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Comparative Evaluation of Antimicrobial Activities of the Members of *Solanaceae*

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ABSTRACT

The present study deals with the antimicrobial activities of the chloroform, ethyl acetate and methanol leaf extracts of, Solanum anguivi Lam., S. nigrum Linn., S. pubescens Willd., S. surratense Burm.F., S. torvum Swartz., and S. trilobatum Linn. by following agar well diffusion method against human pathogens: Staphylococcus aureus MTCC *96, Micrococcus luteus* ATCC *4698, Vibrio cholerae* ATCC *14035 and Klebsiella pneumoniae* MTCC *109, Candida albicans MTCC 183, Candida parapsilosis MTCC 2509 and Candida tropicalis MTCC 184. All the ethyl acetate extracts of the selected members of Solanaceae of the selected species of Solanaceae were effective against four human bacterial species such as S. aureus, M. luteus, V. cholerae, and K. pneumoniae, and three fungal species of C. albicans, C. parapsilosis and C. tropicalis. Among these S. anguii leaf extract showed maximum antimicrobial activity against the test pathogens. The results showed that the plant could be further explored for possible antibiotic and antifungal agents and provides preliminary scientific validation of the traditional medicinal use of this plant.*

Keywords: Antimicrobial activity, Plant extracts, Growth inhibition, *Solanum anguivi*.

INTRODUCTION

Plants are used as medicines since time immemorial. India has rich heritage of using medicinal plants in traditional medicines such as Ayurveda, Siddha, Unani besides, folklore practices. The earliest mention of the medicinal uses of plants found in the Rigveda which is one of the oldest repositories of human knowledge [1]. The vast majority of people worldwide still rely on traditional medicine for their everyday healthcare needs. It is also a known fact that one quarter of all medical prescriptions are formulations based on substances derived from plants or plant-derived synthetic analogs. According to the WHO, 80% of the world's population, primarily those of developing countries depend on plant derived medicines for their healthcare [2].

Solanaceae is a large Family in Angiosperm with around 2000-3000 species in 90 different genera, found in most temperate and tropical regions, with a large number occur in Australia and Central and South America. It is a family mainly of herbs, with a few shrubs and trees, and contains many of our most well-known food plants, including Potatoes, Tomatoes, Aubergines and Peppers. It also contains many popular garden ornamental plants, including *Petunias*, *Browallia* and *Salpiglossis*. There are several poisonous species, including Deadly Nightshade (*Atropa belladonna*), Henbane (*Hyoscyamus niger*) and Thorn Apple (*Datura stramonium*), and the family also consists the important economic plant, Tobacco (*Nicotiana tabacum*), which contains the highly toxic alkaloid nicotine.

Members of this Family are often climbers or at least scrambling plants, often with hairy stems and leaves. The leaves are variable, and may be entire or dissected, without stipules, and are usually alternate. The flowers have five petals and are generally regular in shape. They may be round and flat or star-shaped, but are often bell shaped or tubular. The ovary is superior (inside the flower), and the fruit is either a berry or a capsule, often containing many light brown disc-shaped seeds.

Antimicrobial drugs are used in medicinal practices for treating food-borne diseases [3]. Use of medicinal plant extracts that are rich in antibacterial compounds could be an alternate way to eliminate these bacteria from palatable items [4,5], which has already been proved *in vitro* by Kaushik [6]. Over the last 25 years, a large number of plant species have been evaluated for their antimicrobial activity. So, the present study attempt aims to evaluate the antimicrobial activities of the leaf extracts of, *S. anguivi*, *S. nigrum*, *S. pubescens*, *S. torvum*, *S. trilobatum*, and *S. surratense* against certain selected pathogenic bacteria and fungi.

MATERIALS AND METHODS

Plants Collection:
Fresh leaf samples of *Solanum nigrum*, *S. torvum* and, *S. trilobatum* were collected from Madras University, Guindy campus and *Solanum anguivi*, *S. pubescens*, *S. surratense* were collected in and around Tirupathi and Hosur.

Preparation of plant extracts:
The leaf samples were washed with tap water thoroughly, rinsed with distilled water and shade dried (for three days) until they completely dried. Then they were cut into small pieces and ground into powder using pestle and mortar and stored at room temperature.

Plant extracts preparation:
The above leaf samples were extracted with different solvents such as, hexane, ethyl acetate and methanol 1:10 (w/v) and kept under shaking condition at 100 rpm over night [7]. The extracts were collected and repeated the above extraction procedures for thrice and collected maximum extracts. The samples were condensed and concentrated at reduced pressure by using roto-evaporator at their respective boiling points of the solvents. The concentrated samples were weighed and re-dissolved in Dimethyl sulphoxide to yield 10mg/ml for further analysis.

Antimicrobial activity:
The crude extracts were subjected to antibacterial screening against *Staphylococcus aureus* MTCC 96, *Micrococcus luteus* ATCC 4698, *Vibrio cholerae* ATCC 14035 and *Klebsiella pneumoniae* MTCC 109, *Candida albicans* MTCC 183, *Candida parapsilosis* MTCC 2509 and *Candida tropicalis* MTCC 184.

Well diffusion assay
Agar diffusion assay is used widely to determine the anti-bacterial activity of crude extract. The technique works well with defined inhibitors. Nutrient agar prepared was poured in the Petri dish and 24 h old cultures of *K. pneumoniae* MTCC 109, *M. luteus* ATCC 4698, *S. aureus* MTCC 96 and *V. chloerae* ATCC 14035 and the fungi viz., *C. albicans*, *C. parapsilosis* and *C. tropicalis* were swabbed on it. The wells (10mm diameter) were made by using cork borer. The different concentrations of the crude extracts (250µg, 500µg, 750µg and 1000µg)were added in the respective wells Dimethyl sulphoxide was served as control. The plates were then incubated at 37ºC for 24 h. The diameter of the inhibition was measured [8].

RESULTS AND DISCUSSION

Medicinal plants continued to be an important therapeutic aid for the treatment of various diseases [9]. Over the last few decades there has been much interest in the discovery of natural antibacterial agents from plants. Few of them includes *Sanseiveria roxburghiana* [9], *Cissus quadrangularis* L. [10], *Adhatoda vasica* [11], *Syzigium cumini* (L.) and *Lannea coromentalica* Houtt (Merr.) [12]. The antimicrobial activities of the leaf extract of selected 6 members belonging to the Solanaceae family were observed using the well diffusion method. Three solvents were used in this study such as Chloroform, Methanol and Ethyl acetate. *In vitro* antibacterial study indicated that methanol and chloroform extracts showed moderate activity while ethyl acetate extract showed higher antibacterial activity against the tested pathogenic bacterial strains such as *Klebsiellla pneumoniae* MTCC 109, *Vibrio cholerae* ATCC 14035, *Micrococcus luteus* ATCC 4698, *Staphylococcus. aureus* MTCC 96 (Table 1). Venkatesan *et al.*, [13] reported that

ethanolic extract of *Solanum nigrum* exhibited antimicrobial activities against 16 types of bacteria and 4 fungi. All the 6 different ethyl acetate leaf extracts of *Solanaceae* members underwent for antimycotic activities against the test fungal isolates such as *Candida albicans* MTCC 183, *Candida parapsilosis* MTCC 2509 and *Candida tropicalis* MTCC 184. Out of 6 extracts, the leaf extract of *S.anguivi* showed a broad spectrum of antifungal activity (Table 2).

Table 1 Antibacterial activity of ethyl acetate extracts of Solanaceae plants

Leaf Extracts	Organisms	Chloroform Concentrations (µg)				Ethyl acetate Concentrations (µg)				Methanol Concentrations (µg)			
	-	250	500	750	1000	250	500	750	1000	250	500	750	1000
Solanum anguivi	***K. pneumoniae* MTCC 10**	-	-	11	12	13	16	19	21	11	12	13	14
	***V. cholerae* ATCC 14035**	-	-	11	13	11	13	14	15	11	12	13	15
	***M. luteus* ATCC 46**	-	11	11	12	-	13	14	14	11	13	14	14
	***S. aureus* MTCC 96**	-	-	-	12	-	15	15	19	11	12	14	16
Solanum nigrum	***K. pneumoniae* MTCC 10**	-	-	11	11	-	12	14	15	-	-	11	11
	***V. cholerae* ATCC 14035**	-	-	14	16	-	12	13	13	-	-	11	11
	***M. luteus* ATCC 46**	-	-	-	-	-	11	13	16	-	11	13	13
	***S. aureus* MTCC 96**	-	-	-	-	-	13	15	16	-	-	-	-
Solanum pubescens	***K. pneumoniae* MTCC 10**	-	11	14	15	-	11	11	13	11	11	12	15
	***V. cholerae* ATCC 14035**	-	-	11	12	-	-	-	13	-	-	13	15
	***M. luteus* ATCC 46**	-	11	12	13	-	11	12	12	-	-	-	11
	***S. aureus* MTCC 96**	-	-	11	14	-	11	13	13	-	-	-	14
Solanum surratense	***K. pneumoniae* MTCC 10**	-	-	11	12	11	11	12	14	-	11	12	12
	***V. cholerae* ATCC 14035**	-	-	-	11	-	11	12	13	-	13	15	15
	***M. luteus* ATCC 46**	-	-	-	11	-	-	-	11	-	-	11	12
	***S. aureus* MTCC 96**	-	-	-	11	-	11	12	12	-	11	11	12
Solanum torvum	***K. pneumoniae* MTCC 10**	-	11	12	12	-	12	15	16	-	-	11	13
	***V. cholerae* ATCC 14035**	-	-	-	11	-	-	11	13	-	-	11	12
	***M. luteus* ATCC 46**	-	-	11	12	-	-	12	14	-	11	12	12
	***S. aureus* MTCC 96**	-	11	14	15	-	-	11	11	-	11	12	13
Solanum trilobatum	***K. pneumoniae* MTCC 10**	-	-	-	11	-	-	-	11	-	-	-	11
	***V. cholerae* ATCC 14035**	-	13	15	15	-	-	-	11	-	-	-	12
	***M. luteus* ATCC 46**	-	-	-	11	-	-	-	12	-	-	-	-
	***S. aureus* MTCC 96**	-	-	-	-	-	11	11	12	-	-	11	12

Table 2 Antifungal activity of ethyl acetate extract of *Solanum anguivi*

Leaf Extracts	Organisms	Ethyl acetate Concentrations (µg)			
	-	**250**	**500**	**750**	**1000**
Solanum anguivi	***C. albicans* MTCC 183**	-	-	11	12
	***C. parapsilosis* MTCC 2509**	-	11	14	17
	***C. tropicalis* MTCC 184**	-	14	18	18
Solanum nigrum	***C. albicans* MTCC 183**	-	-	-	12
	***C. parapsilosis* MTCC 2509**	-	-	-	11
	***C. tropicalis* MTCC 184**	-	11	13	14
Solanum pubescens	***C. albicans* MTCC 183**	-	-	-	-
	***C. parapsilosis* MTCC 2509**	-	-	-	11
	***C. tropicalis* MTCC 184**	-	11	13	14
Solanum surratense	***C. albicans* MTCC 183**	-	-	-	14
	***C. parapsilosis* MTCC 2509**	-	11	12	12
	***C. tropicalis* MTCC 184**	-	13	13	14
Solanum torvum	***C. albicans* MTCC 183**	-	-	-	11
	***C. parapsilosis* MTCC 2509**	-	-	11	13
	***C. tropicalis* MTCC 184**	-	-	12	14
Solanum trilobatum	***C. albicans* MTCC 183**	-	-	12	16
	***C. parapsilosis* MTCC 2509**	-	-	-	11
	***C. tropicalis* MTCC 184**	-	12	13	15

CONCLUSION

The present investigation revealed that the chloroform and methanol leaf extracts of the selected 6 members of *Solanaceae* family *were* shown moderately active against all the bacterial pathogens. The ethyl acetate leaf extracts

were found to show a wide range of antibacterial activity and the *S.anguivi* in particular exhibited greater prosperity to inhibit fungal growth even at low concentration. Further studies on this plant will certainly elucidate the identification and isolation of bioactive compounds for their pharmacological importance to check growth the growth of harmful microbial growth.

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