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Evaluation of antifungal potential of *Solanum xanthocarpum* Schrad. and Wendl., an important medicinal plant of arid region

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Abstract

Solanum xanthocarpum Schrad. and Wendl., is an important medicinal plant of Indian arid region. The whole plant with roots is used as a medicine in traditional medicine system. Roots are one of the main components of well known Ayurvedic preparation "Dasmul Asava" and also used to treat cough, asthma, chest pain, tympanitis, misperistalsis, piles and dysuria. Medicinal plants represent a rich source of antimicrobial agent. In vitro evaluation of plants for antifungal property is the essential primary process in way of developing eco-friendly antifungal substance of plant origin. In this respect, an attempt was made to investigate the antifungal potential of *S. xanthocarpum* fruit and root against four plant pathogenic fungi. Dried and powdered fruit and root of *S. xanthocarpum* extracted with ethanol and water using soxhlet extraction apparatus. This extract was tested against four fungal pathogens namely, *Rhizoctonia solani, Rhizoctonia bataticola, Fusarium solani, and Alternaria alternata* using poison food technique while, bavistin (a broad spectrum systemic fungicide) was used as a standard fungicide. The extract exhibited antifungal activity against selected fungi Thus, the current investigation leads to source of new antifungal compound in future.

Keywords: *Solanum xanthocarpum* , fungal pathogens, extract, medicinal plant.

Introduction

The *Solanum Xanthocarpum* is popularly known as kateli, Kandakarichunda, Kandankattiri and Indian Solanum. It occurs throughout India, in dry situations as a weed along the roadsides and wastelands (Kirtikar and Basu, 2005). It belongs to the family Solanaceae (Singh and Singh, 2010). It has sharp and prickly branches that are densely covered with rather minute star shaped hair. The herb has yellow colored shining prickles that are of 1.5 cm in size. It has sparsely hairy egg shaped leaves, purple colored flowers and round fruits. Flowers are purple color. Fruits are berries with green and white strips when young but turn yellow when mature. This plant is used widely by Ayurvedic herbalists for curing common ailments. Roots are one of the constituents of well known Ayurvedic preparation "Dasmul Asava" and used as an expectorant, cough, asthma, and chest pain in Ayurvedic medicine (Amir and Kumar, 2004; Khare, 1995). Medicinal plants represent a rich source of antimicrobial agent (Mahesh and Satish, 2008). These medicinal plants are easily available in rural areas and relatively cheaper due to plant origin (Chitme, 2003, Mann et al, 2008). Plants generally produce many secondary metabolites which constitute an important source of fungicide agent. These secondary metabolites are the main agents used in traditional medicine system (Ibrahim, 1997; Ogundipe, 1998). *S. Xanthocarpum* is source of alkaloids, phenolics, flavonoids, sterols, saponins and their glycosides and also carbohydrates, fatty acids, tannins and amino acids (Prasanta and Singh, 2010). It is used as systematic medicines in various traditional medicine

systems (Abbas et al., 2014). It is a good source of various phytochemicals found in different parts of this plant and responsible for its medicinal properties (Govindan et al., 1999; Parmar et al., 2010; Poonam et al., 2017; Sazda and Verma, 2009). Its fruits contains several steroidal alkaloids like solanacarpine, solanacarpidine, solancarpine, solasonine, solamargine and other constituents like caffeic acid, coumarins like aesculetin and aesculin, steroids carpesterol, diosgenin, campesterol, daucosterol and triterpenes like cycloartenol and cycloartenol (Fatima, et al., 2019 Paul et al., 2008). The fruit has several medicinal properties like antimalarial, antipyretic, anthelmintic, antiinflammatory, urinary bladder, enlargement of the liver, laxative, anti-asthmatic activities (Bhutani, 2010; Mohan et al, 2007; More et al, 2013). In vitro evaluation of plants for antifungal property is the essential primary process in way of developing eco-friendly antifungal substance of plant origin. In this respect, an attempt was made to investigate the antifungal potential of *S. xanthocarpum* fruit and root against four plant pathogenic fungi.

Materials and Methods

The study was carried out at the Arid Forest Research Institute Jodhpur. Following steps were included to find out antifungal potential of selected plant species:

Collection of Plant Material

Plant material was collected from some places of Jodhpur District, Rajasthan, India. Plant samples were identified with the help of taxonomic literature, standard flora and herbarium. Collected material was washed thoroughly with running tap water followed by distilled water to remove dirt. After washing and cleaning, material was shade dried at room temperature and finely ground with help of grinder. Powdered material was stored in airtight bottles for further use in preparation of extract.

Preparation of Extracts

Two types of extract aqueous and alcoholic (Ethyl alcohol) were prepared from every collected plant part with the help of Soxhlet apparatus and dried with help of water bath and rotary evaporator respectively. Extract were dissolved in DMSO and solution of different concentrations (10, 20, 30, 40 & 50) were prepared. The effect of extract on selected fungi was tested in vitro by poison food technique (Nane and Thapliyal, 1979).

Poison food technique

Starter culture of selected fungi was prepared in PDA medium. Plant Extract of different concentration was mixed with cooled molten media in conical flask and poured into petriplates and allowed to solidify at room temperature. A mycelium disk of 5 mm diameter was cut out from periphery of actively growing fungus (4-7 days old culture) with the help of cork borer and aseptically plated at centre of each petriplate. Three replication of each treatment were maintained, Plate without extract act as negative control and plate with chemical fungicide (.2%) served as positive control. All petriplates were incubated at 25±1˚C for seven days. After incubation the effect of extract was determined by measuring the radial growth of fungi in test plate and compared with control plate. Colony diameter of fungus in each plate was measured in mm. The antifungal activity was assessed in terms of percentage inhibition.

The percentage inhibition was calculated with the help of following formula suggested by Vincet (1947).

Inhibition Percent = I% = C-T/C X 100

C= Growth of mycelium in control plate (mm)
T=Growth of mycelium in treatment plate (mm) mean of three plates considered as final reading

Mean value and standard error mean were calculated for result of poison food technique and inhibition percentage calculated.

Results and Discussion

The result of this project experiments clearly showed that *Solanum xanthocarpum* has ability to inhibit selected fungi in vitro. Both aqueous and ethanolic extract *Solanum xanthocarpum* showed varied result against target fungi. Fruit showed greater antifungal potential then root. All the ethanolic extracts of *Solanum xanthocarpum* fruit showed wide range of activity against the targeted fungi as compared to aqueous extract which showed limited antifungal activity. The fruit showed maximum antifungal activity while root showed least antifungal activity. The maximum percentage inhibition with aqueous extract of *Solanum xanthocarpum* fruit (at 50%) for *Rhizoctonia solani*, was 39%, for *Rhizoctonia bataticola* was 36 % , for *Fusarium solani* was 54.2% and *Fusarium moniliforme* was 42%.

The maximum inhibition percentage with ethanolic extract (50%) for *Rhizoctonia solani*, was 82% for *Rhizoctonia bataticola* was 42%, for *Fusarium solani* was 54 % for *Alternaria alternata* was 73%. It is clearly indicates that the ethanolic extract of *Solanum xanthocarpum* fruit exhibited more antifungal properties against all fungi then aqueous extract. Effect of different concentration (10%, 20%, 30%, 40% and 50%) of ethanol extract on growth of all fungi showed that inhibition of fungus growth increase with concentration of extract. The ethanolic extract of *Solanum xanthocarpum* fruit exhibit maximum inhibition against *Rhizoctonia solani* (82%) followed by *Alternaria alternata* (73%). All the concentration of ethanolic extract of *Solanum xanthocarpum* fruits was found effective in inhibition of mycelia growth over the untreated control plate . However highest concentration of extract (50%) recorded maximum inhibition.

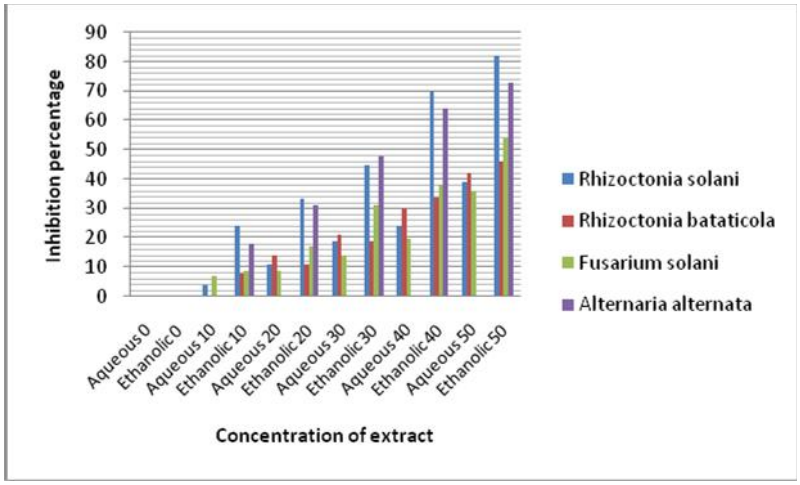
The result of antifungal screening of aqueous and ethanolic extract of *Solanum xanthocarpum* fruit and roots are given in tables 1-4 and comparative effectiveness is shown with the help of graph 1and 2.

Table.1 Showing inhibition percentage of ethanolic extract of *Solanum xanthocarpum* fruit against selected fungi

Fungus species	Concentration of extract/Inhibition Percentage					
	Control	10	20	30	40	50
Rhizoctonia solani	0	24	33.3	45	69.7	82
Rhizoctonia bataticola	0	8	11	19	34	46
Fusarium solani	0	9	17	31.2	38	54
Alternaria alternata	0	18	31	48	64	73

Table: 2 showing inhibition percentage of aqueous extract of *Solanum xanthocarpum* fruit against selected fungi

Fungus species	Concentration of extract/Inhibition Percentage					
	Control	10	20	30	40	50
Rhizoctonia solani	0	4	11	18.8	24	39
Rhizoctonia bataticola	0	0	14	21	30	42
Fusarium solani	0	7	9	14	19.6	36
Alternaria alternata	0	0	0	0	0	0



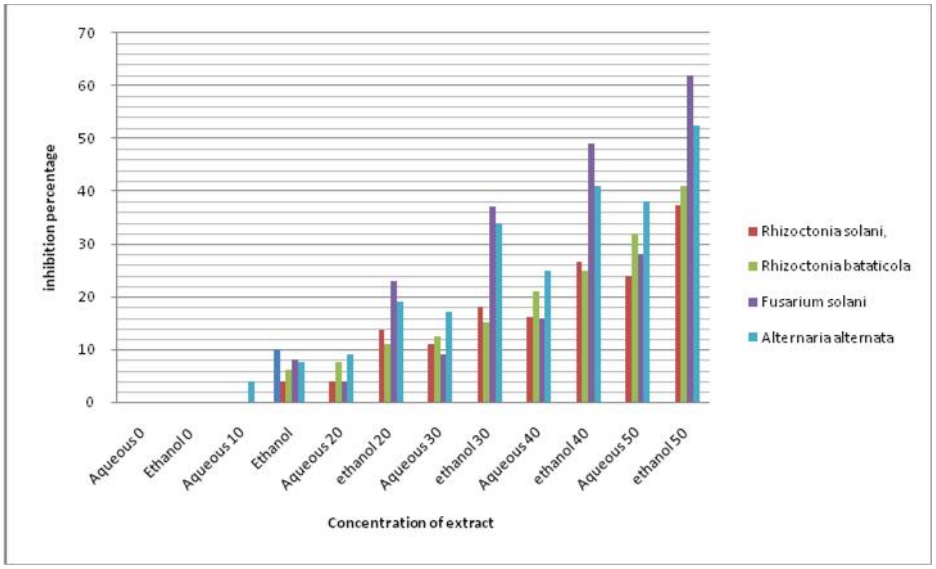
Graph 1 showing comparison of aqueous and ethanolic extract of *Solanum xanthocarpum* fruit against selected fungal species

Table.3 Showing inhibition percentage of ethanolic extract of *Solanum xanthocarpum* root against selected fungi

Fungus species	Concentration of extract/Inhibition Percentage					
	Control	10	20	30	40	50
Rhizoctonia solani	0	4.0	13.6	18	26.5	37.4
Rhizoctonia bataticola	0	6.0	11	15	24.8	41.0
Fusarium solani	0	8.0	23	37	49	62.0
Alternaria alternata	0	7.5	19	34	41.0	52.5

Table: 4 showing inhibition percentage of aqueous extract of *Solanum xanthocarpum* root against selected fungi

Fungus species	Concentration of extract/Inhibition Percentage					
	Control	10	20	30	40	50
Rhizoctonia solani,	0	0	4.0	11	16	24
Rhizoctonia bataticola	0	0	7.5	12.5	21	32
Fusarium solani	0	0	4.0	9.0	15.8	28
Alternaria alternata	0	4	9	17	25	38



Graph 2 showing comparison of aqueous and ethanolic extract of *Solanum xanthocarpum* root against selected fungal species

There are meager reports on the antimicrobial activity *of S. xanthocarpum* in the literature. Much work has been done on ethno medicinal plants in India on bacterial species and little work on fungus species (Maheshwari et al., 1986 and Negi et al., 1993). On same line more work done on antibacterial properties of *S. xanthocarpum (*Abbas et al., 2014; Kumar et al., 2016; Pardhi et al., 2010; Perumal and Murugesan, 2015; Suganya et al., 2014; Udaykumar et al., 2003;), although some worker reported antifungal potential of *S. xanthocarpum* (Gaherwal et al., 2014; Mamta, 2016; Shubha et al., 2016;) Antifungal properties of water and alcoholic extracts of *Solanum xanthocarpum* leaves were tested and proved (Saini et al., 2006). Antifungal activity of the aqueous and organic solvent extracts of different parts (roots, stems, leaves and fruits) of *S. xanthocarpum* against a fungus *Aspergillus niger* was evaluated and found that extracts prepared in organic solvents showed antifungal activity (Salar and Suchitra, 2006).

The distilled water and hexane extract of *S. xanthocarpum* were tested against *A.niger* and *C. albicans* and indicated that distil water extract not effective against both the fungal species but hexanic extract was effective against *C. albicans* (Gaherwal et al. 2014). This finding is similar according to present study, extract with an organic solvent was shown to provide a better antifungal activity than aqueous extract. The methanolic extract of *Solanum xanthocarpum* fruits showed radial growth inhibition on *Aspergillus niger* and *Trichoderma viride* (Singh and Kaushal, 2007).

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