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Studies on antimicrobial activity and phytochemical analysis of *Solanum xanthocarpum* (Schrad and Wendl.)

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Abstract

The *in vitro* antimicrobial activity of acetone, ethanol, hexane and aqueous extract of medicinal plant *Solanum xanthocarpum* (Schrad and Wendl.) against the human pathogenic bacteria such as *Achromobacter hygiene*, *Bacillus cereus*, *Streptococcus pyogenes* and fungus *Candida parapsilosis* were evaluated. The ethanolic extract of *Solanum xanthocarpum* (Schrad and Wendl.) showed the highest activity and other extracts were also found effective against all microbial strains. A qualitative phytochemical analysis performed for the detection of bioactive compounds. Phytochemical analysis revealed the presence of compounds such as amino acids, glycosides, flavonoids, tannins, terpenoids, alkaloids, phenols, steroids, saponins and reducing sugars. The present investigation proved that *Solanum xanthocarpum* (Schrad and Wendl.) extracts possess a broad spectrum of activity against the selected pathogens. Thus, the study righteously proves the use of herbal plants in therapeutics. It thus serves as encouragements towards the development of new drugs for the benefits of mankind.

Keywords: *Solanum xanthocarpum* (Schrad and Wendl.), phytochemical analysis, antimicrobial activity, solvent, extracts

Introduction

Nature has been a source of medicinal agents for thousands of years and an imprensive numbers of drugs have been isolated from nature sources. The medicinal plants are re-emerging health aid has been fuelled by the rising costs of prescription drugs in the maintenance of personal health and well being and the bio-prospecting of new plant derived drugs (Bintu, 1997) [3]. Various medicinal plants have been used for years in daily life to treat disease all over the world. They have been used as a source of medicine. The widespread use of herbal remedies and healthcare preparations, such as those described in ancient texts like the Vedas and Bible, has been traced to the occurrence of natural products with medicinal properties. In fact, plants produce a diverse range of bioactive molecules, making them a rich source of different types of medicines (Farombi, 2003) [5].

The medicinal values of plants lay some substances that produce a definite physiological action on the human body. The most important substances are the bioactive compounds which consist of alkaloids, flavonoids, tannins, phenolic compounds etc. Numerous studies have identified compounds within herbal plants that are effective antibiotics (Basile *et al*., 2000) [2]. Traditional healing systems around the world that utilize herbal remedies are an important source for the discovery of new antibiotics (Okpekon *et al*., 2004) [9]. Some traditional remedies have already produced compounds that are effective against antibiotic-resistant strains of bacteria (Kone *et al*., 2004) [7].

Solanum xanthocarpum (Schrad and Wendl.) is a very spiny diffused herb, with a height of upto 1.2 meters. The young branches are densely covered with minute star-shaped hair, while the mature branches are zig-zag, covered with yellow, sharp shining prickles and spread close to the ground. The midribs and other nerves of the leaves have sharp yellow prickles and grow upto 10cm in length. The purple flowers, that are 2cm long with five peals can be seen in small bunches, sometimes opposite to the leaves. It bears glabrous, globular, drooping berries as fruits, yellow or pale in colour with green veins. The plant is cultivated throughout India.

Antibacterial activity of various parts (stem, leaves and fruit) of solvent extracts (petroleum ether, alcohol and acetone) of *Solanum xanthocarpum* (Schrad and Wendl.) against *Escherichia coli*, *Klebsiella pneumoniae*, *Salmonella typhi* and *Bacillus cereus* were detected by zone of inhibition. The extracts of *Solanum xanthocarpum* showed high sensitivity to *Klebsiella pneumoniae* and *Salmonella typhi*, moderate sensitivity to *Escherichia coli* and less sensitivity and resistant to *Bacillus cereus* (Udayakumar *et al*., 2003) [13]. Neelima *et al*. (2011) [8] investigated the phytochemicals present in the leaf extract of *Solanum xanthocarpum* (Schrad and Wendl.). The leaves of *Solanum xanthocarpum* contain phytochemical constituents like alkaloids, glycosides, tannins, phenolic compounds, flavonoids, proteins, amino acids, sterols, triterpenoids, carbohydrates and fats. The plant extracts also gives an idea of the presence of various phytochemical compounds.

Materials and Methods

Collection of Plant Material

Fresh plants of *Solanum xanthocarpum* (Schrad and Wendl.) were collected from Kulasekaram in Kanyakumari district. The plants were identified taxonomically. Fresh leaves were washed thoroughly in running tap water for 2-3 times and then sterile water. Then it was shade-dried, powder and used for extraction.

Preparation of Plant Extracts

10g of shade-dried powder of plant materials were macerated separately with 60ml of sterile distilled water using mortar and pestle. The macerate was first filtered through four layer of muslin cloth and then filtrate was centrifuged at 8,000 rpm for 15 min at room temperature. Supernatant was filtered through Whatman No.1 filter paper and heat sterilized at 120º C for 30min. The extract was preserved aseptically in a brown bottle at 4º C until further use (Sukanya *et al*., 2009) [12].

10g of shade-dried powder of plant materials were filled separately in the thimble and extracted with 60ml each of acetone, ethanol, hexane and using a soxhlet extractor for 48h. All the extracts were concentrated using rotary evaporator. After complete solvent evaporation each of the solvent extract was weighed and preserved at 4º C in air tight bottle until further use. 1g of each solvent residue was dissolved in 19ml of respective solvents are used as the test extracts for antimicrobial assay.

Phytochemical Analysis

Preliminary phytochemical screening of plant extracts for the identification of presence or absence of amino acids, glycosides, flavonoids, tannins, terpenoids, alkaloids, phenols, steroids, saponins and reducing sugars were carried out by standard method (Harborne, 1973) [6].

Antimicrobial Activity

Human pathogenic bacterial culture such as *Achromobacter hygiene*, *Bacillus cereus*, *Streptococcus pyogenes* and fungal culture of *Candida parapsilosis* were collected from Scudder Laboratory, Nagercoil. All the test bacterial species were maintained on nutrient agar media. Antimicrobial activity of aqueous extract, acetone, ethanol and hexane was determined by disc-diffusion method (Anonymous, 1996) [1].

Result and Discussion

Phytochemical Analysis

The present study of *Solanum xanthocarpum* (Schrad and Wendl.) showed more amount of phytochemicals present in ethanol. The phytochemical screening of *Solanum xanthocarpum* (Schrad and Wendl.) extracts revealed the presence of more amount of compounds such as alkaloids and steroids, moderate amount of compounds such a aminoacids, glycosides, tannins, phenols and saponins. It was represented in (Tab.1; Fig.1). Neelima *et al*. (2011) [8] reported that the ethanolic extracts of *Solanum xanthocarpum* (Schrad and Wendl.) contained alkaloids, flavonoids, steroids and terpenoids. Soni *et al*. (2015) [11] evaluated the presence of alkaloids, flavonoids, saponins and sterols in *Solanum xanthocarpum* (Schrad and Wendl.). Chandraprakash and Prabhakaran (2014) [4] and Selvi *et al*. (2016) [10] also recorded the similar results.

Table 1: Phytochemical analysis of *Solanum xanthocarpum* (Schrad and Wendl.) in different solvents

Chemical Constituents	Aqueous extract	Acetone	Ethanol	Hexane
Amino acids	_	+	++	_
Glycosides	+	++	_	+
Flavonoids	+	_	_	+
Tannins	_	++	+	_
Terpenoids	_	_	+	_
Alkaloids	+	+++	++	+++
Phenols	++	_	+	_
Steroids	_	+++	++	+
Saponins	+	_	++	_
Reducing sugars	+	_	_	_

+++ - High ++ - Moderate + - Low – - Absent

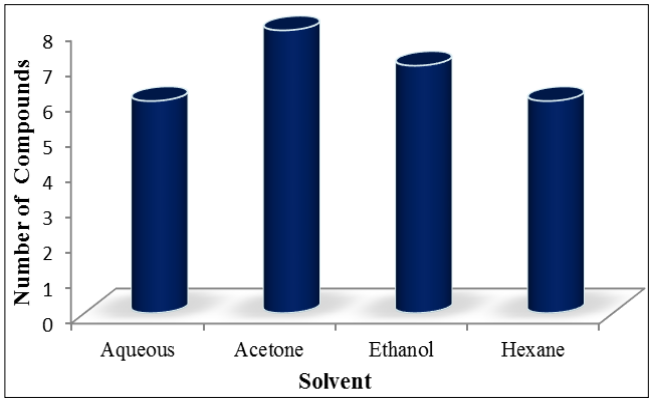

Fig 1: Phytochemical analysis of *Solanum xanthocarpum* (Schrad and Wendl.) in different solvents

Antimicrobial Activity

The antimicrobial activity of *Solanum xanthocarpum* (Schrad and Wendl.) is represented in (Tab. 2; Fig. 2; Plate. 1). In the present study, the ethanolic extract of *Solanum xanthocarpum* (Schrad and Wendl.) exhibited maximum inhibitory zone (20mm) against *Bacillus cereus* and the hexane extract exhibited the maximum zone of inhibition (20mm) against *Candida parapsilosis*. Soni *et al*. (2015) [11] reported high antimicrobial activity of *Solanum xanthocarpum* (Schrad and Wendl.) against *Bacillus pumilus*, *Micrococcus luteus*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Candida albicans*.

Table 2: Antimicrobial activity of *Solanum xanthocarpum* (Schrad and Wendl.) in different solvents

Test Organisms	Width of inhibition zone (mm) in different solvents				
	AE	A	E	H	Control (Flucanozole)
Achromobacter hygiene	_	7	18	17	10
Bacillus cereus	_	13	20	10	23
Streptococcus pyogenes	9	10	12	_	12
Candida parapsilosis	_	9	16	20	32

AE - Aqueous Extract A - Acetone E - Ethanol H - Hexane

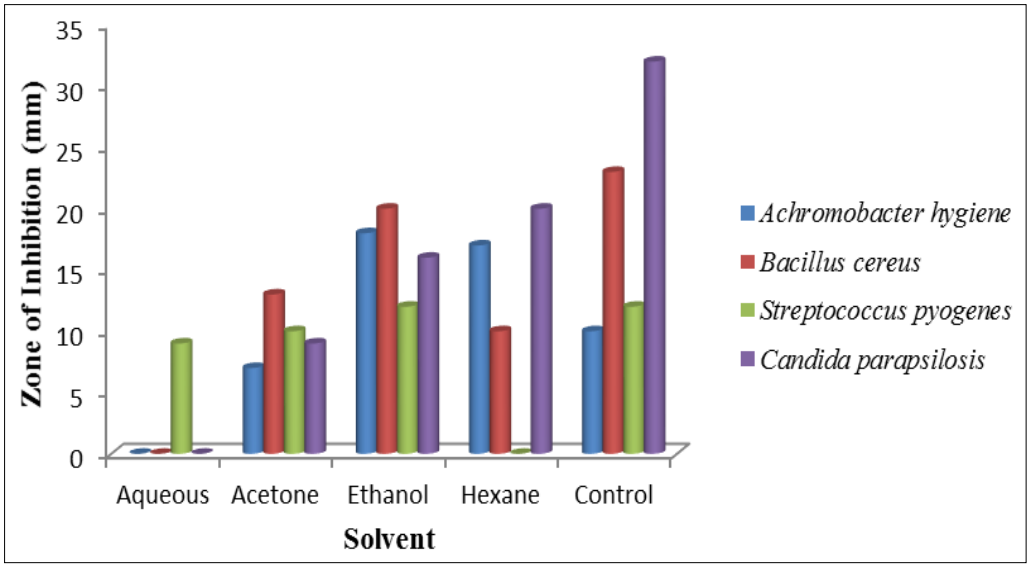

Fig 2: Antimicrobial activity of *Solanum xanthocarpum* (Schrad and Wendl.) in different solvents

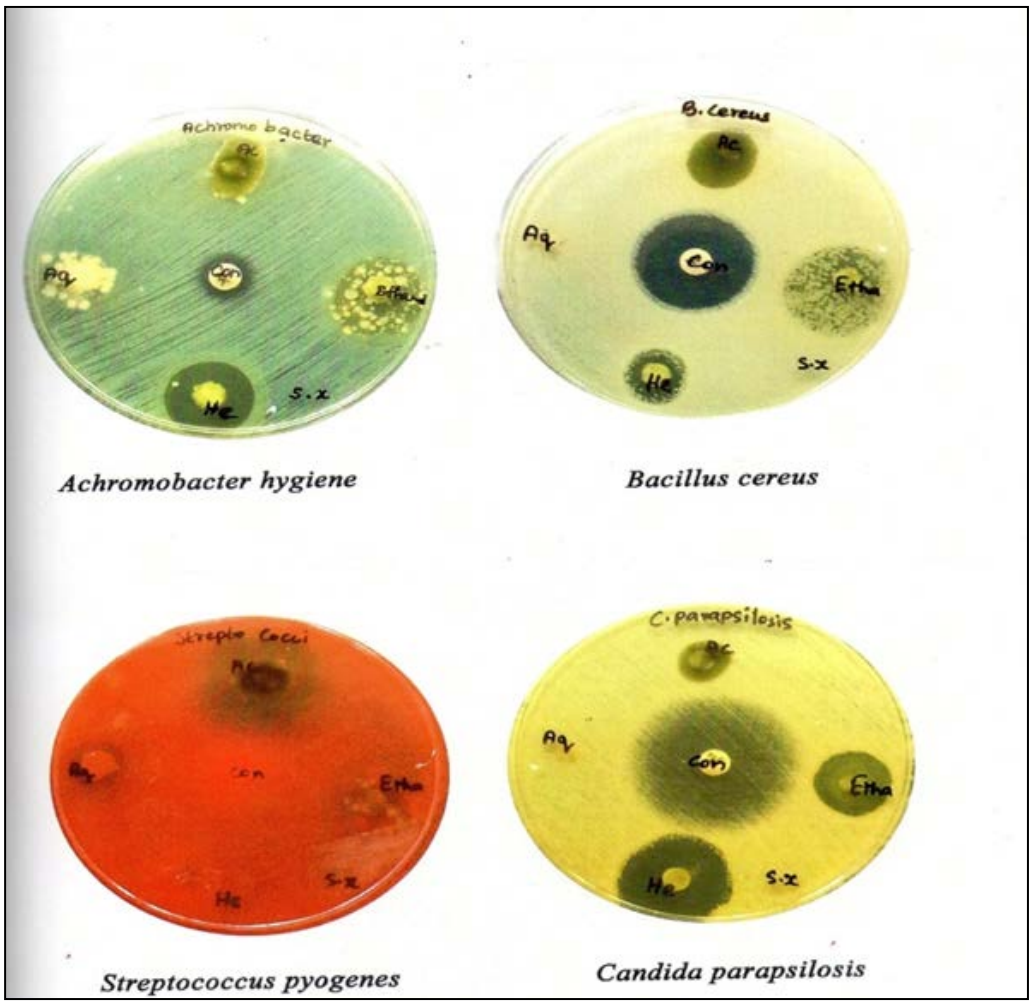

Plate 1: Antimicrobial activity of *Solanum xanthocarpum* (Schrad and Wendl.) in different solvents

Summary and Conclusion

Herbal medicine has become a popular form of health care even though several differences exist between herbal and conventional pharmacological treatments. Several specific herbal extracts have been demonstrated to be efficacious for specific conditions. Even though public do the carry risk of taking allopathic medicine instead of herbal treatments.

The ethanol and hexane extracts of *Solanum xanthocarpum* (Schrad and Wendl.) showed the maximum inhibition zone of 20mm against *Bacillus cereus* and *Candida parapsilosis* respectively. Other solvents also showed significant antimicrobial activity. The compounds recorded from various solvents and aqueous extracts were amino acids, glycosides, flavonoids, tannins, terpenoids, alkaloids, phenols, steroids, saponins and reducing sugars.

Finally, our work showed that the ethanolic extract of *Solanum xanthocarpum* (Schrad and Wendl.) showed highest activity than any other extracts. The least activity was noted in aqueous extract and some of the extracts showed no activity against selected pathogens. Although, all the extracts have demonstrated the antimicrobial activity. The present investigation proved that *Solanum xanthocarpum* (Schrad and Wendl.) extracts possess a broad spectrum of activity against the selected pathogens.
Thus, the study righteously proves the use of herbal plants in therapeutics. It thus serves as encouragements towards the development of new drugs for the benefits of mankind.

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