

A Comparative Study of Antimicrobial and Pharmacological Properties of *Argemone mexicana*, *Solanum xanthocarpum* and *Thevetia peruviana*

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Abstract

Extracts obtained from different parts of the plants are reported to exhibit therapeutic potential due to presence of different phytochemical compounds. The extracts plant leaves, stem, seeds, flowers, fruits and roots of so many medicinal plants and weeds have been found to contain antibacterial and therapeutic potential. However, not much work has been conducted with the extracts of *Argemone mexicana*, *Solanum xanthocarpum* and *Thevetia peruviana*. This article presents a recent account of preparation of extracts from different parts of these plants, their chemical and biochemical characterization and future perspectives.

Keywords: *Argemone mexicana*; *Solanum xanthocarpum*; *Thevetia peruviana*

Introduction

Therapeutic potential of medicinal plants have proved to be a boon to mankind. The medicinal plants are known to contain different pharmacological properties. In addition many wild and ornamental plant species have been found to offer protection of humans from variety of ailments and diseases [1-3]. The increased resistance of microorganism may be associated with unrestricted use of antimicrobial substance or antibiotics. With the current trend of rise in resistance in microorganism towards many antibiotics, the treatment of several diseases by using antibiotics is posing challenge to chemotherapy. Thus, there is an urgent need of some novel drugs to cure various microbial infections and diseases. It prompted the workers to explore new plant based molecules as modern antimicrobial substances which may prove to be safe, cost effective and efficient regimen [3-5].

Some weeds are known to have toxicants. Such weeds might be using these toxic chemicals in order to protect themselves from other living beings. Some of these plants contain certain phytochemicals which act as therapeutic agents. These compounds possess significant antimicrobial properties and immense potential to cure deadly diseases [6].

Different parts of the plants such as leaves, stem, seeds, flowers, fruits and roots of so many medicinal plants and weeds have been reported to have antibacterial potential from last two decades. The extracts from these parts of the plants have been shown to contain major phytoconstituents such as Alkaloids, glycosides, flavonoids, sterols, tannins and luxuriant antibacterial compounds [7,8].

Argemone mexicana L. (Papaveraceae), is mainly found in Mexico but now it is widely distributed in many parts of the world

including India, Bangladesh, United States and Ethiopia. It is a species of poppy [8] and commonly known as Prickly Poppy in English and "pili kateri" in Hindi (Figure 1). Some workers have reported that leaves and seeds of *A. mexicana* have significant antimicrobial activity. The essential oil of *A. mexicana* is also found active against some microbial species [9].



Figure 1: The leaves, flowers, fruits and seeds of *A. mexicana*.

The plant, *Solanum xanthocarpum*, belonging to the family Solanaceae, is commonly known as yellow Berried Night Shade or Indian night shade plant. Another synonym to it is Kantakari (Figure 2). It is used for various medicinal purposes in many regional areas. The plant is known to contain chemical ingredients of medicinal significance. The leaves, stem, flowers, fruits and roots of the plant are used in Aurvedic medicines. It contains several phytochemicals such as alkaloids, flavonoids, phenolics, flavonoids, tannins, carbohydrates, glycosides and saponins in plenty in addition to some essential amino acids and fatty acids. "Dasmula Ashva" is prepared by roots of *S. xanthocarpum* [10,11]. The extracts of *S. xanthocarpum* exhibited antioxidant, antifertility, anticancer, antipyretic, antifungal, antibacterial antiallergic, anti-inflammatory, antihistamine, and hypoglycemic properties [11].

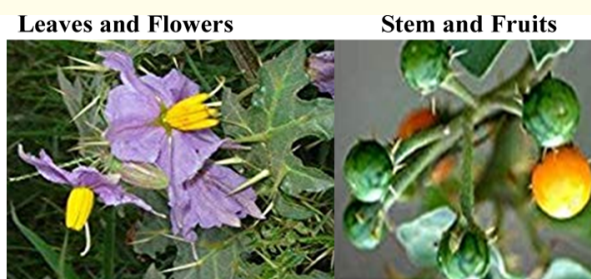


Figure 2: The leaves, flowers, stem and fruits of *S. xanthocarpum* (Kantkari).

The plant, *Thevetia peruviana*, belongs to the family Apocynaceae, commonly known as Yellow oleander and Lucky nut. Several species of this plant are found world-wide, mostly in India, Australia, and China. It is a shrub grown for ornamental and medicinal purposes (Figure 3).

Leaves, Stem, Flowers and Fruits



Figure 3: The leaves, stem, flowers and fruits of *T. peruviana*.

The extracts of stem and bark of the plant have been reported to antipyretic properties. The leaves of this plant contain Flavanones and Flavanol glycosides which are used as antimicrobial agents especially against *Cladosporium cucumerinum*. The extracts of leaves of this plant have also been found to possess antiHIV-1 RT and antiHIV-1 integrase properties. The extracts of its seeds are reported to exhibit genotoxic potential. In addition, the bioactive chemical ingredients isolated from *T. peruviana* may be used as fungicides, bactericides, insecticides and rodenticides [12].

Materials and Methods

The methodology involved in the preparation of the present manuscript associates collection of various review articles, research articles and case studies / reports from various sources such as Google Scholar, PubMed, ResearchGate and Semantic Scholar.

Traditional perspectives of plants

From the ancient times plants have been known for their potential of having antibiotic properties to treat microbial diseases involving bacterial, viral and fungal infections. The plant parts root, leaves, stem and flowers have been utilized by Indians as medicinal source. The presence of medicinal property is due to presence of secondary metabolites in plant. As per World Health Organization (WHO), a huge variety of drug can be obtained by medicinal plants [2,3].

Argemone mexicana is traditionally used as hallucinogenic, analgesic antispasmodic, antimicrobial [13] and antitussive [8,14]. In snake poisoning seeds of *A. mexicana* have been used as an antidote [15]. The treatment of diuretic, leprosy, cold sores, wound healing, scorpion sting, warts skin diseases, itches, jaundice, malarial fever, anti-inflammatory is by the milky seed extracts because they are rich in protein-dissolving substances. It is also used as antidote to many poisons and smoke of the seed used in toothache [8]. Another Indian weed *Solanum xanthocarpum* is reported to have therapeutic potential due to presence of phytochemicals. leaves, stem, root, fruits and flowers are used many Ayurvedic preparations. "Das-mula Ashva" is prepared from roots of the plant [10,11]. *Thevetia peruviana* used as traditional medicine by so many practitioners because it contains a wide range of natural substances which are non-allergenic, nontoxic or selectively toxic to the host and do not exhibit any side effects [16]. In general, the medicinal plants could serve as a potential reservoir for the development of novel chemotherapeutic agents against various diseases.

Pharmacological chemistry of chemical ingredients from *Argemone mexicana*, *Solanum xanthocarpum* and *Thevetia peruviana*

The plants *Argemone mexicana*, *Solanum xanthocarpum*, and *Thevetia peruviana* are well known Indian weeds. They possess medicinal properties due to presence of phytochemicals in their roots, stem, leaves, fruits, and flowers. Major phytoconstituents found in different parts of these plants are berberine, allocryptopine, sanguinarine, saponins, solanacarpine, solamargine, caffeic acid, coumarins, aesculetin, aesculin, and thevetin [17]. The pharmacological properties of some important phytochemicals are summarized in Table 1.

Antimicrobial properties of argemone mexicana, solanum xanthocarpum, and thevetia peruviana

The extracts of *A. mexicana* showed wide spectrum of antimicrobial properties observed through screening. On comparison of the antimicrobial activity of the extracts prepared from root, stem and leaves of *A. mexicana* in the solvents such as H₂O, acetone, ethanol and chloroform, the ethanolic extract of stem showed the

Plant name	Plant parts	Major constituents	Pharmacological properties	References
<i>Argemone mexicana</i>	Apigeal parts, seeds	Berberine	Anti-fertility activity Effect on ileum contraction in guinea pig, Antimalarial activity	[18,19,20,21,22]
	Apigeal parts	Allocryptopine	Effect on ileum in guinea pig Antimalarial activity	[20, 21]
	Seeds	Sanguinarine	Molluscicidal activity	[23, 21]
<i>Solanum xanthocarpum</i>	Fruit	Saponins	Function in stimulation of Heart	[24]
	Fruit	Solanacarpine, solamargine, caffeic acid coumarins, aesculetin and aesculin	Lowering of cholesterol, protection against infection by <i>Salmonella typhimurium</i> , anti-cancer activity	[24]
<i>Thevetia peruviana</i>	Seeds	Thevetin	Heart stimulant, blood pressure irreguation	[25]

Table 1: Pharmacological properties of some phytochemicals present in *Argemone mexicana*, *Solanum xanthocarpum*, and *Thevetia peruviana*.

highest potential as compared to acetone, aqueous and chloroform extracts. The ethanolic extract of *A. mexicana* stem was recorded with highest antimicrobial activity against *K. pneumoniae* followed by, *S. aureus* and *E. coli*. The authors demonstrated least inhibitory activity against *B. cereus*. In each of these experiments, a standard antibiotic, Ampicillin, was used as a positive control [8]. More *et al.* (2017) have reported that oil extracts of *A. mexicana*, exhibited significant inhibitory effects on the growth of filamentous and non-filamentous fungus (*C. albicans*) along with a few bacterial species such as *Bacillus subtilis*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus* in concentration dependent manner. While using the agar well diffusion method, they have evaluated the antimicrobial activity of crude extracts prepared from the leaves, stem, seeds and roots of *A. mexicana*. These extracts were found to be active against different bacterial species belonging to both of the groups such as the Gram positive bacteria (*Bacillus cerus*, *Bacillus subtilis*, *Clostridium perfringens*, *Enterobacter faecalia*, *botulinum Staphylococcus aureus*, and *Streptococcus agalactae*,) and the Gram negative bacteria (*E. coli*, *Klebsiella pneumoniae*, *Proteus mirabilis*, *Proteus vulgaris*, *Pseudomonas aeruginosa* and *Salmonella typhimurium*) [22].

One of such studies carried out by Rana *et al.* (2016) have shown that the *Solanum xanthocarpum* leaf extracts prepared in solvents like methanol and acetone were possessing antibacterial properties; the methanolic extracts showing better antibacterial property than that of acetone extract (Table 1). However, the acetone extracts of *S. xanthocarpum* proved to be a better antibacterial agent against certain *S. aureus* species [11].

The aqueous, hydroethaolic and ethanolic extracts of *S. xanthocarpum* inhibited the growth of Gram negative bacterial species such as *S. aureus* and *E. coli*. The aqueous extracts of *S. xanthocarpum* exhibited mild to moderate inhibition over the growth of tested bacterial pathogens. The ethanolic extract was found to be

having more potent anti-microbial activity than those of aqueous and hydro ethanolic extracts [26].

The extracts from different parts of the plant, *Thevetia peruviana*, have been found to effectively inhibit the growth of several microbial species. The results as presented by Gezahegn *et al.* (2015) showed minimum inhibitory concentration (MIC) of the plant extracts prepared in the different solvents. The extracts of leaves of *T. peruviana* prepared in acetone, chloroform, methanol and petroleum ether inhibited the growth of standard strains of *E. coli*, while the leaf extract of *T. peruviana* prepared in acetone, chloroform, methanol and petroleum inhibited the growth of *S. aureus* and *S. typhimurium* [27]. However, the antimicrobial activity of *T. peruviana* leaf extract prepared in ethanol is reported to exhibit with narrow zone of inhibition against *Shigella flexineri*, *Salmonella typhi*, *Staphylococcus aureus* and *Shigella sonnei* [25].

Recently, Deshmukh *et al.* (2019) have reported that the aqueous and ethanolic extracts of flowers of *T. peruviana* exhibited maximum antibacterial activity against *E. coli* with ethanol as compared to water. They have displayed similar trend of antimicrobial activity of ethanolic extracts of fruits of *T. peruviana* against *E. coli* [28].

Conclusions

As evident from above information, each of the three plant species display significant amount of antimicrobial properties. These plant species are widely distributed in India. However, extensive work is needed to explore the antimicrobial properties of different specific phytochemicals isolated from different parts of these plants to exploit their full medicinal potential.

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Conflict of Interests

Authors declare no any conflicts of interest.

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