their chemical composition [3]. Now a day, natural products which are derived from plants are being tested for the presence of new drugs which shows pharmacological action. Large numbers of secondary metabolites like flavonoids, phytic acid, phytoestrogens, and carotenoids produced in higher plants. Recent, studies involve the new therapeutic compounds of medicinal importance from higher plants for specific diseases are identified and isolated. Flavonoids are the bioactive phytoconstituents which belong to the family of polyphenols having an important role in control and prevention of tissue damage by activated oxygen species. Flavonoids have antioxidant protective effects on anti-inflammatory, anti-coagulant properties which inhibit the initiation, promotion and progression of tumor [4]. Medicinal plants are producing bioactive molecules which react with other organisms in the environment, inhibiting bacterial or fungal growth (antimicrobial activity). Higher plants have been shown effective source for new anti-microbial agents. Plant extracts and phytochemicals both have antimicrobial properties, which show great significance in therapeutic treatments [5].

Calotropis procera

Sodom apple is another name of *Calotropis procera*, that is a member of plant family Asclepiadaceae, a shrub about 6m high. The plant is tall, large, much branched and with milky latex throughout. In India, treatment of skin diseases, enlargements of abdominal viscera and intestinal worms are cure from root bark. In Senegal, for the treatment of cutaneous diseases such as ringworm, syphilitic sores and leprosy the milky latex is used [6]. Its local names are madar, akanda, arks, etc. In northern Nigeria dried leaves are used for asthma, cough, etc. It is used alone or with other herbs to treat common diseases such as fever, indigestion, cold, eczema and diarrhea. In addition, preparations from the latex with honey are used as antibiotics and also in the treatment of toothaches and cough. *Calotropis procera* could be a probable source of chemotherapeutic agents, thus could be used for the treatment of tinea diseases [7]. *Calotropis procera* is an Ayurvedic plant with important medicinal properties. It is identified by various languages like Swallow wort in English, Madar in Hindi, and Alarka in Sanskrit. It is mostly found in dry, sandy and alkaline soils. *Calotropis procera* is an erect, highly branched and permanent shrub or small tree that grows to a height of 5.4 m. The bark is soft and corky. The parts of the plant used in Ayurvedic medicine are the leaves, fresh or dried, the roots and root bark, and the flowers. For the fast healing of wounds, as a purgative and to treat indigestion powdered leaves are used. Skin disorders and liver problems are also treating by using it [8]. The methanol, ethanol and aqueous extracts of *Calotropis procera*, were subjected to the potential antioxidant and antibacterial activity. The results of study suggest that, stem could be a potential source of chemotherapeutic drugs for the treatment of tinea associated with epidermophyton and trichodermophyton. In central India, its root bark and leaves are used for the treatment of jaundice. The damages of liver by Carbon Tetrachloride (CCl₄) is protected by chloroform extract of root of *Calotropis procera* [9].

Datura innoxia

Datura is one of the most plants which show hallucinogenic properties.

Datura is now divided into five sections; the Genus contains about ten different herbaceous species, the most important ones *Datura stramonium*, *Datura innoxia*, *Datura metel*, and *Datura ceratocaula*. *Datura* can be found throughout Asia, Europe, and the Americas as either native or adventive plants, and some have also found in Africa and Australia. By Botanists the "nut" of the plant was recognized as a fruit of a solanaceous plant, later on called *Datura metel*. The chemistry and alkaloid composition of *Datura* is also important to understand the plant history. Alkaloids have some medicinal value in *Datura*. The medicinal value of the alkaloids is significant, but *Datura* is not considered the best source for them. In *Datura atropine* is present in small amounts and can be extracted from hyoscyamine in a commercial process. The alkaloid has a paralyzing action that used in the treatment of asthma [10]. *Datura* is belonging to the family Solanaceae and genus *Datura*. It has been a popular poison for suicide and murder in some parts of India and other countries. The presence of alkaloids From *Datura* seeds in feeding stuffs may be responsible for chronic and/or subclinical toxic effects; acute poisoning from *Datura* seeds is rare. Pigs are the most sensitive animals to *Datura* poisoning, followed by cattle, horses and chickens [11]. Common names for *Datura* are numerous, some of the most common ones being raving nightshade, thorn apple, stinkweed, Devil's apple, Jimson weed, and angel's trumpet [12]. It is also known as Dhatura which is also medicinal. Seeds are used to cure premature ejaculation and are sedative; it also cures asthma and gastric problems; some local inhabitant consider this plant to subject to have antitumor activity [13]. *Datura* is belonging to Nightshade family and tea made from the plant is reported to have stronger hallucinogenic properties. After drinking the tea, a person may experience sweating, salivation, widespread paralysis of the parasympathetic system (controls breathing, salivation, and defecation) and acute psychosis or delirium. *Datura* is very lethal in high doses [14].

Eichhornia crassipes

Eichhornia crassipes also known as water hyacinth or water lily belonging to the family Pontederiaceae and considered as the world's worst aquatic weed. Its environment ranges from tropical desert to subtropical or warm temperate desert to rainforest zones. It tolerates annual temperatures ranging from 21.1°C to 27.2°C and its pH to be likely at 5.0 to 7.5. The main objective of the present work is to determine the number of flavonoids in the extracts of shoot of *Eichhornia crassipes* after an initial phytochemical screening [15]. Water hyacinth is a flowering, floating, perennial weed (requiring a wet habitat), form dense rafts in the water and mud. It can grow faster to very high densities thereby completely clogging water bodies, which in turn may have negative effects on the environment, human health and economic development. It contains a variety of active compounds with antimicrobial activity such as tannins, flavonoids, alkaloids and saponins. Alkaloids & flavonoids have been used as antiviral, antibacterial, antiamoebal & anticancer agents. Phenolic and polyphenolic are the other group of secondary metabolites. Water hyacinth is a floating, flowering weed form dense rafts in the water and mud. It can quickly grow to very high densities which have fully clogging water bodies, which in turn may have negative effects on the environment, human health and economic development [16]. It is a species of great ornamental value used in gardening because of the beauty of its foliage and flowers but it is most dangerous species. Most of the problems associated are due to its rapid growth rate, its ability to successfully compete with other aquatic plants, and its ease of propagation [17].

Review of Literature

Satish *et al.*, (2007) studied the aqueous extract of fifty-two plants from different families and tested their antifungal activity against eight species of *Aspergillus* such as *Aspergillus candidus*, *Aspergillus columnaris*, *Aspergillus flavipes*, *Aspergillus flavus*, *Aspergillus fumigatus*, *Aspergillus niger*, *Aspergillus ochraceus*, and *Aspergillus tamarii* which was isolated from sorghum, maize and paddy seed samples. After the testing of fifty-two plants, aqueous extract of *Acacia nilotica*, *Achras zapota*, *Datura stramonium*, *Embilica officinalis*, *Eucalyptus globules*, *Lawsonia inermis*, *Mimusops elengi*, *Peltophorum pterocarpum*, *Polyalthia longifolia*, *Prosopis juliflora*, *Punica granatum* and *Syngium cumini* have antifungal activity against *Aspergillus* species. *Aspergillus flavus* have highly

resistance and hence solvent extracts viz., petroleum ether, benzene, chloroform, methanol and ethanol extracts of all the twelve plants were tested for their antifungal activity against it. The solvent extracts tested, methanol was more effective than ethanol, chloroform, benzene and petroleum ether, except for *Polyalthia longifolia*, whereas petroleum ether extract have more antifungal activity than other solvent extracts. Kareem *et al.*, 2008 studied the antimicrobial effect of ethanol, aqueous and chloroform extracts of leaf of *Calotropis procera* on six bacteria namely, *Escherichia coli*, *Staphylococcus aureus*, *Staphylococcus albus*, *Streptococcus pyogenes*, *Streptococcus pneumoniae* and three fungi: *Aspergillus niger*, *Aspergillus flavus* were determined by using agar well diffusion and paper disk methods. The results exposed that ethanol was the best solvent for antimicrobial activity of leaf and latex of *Calotropis procera*. The ethanol extracts of *Calotropis procera* latex gave the widest zone of inhibition (14.1mm) against *Escherichia coli* using agar well diffusion whereas by using same organism in the disc plate method showed 9.0 mm zone of inhibition. By ethanol extracts the growth of fungi was inhibited although the aqueous extract was the least effective on the test fungi. The results were show that the of *Calotropis procera* used as traditional medicine. Kaushik *et al.*, 2008 studied the antibacterial activity of *Datura innoxia* by preparing their crude aqueous and organic extracts against Gram-negative bacteria (*Escherichia coli* and *Salmonella typhi*) and Gram-positive bacteria (*Bacillus cereus*, *Bacillus subtilis* and *Staphylococcus aureus*). The results indicated that the pattern of inhibition depends upon the part of the plant. As compared to stem and root extracts, Leaves extract were shown better activity. From all the extracts, methanol extract was shown most antimicrobial activity against all the bacterial species. Gram-positive bacteria were most sensitive as compared to Gram-negative bacteria. *Staphylococcus aureus* was inhibited b all the extracts even at very low MIC followed by other Gram-positives. The end point was not reached for ethyl acetate extract for *E. coli* while it was very high for other extracts. Kawo *et al.*, 2009 studied on the phytochemistry and antibacterial effects of ethanol and aqueous extracts of the leaves and latex of *Calotropis procera* on four pathogenic clinical isolates bacterial namely *Escherichia coli*, *Staphylococcus aureus*, *Salmonella* species and *Pseudomonas* species by using paper-disc diffusion and broth dilution techniques. The result was obtained that ethanol was the best extractive solvent for the antibacterial activity of the *Calotropis procera* leaves and latex. They also studied phytochemical analysis of the leaf and latex extracts which show the presence of tannins, steroids, saponins and flavonoids while in both extracts' alkaloids were absent. The antibacterial activity of the leaf extracts had stronger activity in comparison with latex. Vasu *et al.*, 2009 evaluated the aquatic plants that produce a variety of compounds which show therapeutic properties and can be used as food and feed. For the development of new antimicrobial drugs these substances are used. The author studied on three aquatic plants *Eichhornia crassipes*, *Ipomoea aquatica* and *Nymphaea pubescens*. For the biomolecules and phytochemicals, these three aquatic angiosperms were analyzed. Kumar *et al.*, 2010 reported the medicinal effects of plant materials due to the combinations of secondary products present in the plant. In plants, these compounds have secondary metabolites such as alkaloids, steroids, tannins, and phenol compounds, which are synthesized and deposited in specific parts or in all parts of the plant. *Datura* is a medicinal plant was tested against three microorganisms *Escherichia coli*, *Bacillus amyloliquefaciens* and *Pseudomonas aeruginosa* for antibacterial activity. Kumar *et al.*, 2010 studied that *Calotropis gigantea* is a common wasteland weed and also known for various medicinal properties. The leaves of *Calotropis gigarentea* were used for the antimicrobial activity against clinical isolates bacteria. The aqueous extract of the *Calotropis gigantea* was studied for its antagonistic activity against *Staphylococcus aureus*, *Escherichia coli*, *Bacillus cereus*, *Pseudomonas aeruginosa*, *Micrococcus luteus* and *Klebsiella pneumoniae*. In vitro antimicrobial activity was performed by well diffusion method in Miller Hilton agar. The extract showed maximum zone of inhibition against *E. coli*, whereas, lowest against *Klebsiella pneumoniae*. Crude extract showed maximum inhibition against *B. cereus* and lowest inhibition against *Micrococcus luteus*. By agar well diffusion method minimum Inhibitory Concentration (MIC) was measured. Extract showed 50, 25, 6.25, 3.1, 1.5 and 12.5 mg/ml MIC values for *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Bacillus subtilis*, *Pseudomonas aeruginosa*,

Micrococcus luteus and *Escherichia coli*. Vadlapudi, 2010 studied the antimicrobial activities of the methanolic plant extracts of *Abutilon indicum*, *Adenocalymma alliaceum*, *Carica papaya*, *Crotalaria laburnifolia*, *Croton bonplandianum*, *Derris scandens*, *Eichhornia crassipes*, *Iopomea hispida*, *Moringa heterophylla*, *Peltophorum pterocarpum* that have been normally used as folk medicines. The antimicrobial activities of the organic solvent extracts against various test microorganisms, including bacteria and fungi such as *Alternaria alternate* (MTCC 1362), *Aspergillus flavus* (MTCC 4633), *Fusarium oxysporum* (MTCC 1755), *Rhizoctonia solani* (MTCC 4633), *Xanthomonas compestries* (MTCC 2286) were analyzed by using agar well diffusion technique. Akharaiyi *et al.*, 2011 studied the antibacterial activity of crude aqueous and ethanol extracts on leaf, stem bark and roots of *Datura metel* against eight clinical isolates bacteria (*Streptococcus hemolytic*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Bacillus cereus* and *Streptococcus dysenteriae*) by well diffusion method agar method. The leaf and stem bark of the plant shown antagonistic activity against the bacteria species with zone of inhibition between 35-12 mm while the highest zone of inhibition was displayed by one drug (streptomycin) was 45 mm at 10mg/ml concentration. The aqueous extract shows zone of inhibition between 22-10 mm while the crude ethanol extract has inhibition affinity between 32-12 mm. The aqueous extracts of the plants were more sufficient than ethanol extract in the extraction of the substances with phytochemical and antioxidant activities. The phytochemical compounds mainly present in the crude aqueous and ethanol extracts of the plant parts were saponins, flavonoids, alkaloids, glycosides and phenol. The study evaluated the plant act as natural source of antioxidants and phytochemical compounds for antimicrobial activity. Baral *et al.*, 2011 studied the bioactivity of water hyacinth by using the soxhlet extraction (hot method) and cold percolation method in chloroform and ethanol to evaluate the antimicrobial activity of the plant. The well diffusion method was used to perform antimicrobial activity against different bacterial strain. The result showed that the presence of biologically active phytochemicals in aquatic weed and has strong antimicrobial activity. It may be useful for developing alternative compounds to treat infectious diseases caused by bacterial and fungal pathogens. Johnson *et al.*, 2011 studied several antimicrobial compounds are used in all traditional medicine. The leaf extracts of *Aloe vera*, *Datura stramonium*, *Pongamia pinnata*, *Lantana camara*, *Calotropis procera* were screened for the antimicrobial activity. These aqueous and alcoholic extracts of plants were prepared by decoction and hot percolation process against the pathogens *Staphylococcus*, *Escherichia coli* and *Aspergillus species*. Different dilutions of the test drugs were prepared with saline and by using Turbidity method. Alcoholic extracts show higher antibacterial and antifungal activity than aqueous extract. Results concluded that *Aloe vera* had highest and strong activity against *Staphylococcus aureus* and *Escherichia coli*. *Lantana camara* does not show antibacterial and antifungal activity. *Datura stramonium* showed better activity against *Staphylococcus aureus* and showed little anti *Aspergillus* activity. *Calotropis procera* showed antibacterial activity against *Staphylococcus aureus* and *Escherichia coli* and does not showed anti *Aspergillus* activity. Oseni *et al.*, 2011 studied the fruits of *Datura stramonium* L (thorn apple) which were separated into seed coat, seeds and whole seeds, the various parts of thorn apple were analyzed for their composition, minerals and functional properties. The results showed that, in the seed coat protein and ash were highly spread than the seed. In contrast the seed were containing higher fat, carbohydrate and fiber contents than the coat. Additionally, the seeds also contained higher concentration of phytate, tannin and oxalate than the coat. The gain of water absorption, foaming capacities and least gelation were higher in the seed coat than seed. In seed coat oil absorption and emulsion capacities were also higher than seed. The result of the physicochemical properties indicates that, oil of *Datura* could be utilized for industrial purposes. Mako *et al.*, 2012 analyzed the antimicrobial activity of aqueous and ethanol extract of root and leaves of *Calotropis procera* against *Staphylococcus aureus*, *Streptococcus pyogen*, *Escherichia coli* and *Pseudomonas aeruginosa* was done by disc method. By using crude ethanol and aqueous extracts of *Calotropis procera* showed zone of inhibition against bacteria. The result was obtained that both ethanol and aqueous extracts of *Calotropis procera*, had inhibitory effect on the growth of isolates. The activity of ethanol

extract of the leaves and roots was greater than the aqueous extract of leaves and roots. This result provides a support for the use of *Calotropis procera*, in traditional medicine and suggest its further advance investigation.

Conclusion

All these plants were screened against the pathogens *Bacillus subtilis*, *Staphylococcus epidermidis*, *Escherichia coli* and *Pseudomonas aeruginosa* were used to evaluate the antimicrobial activity of plant extract (methanol, ethanol and aqueous extract). The antimicrobial activity almost shown by *Bacillus subtilis*, *Staphylococcus epidermidis*, *Escherichia coli*, *Micrococcus lutes* and *Streptomyces Cattaleya* but *Pseudomonas aeruginosa* show less activity in all plant extract.

Application of review: Phytochemical analysis also done which shows the phytochemical constitutes such as alkaloids, flavonoids and tannins are present in plants and may pharmaceutical and medicinal value.

Review Category: Phytochemical analysis

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Study area / Sample Collection: Chandigarh University, Mohali, 140413, Punjab

Cultivar / Variety name: *Calotropis procera*, *Eichhornia crassipes*, and *Datura innoxia*

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