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ANTIMICROBIAL SCREENING OF DIFFERENT SOLVENT EXTRACTS OF AN ENDANGERED MEDICINAL PLANT, *STRYCHNOS WALLICHIANA* STEUD EX DC.

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ABSTRACT

Strychnos wallichiana is very important medicinal plant for phytochemicals and other biologically active molecules. In the present work, N-hexane, chloroform, ethyl acetate and methanol extracts of stem, leaf, root and fruit coat of *S. wallichiana* were screened against six microbes like *Candida albicans*, *Staphylococcus aureus, Klebsiella pneumoniae, Bacillus subtilis, Bacillus cereus*, and *E. coli* and fungus *Candida albicans* by agar well diffusion method. Among four solvent leaf extracts, chloroform and ethyl acetate extracts exhibited significant activity in terms high zone of inhibition (0.8 to 1.3cm). High zone of inhibition and less zone of inhibition was formed by leaf ethyl acetate and methanol extracts against *Candida albicans* and *S.aureus.* The leaf methanol formed high zone of inhibition against *K.pneumoniae.* Moderate activity was displayed by leaf methanol, ethyl acetate, chloroform, and n-hexane extracts against *B. subtilis* and *B. cereus.* Good activity against *E.coli* was observed with leaf methanol and ethyl acetate extracts. Moderate antimicrobial activity with range of zone of inhibition from 0.6 to 1.4 cm was exhibited by stem ethyl acetate extracts. High zone of inhibition (2cm) was formed by stem chloroform extract against *B.cereus* while other extracts displayed no activity. Whereas *E.coli* exhibited good zone of inhibition in all extracts except in n-hexane. When compared with leaf or stem extracts, the fruit coat extract exhibited poor activity against all treated microbes.

KEYWORDS: *Strychnos wallichiana* treated microbes.

INTRODUCTION

Strychnos is a popular genus with a famous toxins, strychnine and brucine. The genus has various therapeutic and ethno botanical uses such as remedy against snakebites and poisonings; to treat stomach, abdominal and intestinal complaints; to treat ulcers, wounds, and swellings; in skin troubles including leprosy; and in the treatment of more specific diseases like cholera and rabies; and also, it has antipyretic, anti parasitic, antimalarial, and antimicrobial properties (Karthikeyan *et al*., 2016; Philippe *et al*., 2004). A rare and endangered species of this genus, *Strychnos wallichiana* is an endangered and is very important medicinal plant (Anonymous, 2001; Rao and Prasad, 2008). It is commonly known as Snake wood in English, Nagamusti in Telugu and Kannada (Mallikarjuna *et al*., 2010). It is a wild twining liana species distributed in South East Asia and is rich with alkaloids and is an alternative species to *S. nux-vomica* for strychnine and brucine. It has been widely used as folk medicine to treat bites of venomous snakes, to alleviate pain, and also to remove swellings, to treat rheumatism, ulcers, elephantiasis, fever and epilepsy (De and Bisset, 1988). It is shy flowering and rarely produces seed that could be the reason for rare distribution of this plant. Rao and Prasad (2008) revealed that *S.wallichiana* possess significant amounts of strychnine and brucine, indicating that it is the best alternative to *S.nux –vomica.* The qualitative screening of methanolic and aqueous extracts of both seed and leaf of this species revealed the presence of alkaloids, flavonoids, glycosides, phenols, saponins and sterols (Mallikarjuna *et al*., 2010). Phytochemical screening, antioxidant and antibacterial activity of *Strychnos colubrina* root extracts from Eastern Ghats were reported (Sudhira *et al*., 2015).

Fig 1: A. *S.wallichiana* twig with tendrils.

Fig 1: A. *S.wallichiana* twig with fruits.

The current literature indicates that *S.wallichiana* is rich with valuable phytochemicals like strychnine and brucine, and plants with such kind of phytochemicals are well known to be a

good source of antimicrobial agents (Thomas and Mathew, 2002). Though there is urgent need for screening such plants for antimicrobial agents due to emergence of multidrug resistant bacteria, association of side effects and inefficiency of some allopathic drugs, many studies were not carried out in that aspect on this plant. In the case of *S. wallichiana*, very preliminary screening has been done on few microbes using one or two plant parts. Hence keeping in view of this, in the present paper, we report antimicrobial activity of different solvent extracts of different plant parts of *S.wallichiana* against a wide range of organisms. This kind of study involving variety of extracts may offer a valuable source for the discovery of alternatives to the present antibacterial and antioxidant drugs.

MATERIALS AND METHODS

Collection of Plant material

S. wallichiana plants were collected from Bangaramma Kandriga of Seshachalam hill ranges, Andhra Pradesh, India and established them in our botanical garden. Antimicrobial screening was carried out using various plant parts collected Bangaramma Kandriga area.

Test Bacteria

Gram positive bacteria - *Staphylococcus aureus* (MTCC 3160), *Klebsiella pneumoniae*, (ATCC10031) *Bacillus subtilis* (ATCC 6633) *and Bacillus cereus* (MTCC430), Gram negative bacteria - *E. coli* (ATCC 35218).

Test Fungus

Fungal – *Candida albicans* (ATCC-10231).

Antimicrobial activity determination of *S.wallichiana* crude extracts.

The antibacterial activity is performed by agar well diffusion technique (Chandrakala *et al.*, 2014). The sample solution of *S. wallichiana* is prepared by dissolving definite amount of plant part extract in the appropriate solvent to attain a concentration of 300 mg/ml. 50, 100, 150 and 200 µl of this solution is applied on well and solvent was dried in the hood. The solvent was used as control. In order to diffuse the material from the well to the surrounding media in the petri dishes, petri dish was seeded with particular microbes and kept at room temperature. The petri dishes were incubated at 37^{o}C for 12h to allow the bacterial growth. The antimicrobial activity of the *S. wallichiana* was determined by measuring the zone of inhibition in cm.

RESULTS

Screening of antimicrobial activity of *S.wallichiana* plant parts

S.wallichiana is an important medicinal plant and is best alternative to multipurpose plant *S. nux-vomica*. Both plants are very important economically and medicinally owing to the presence of valuable alkaloids like strychnine, brucine and curare. Though the identity and distribution of S. wallichiana is known, but information of phytochemistry and pharmacology are completely lacking. Hence in the present paper, the plant parts of *S.wallichiana* were screened for antimicrobial activities. And indeed the plant parts exhibited significant activity measured in terms of zone of inhibition. The results are summarized below.

Table-2.1: Screening of *S. wallichiana* leaf extract for antibacterial activity.

Leaf extract	Zone of inhibition in cm															
	Methanol				Ethyl acetate				Chloroform				n-Hexane			
	50	100	150	200	50	100	150	200	50	100	150	200	50	100	150	200
Candida albicans	0.4± 0.10	0.6± 0.10	0.7± 0.15	0.9± 0.09	**0.4± 0.15**	**0.8± 0.18**	**1± 0.16**	**1.3± 0.18**	0.2± 0.10	0.4± 0.14	0.6± 0.16	0.8± 0.15	Nil	0.2± 0.05	0.6± 0.10	0.8± 0.15
Staphylococcus aureus	0.4± 0.2	**0.8± 0.08**	**0.9± 0.10**	**1.0 ± 0.10**	**0.2± 0.03**	**0.7± 0.6**	**1.0 ± 0.05**	**1.15± 0.05**	0.2± 0.15	0.4± 0.12	0.6± 0.14	0.8± 0.15	NIL	0.3± 0.09	0.5± 0.5	0.7± 0.10
Klebsiella pneumoniae	**0.8± 0.10**	**1.0± 0.08**	**1.15± 0.10**	**1.2± 0.15**	0.4± 0.15	0.6± 0.18	0.8± 0.16	**1.0± 0.15**	0.2± 0.16	0.4± 0.12	0.7± 0.10	0.8± 0.16	0.4± 0.10	0.5± 0.5	0.7± 0.09	0.9± 0.12
Bacillus substilis	0.4± 0.10	0.6± 0.12	0.8± 0.10	0.9± 0.08	0.4± 0.10	0.6± 0.12	0.7± 0.16	0.85± 0.15	0.2± 0.06	0.4± 0.10	0.5± 0.12	0.7± 0.13	0.4± 0.06	0.7± 0.09	**0.9± 0.11**	**1.2± 0.14**
Bacillus cereus	0.2± 0.18	0.4± 0.15	0.7± 0.11	0.9± 0.09	0.3± 0.04	0.7± 0.04	**0.9± 0.08**	**1.1± 0.10**	Nil	Nil	Nil	Nil	0.2± 0.05	0.5± 0.05	**0.8± 0.08**	**1.0± 0.10**
Escherichia coli	**0.8± 0.12**	**1.0± 0.08**	**1.1± 0.05**	**1.2± 0.10**	**0.4± 0.08**	**0.8± 0.06**	**1.0± 0.09**	**1.2± 0.15**	0.45± 0.2	**0.8± 0.10**	**1± 0.12**	**1.1± 0.2**	Nil	Nil	Nil	Nil

Each value represents mean of triplicate analysis.

Antimicrobial screening of leaf extracts of S. wallichiana

The phytochemicals were extracted into four solvents like methanol, ethyl acetate, chloroform and n-Hexane. Each extract were prepared in four different concentrations like 50, 100, 150 and200 micro liters of stock solution (300 mg extract/ml of solvent). And these extracts were screened against six microbes like *Candida albicans*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Bacillus substilis*, *Bacillus cereus*, and *E. coli*. In all solvent extract treated plates, the activity against particular microbe increased with increase in the concentration of extract. Among four solvent extracts, chloroform and ethyl acetate extracts exhibited significant activity in terms high zone of inhibition (0.8 to 1.3cm) indicating that those extracts contained more amount of phytochemicals. The high zone of inhibition (Table-2.1; Plate-2.1) and less zone of inhibition was formed by ethyl acetate and methanol extracts on *Candida albicans* and *S. aureus* (Table-2.1; Plate-2.2).Whereas leaf methanol extract formed high zone of inhibition (0.8 to 1.2 cm) against *K.pneumoniae.* In against to this, the

other extracts poorly responded on above microbe. Moderate activity was displayed by methanol, ethyl acetate chloroform and n-hexane extracts against *B. subtilis* (Table-2.1; Plate-2.1) and *B. cereus.* Good activity against *E.coli* was observed with methanol and ethyl acetate extracts but other two not responded very well (Table-2.1 and Plate-2.2).

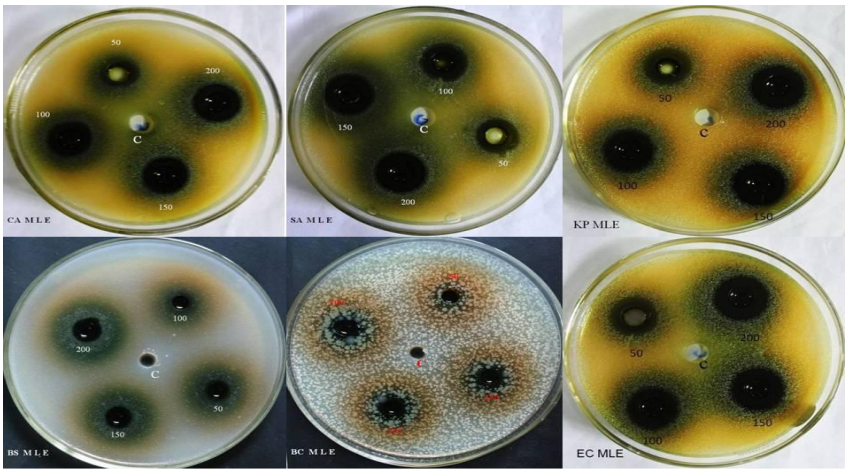

Plate-2.1: Antimicrobial activity of *S.wallichiana* methanol leaf extract.

Where CA MLE= *Candida albicans* methanol leaf extract; SA MLE= *Staphylococcus aureus* methanol leaf extract;

KP MLE= *Klebsiella pneumoniae* methanol leaf extract; BS MLE= *Bacillus subtilis* methanol leaf extract; BC MLE= *Bacillus cereus* methanol leaf extract; EC MLE=*Escherichia coli* methanol leaf extract.

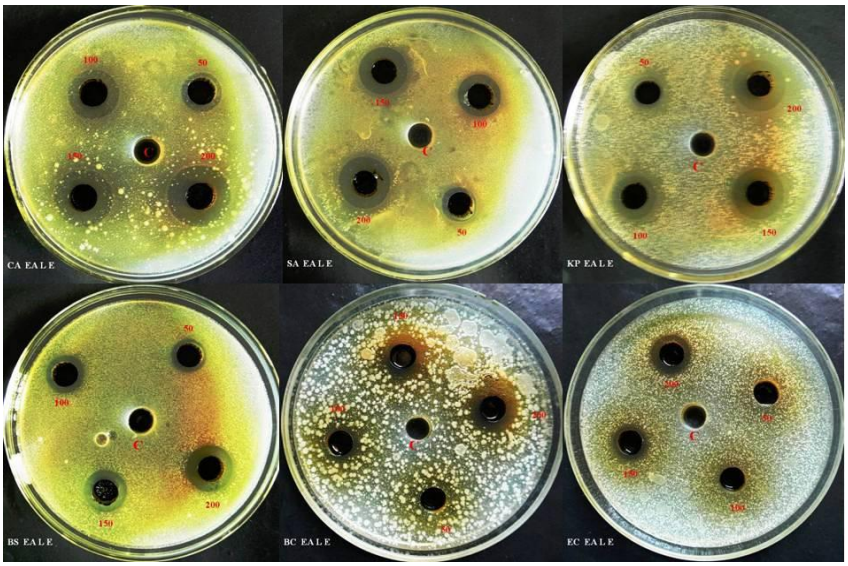

Figure-2.2.Antimicrobial activity of *S.wallichiana* leaf ethyl acetate extract.

Where CA EALE= *Candida albicans* Ethyl acetate leaf extract; EALE = *Staphylococcus aureus* Ethyl acetate leaf extract; KP EALE = *Klebsiella pneumoniae* Ethyl acetate leaf extract; BS EALE = *Bacillus subtilis* Ethyl acetate leaf extract; BC EALE = *Bacillus cereus* Ethyl acetate leaf extract; EC EALE =E*scherichia coli* Ethyl acetate leaf extract.

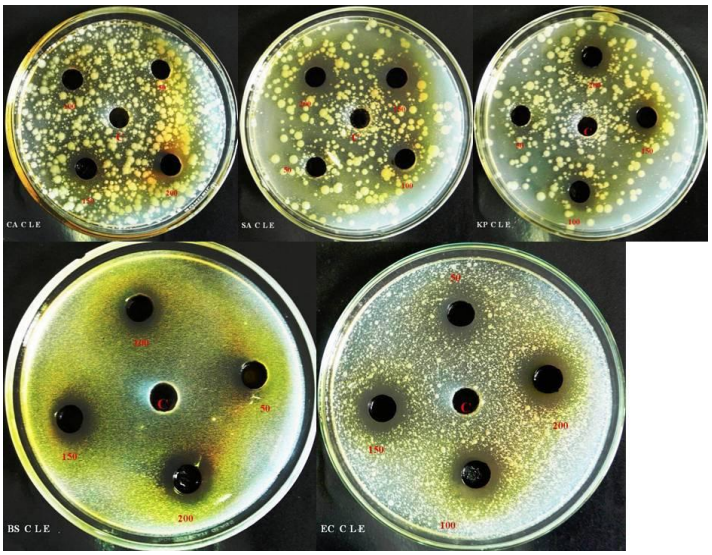

Figure-2.3. Antimicrobial activity of S. wallichiana leaf chloroform extract.

Where CA CLE= *Candida albicans* chloroform leaf extract. SA CLE = *Staphylococcus aureus* chloroform leaf extract; KP CLE = *Klebsiella pneumoniae* chloroform leaf extract; BS CLE = *Bacillus subtilis* chloroform leaf extract; BC CLE = *Bacillus cereus* chloroform leaf extract; EC CLE =*Escherichia coli* chloroform leaf extract.

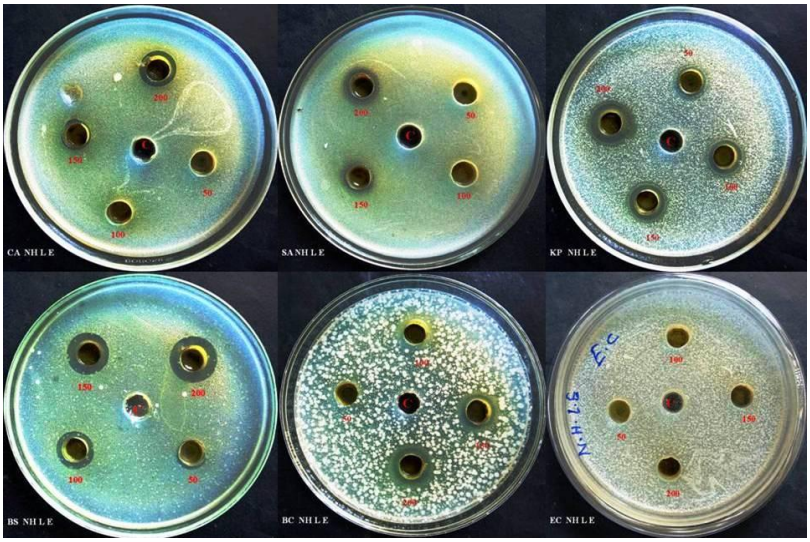

Figure-2.4: Anti-microbial activity of *S.wallichiana* n-Hexane leaf extract.

Where CA NHLE= *Candida albicans* N-Hexane leaf extract; SA NHLE = *Staphylococcus aureus* N-Hexane leaf extract; KP NHLE = *Klebsiella pneumoniae* N-Hexane leaf extract; BS NHLE = *Bacillus substilis* N-Hexane leaf extract; BC NHLE = *Bacillus cereus* N-Hexane leaf extract; EC NHLE =*Escherichia coli* N-Hexane leaf extract.

Assessment of antimicrobial activity *S. wallichiana* stem extract

As observed in the case of leaf extract (except *B.cereus*), n-hexane displayed poor response whereas good antimicrobial activity was observed with chloroform and methanol extracts (Table-2.2 and Plate-2.4). Moderate antimicrobial activity with range of zone of inhibition from 0.6 to 1.4 cm was exhibited by ethyl acetate extract.

High zone of inhibition (2cm) was formed by chloroform extract against *B. cereus* while other extracts displayed no or less activity. All three extracts, except n-hexane has shown good activity against *B. substilis* (Table-2.2 and Plate-2.8). Consistent potential activity against *B.cereus* was seen with all four types of extracts. Whereas *E.coli* exhibited good zone of inhibition in all extracts except in n-hexane. Though stem extract has shown general trend of activity as observed with leaf extract, but it acted strongly on *Bacillus* and *E.coli* indicating these extracts can be used against them.

Table-2.2. Assessment of anti bacterial activity of *S. wallichiana* stem extract.

Stem extract	Zone of inhibition in cm															
	Methanol				Ethyl acetate				Chloroform				n-Hexane			
	50	100	150	200	50	100	150	200	50	100	150	200	50	100	150	200
Candida albicans	0.4± 0.09	0.7± 0.1	**0.9± 0.15**	**1.1± 0.16**	Nil	0.4± 0.05	0.7± 0.04	0.8± 0.06	Nil	0.4± 0.05	0.5± 0.06	0.6± 0.05	Nil	Nil	Nil	0.6± 0.04
Streptococcus aureus	0.3± 0.09	0.7± 0.11	**1.0± 0.12**	**1.2± 0.15**	Nil	0.5± 0.08	0.7± 0.06	0.9± 0.1	Nil	0.4± 0.03	**1.0± 0.08**	**1.2± 0.06**	Nil	Nil	Nil	Nil
Klebsiella pneumoniae	Nil	0.6± 0.12	**0.8± 0.13**	**1.0± 0.15**	Nil	0.5± 0.11	0.8± 0.05	0.9± 0.8	**0.8± 0.06**	**1.1± 0.09**	**1.2± 0.06**	**1.4± 0.05**	Nil	Nil	**0.9± 0.11**	**1.1± 0.08**
Bacillus subtilis	Nil	0.6± 0.08	**0.9± 0.09**	**1.1± 0.06**	**0.8± 0.1**	**1.1± 0.05**	**1.2± 0.15**	**1.4± 0.09**	**0.8± 0.18**	**1.2± 0.08**	**1.5± 0.05**	**1.8± 0.10**	Nil	Nil	**0.9± 0.05**	**1.2± 0.03**
Bacillus cereus	Nil	0.8± 0.05	**1± 0.10**	**1.2± 0.10**	**Nil**	**0.5± 0.1**	**0.8± 0.06**	**1.1± 0.5**	**0.9± 0.15**	**1.5± 0.09**	**1.7± 0.06**	**2.0± 0.03**	**0.9± 0.04**	**1.3± 0.06**	**1.6± 0.07**	**1.8± 0.1**
Escherichia coli	Nil	0.8± 0.19	**1.2± 0.1**	**1.4± 0.09**	**Nil**	**0.4± 0.1**	**0.7± 0.05**	**1.0± 0.08**	**0.6± 0.03**	**0.8± 0.06**	**1.3± 0.09**	**1.5± 0.10**	Nil	0.3± 0.05	0.75± 0.08	0.9± 0.10

Each value represents mean of triplicate analysis.

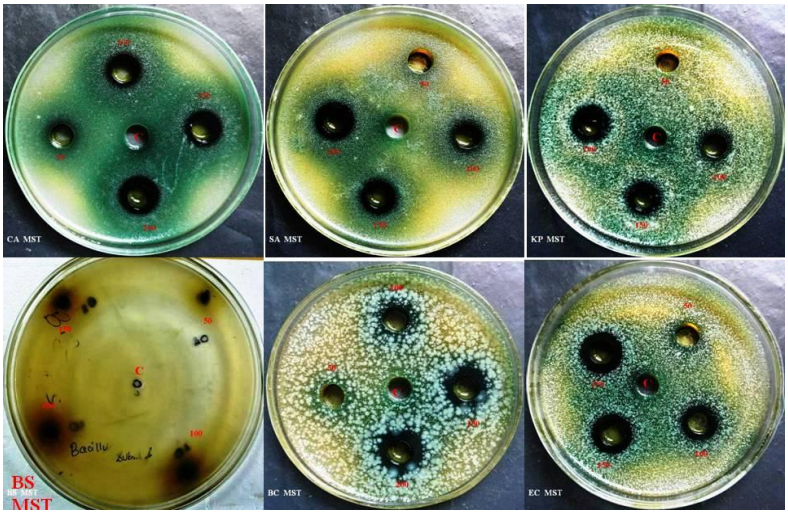

Plate-2.5: Antimicrobial activities of *S.wallichiana* methanol stem extract.

Where CA MST= *Candida albicans* methanol stem extract; SA MST = *Staphylococcus aureus* methanol stem extract; KP MST = *Klebsiella pneumoniae* methanol stem extract; BS MST = *Bacillus subtilis* methanol stem extract; BC MST = *Bacillus cereus* methanol stem extract; EC MST =*Escherichia coli* methanol stem extract.

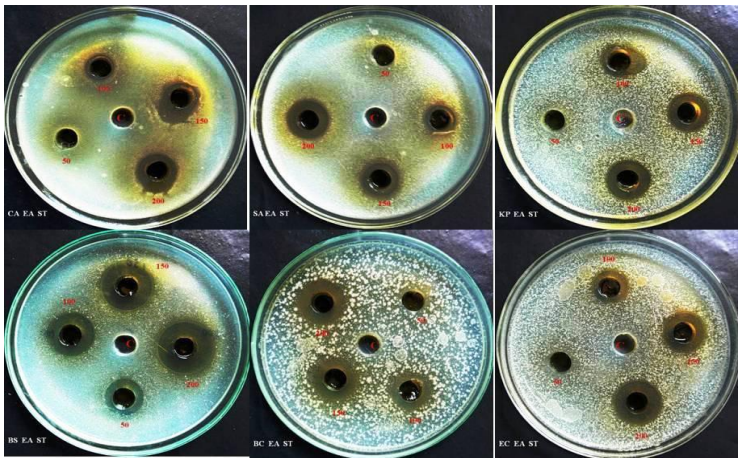

Plate-2.6. Antimicrobial activities of *S.wallichiana* ethyl acetate stem extract.

Where CA EA ST= *Candida albicans* ethyl acetate stem extract; SA EA ST = *Staphylococcus aureus* ethyl acetate stem extract; KP EA ST = *Klebsiella pneumoniae* ethyl acetate stem extract; BS EA ST = *Bacillus subtilis* ethyl acetate stem extract; BC EA ST = *Bacillus cereus* ethyl acetate stem extract; EC EA ST =*Escherichia coli* ethyl acetate stem extract.

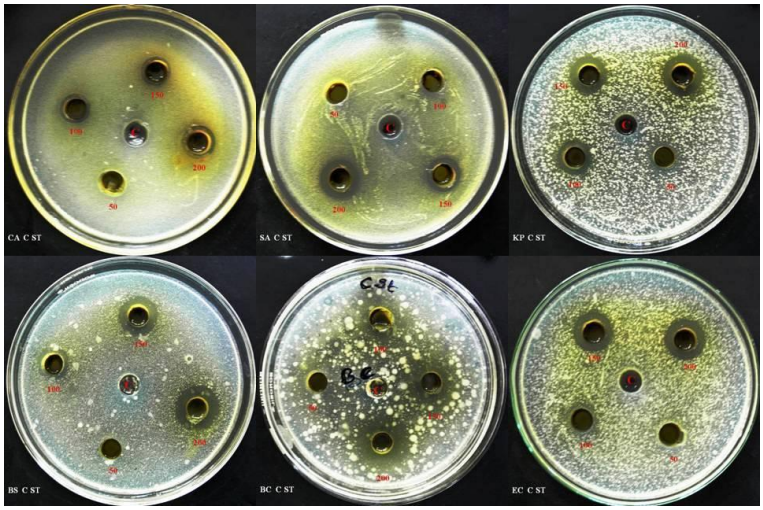

Plate-2.7: Antimicrobial activities of *S.wallichiana* chloroform stem extract.

Where CA C ST= *Candida albicans* chloroform stem extract; SA C ST = *Staphylococcus aureus* chloroform stem extract; KA C ST = *Klebsiella pneumoniae* chloroform stem extract; BS C ST = *Bacillus subtilis* chloroform stem extract; BC C ST = *Bacillus cereus* chloroform stem extract; EC C ST =*Escherichia coli* chloroform stem extract.

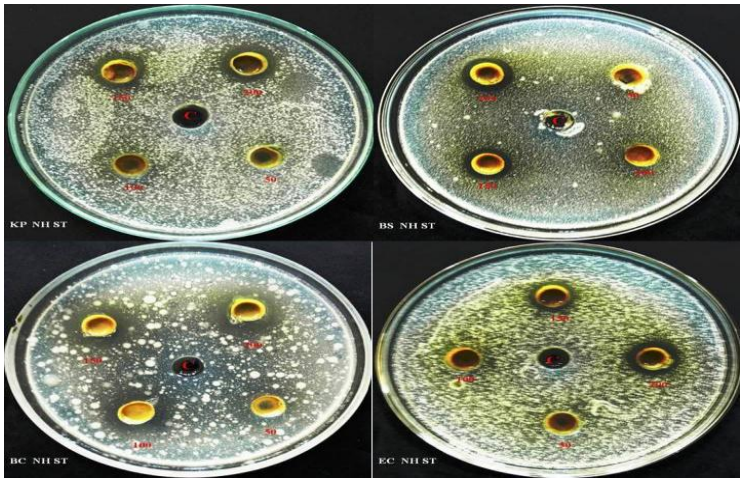

Plate-2.8. Antimicrobial activities of *S.wallichiana* N-hexane stem extract.

Where KP NH ST = Klebsiella pneumoniae N-hexane stem extract; BS NH ST = Bacillus subtilis; N-hexane stem extract; BC NH ST = Bacillus cereus N-hexane stem extract; EC NH ST =Escherichia coli N-hexane stem extract.

Table 2. 3: Antimicrobial screening of fruit coat of *S.* wallichiana plants.

Experiments were also performed to screen the effect of fruit coat extract on the growth of microbes. Screening of extracts of ethyl acetate, chloroform and n-hexane indicated that n-hexane did not display antagonism on microbial growth. When compared with leaf or stem

extract, the fruit coat extract exhibited poor activity against all treated microbes (Table-2.3). All three extracts exhibited less or no activity against *C. albicans* and *S. aureus* (Table-2.3).Good antimicrobial activity (1.1cm) was evidenced with extract of chloroform on *K. pneumoniae* (Table-2.3). The three extracts except ethyl acetate has shown less or no activity against *B.cereus* and *E. coli*. The above observation indicates the in general the fruit coat extracts lack enough quantities of phytochemicals needed for eliciting antimicrobial activity.

Table: 2.3: Antimicrobial screening of fruit coat of *Strychnos wallichiana.*

Fruit coat extract	**Zone of inhibition in cm**											
	Ethyl acetate				**Chloroform**				**n-Hexane**			
	50	100	150	200	50	100	150	200	50	100	150	200
Candida albicans	Nil	Nil	0.6± 0.1	0.7± 0.05	0.4± 0.15	0.6± 0.11	0.7± 0.09	0.8± 0.05	Nil	Nil	Nil	Nil
Streptococcus aureus	Nil	0.2± 0.05	0.5± 0.06	0.8± 0.04	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Klebsiella pneumoniae	Nil	Nil	0.7± 0.11	0.9± 0.09	**Nil**	**0.8± 0.11**	**0.9± 0.07**	**1.1± 0.05**	Nil	Nil	Nil	Nil
Bacillus substilis	Nil	**0.4± 0.08**	**0.7± 0.05**	**1± 0.06**	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Bacillus cereus	Nil	**0.4± 0.02**	**0.9± 0.09**	**1.1± 0.1**	Nil	0.3± 0.10	0.5± 0.06	0.7± 0.04	Nil	Nil	Nil	Nil
Escherichia coli	Nil	**0.4± 0.10**	**0.7± 0.08**	**1± 0.04**	Nil	0.4± 0.12	0.6± 0.08	0.7± 0.05	Nil	Nil	Nil	Nil

Each value represents mean of triplicate analysis.

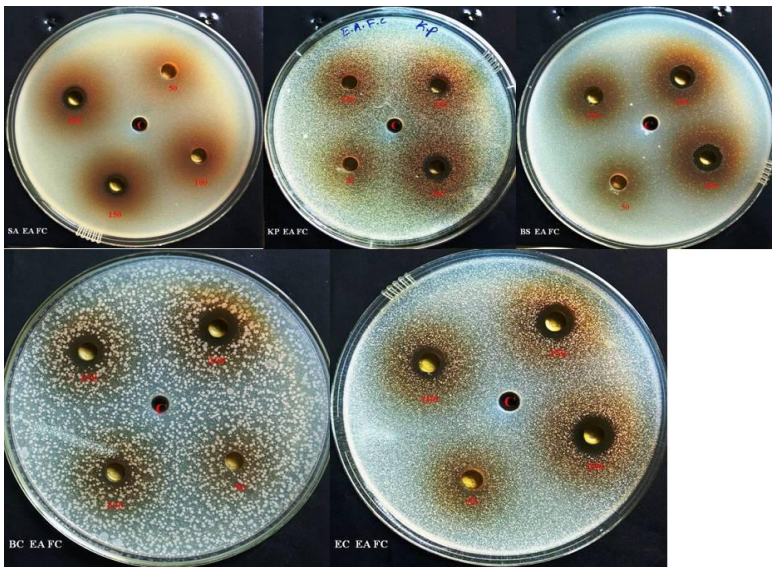

Plate-2.9.Antimicrobial screening of *S. wallichiana* Ethyl acetate fruit coat extract.

Where SA EA FC = *Staphylococcus aureus* ethyl acetate fruit coat extract; KP EA FC = *Klebsiella pneumoniae* ethyl acetate fruit coat extract; BS EA FC = *Bacillus subtilis;* ethyl

acetate fruit coat extract; BC EA FC = *Bacillus cereus* ethyl acetate fruit coat extract; EC EA FC =*Escherichia coli* ethyl acetate fruit coat extract.

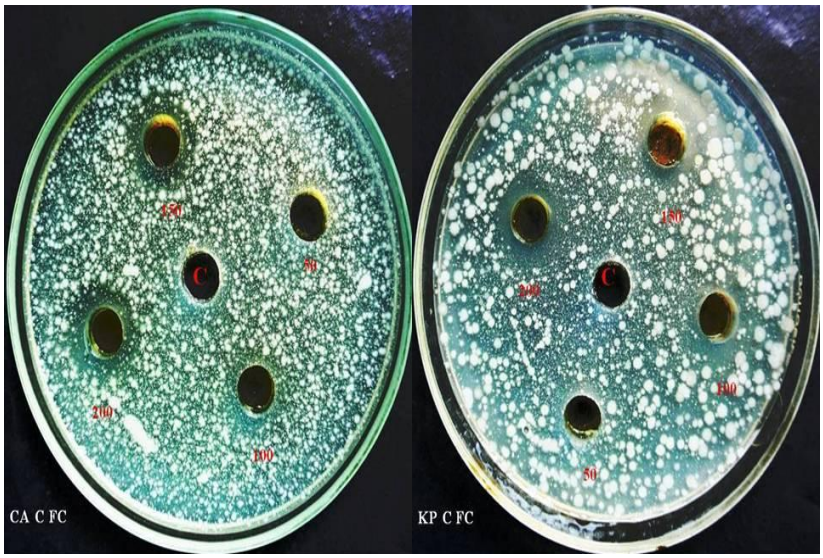

Plate-2.10. Antimicrobial screening of *Strychnos wallichiana* chloroform fruit coat extract.

Where CA C FC= *Candida albicans* chloroform fruit coat extract and KP C FC = *Klebsiella pneumoniae* chloroform fruit coat extract.

DISCUSSION

Medicinal plants since ages have formed the basis of discovery of novel drugs and treatment methods (McGraw et al., 2000). Owing to this, extensive screening of medicinal plants and their secondary metabolites has been carried out to find out a potential drug. *Strychnos* genus is very popular genus owing to the presence of unique class of alkaloids like Brucine, Strychnine and Curare. Pharmacological screening of these plants has reported identification of biological activities displayed by members of the genus *Strychnos*. *S.wallichiana* represents the best alternative to the popular species of the genus, *S. nux-vomica*. *S. wallichiana* also contains same amount and kind of chemicals as reported in *S. nux vomica*. Knowing that *Strychnos* is good genus with important biological activities and antimicrobial agents extensive screening has been carried on Strychnos species. The antimicrobial activity of *S. nux-vomica* against *Staphylococcus, Salmonella, K. pneumonia* and fungal species *Aspergillus flavus, A. niger* was reported using n-butanol, methanol and distilled water extracts (Gnanavel *et al*., 2012).

Very significant *in vitro* antimicrobial screening of alkaloid fractions of *S. potatorum* against *P. vulgaris, Staphylococcus aureus, Salmonella typhimurium, Vibrio cholerae, Mycobacterium tuberculosis, Aspergillus niger* and *Candida albicans* (Mallikarjuna and Seetharam, 2009). *Strychnos lucida* plant stem, stem bark, twig and leaves hexane, ethyl acetate and methanol solvents displayed potent antimicrobial activity against 29 microbes (Sarmento *et al*., 2015). Where as *S. spinosa* leaf and stem bark aqueous, ethanol and methanol extracts exhibited good antimicrobial activity against *S. aureus, E.coli, P. aeruginosa,* and *C. albicans* (Tor-Anyiin et al., 2015). The methanol extracts of leaves and stem barks were the most potent against *E. coli* while the ethanol extracts of leaf gave higher potency against *P. aeruginosa* (Chukwudi and Stephen, 2013). A preliminary antimicrobial screening of methanol and aqueous extracts seed and leaf of *S. wallichiana* exhibited revealed antimicrobial activity against *E.coli, B. subtilis, S. aureus, A. niger* and *A. mucor.* However among two extracts, methanol extracts of both seeds and leaves have shown greater activity than aqueous extracts. The observed activity increased with increase in the concentration extract of standard drug (Mallikarjuna *et al*., 2010).

S. colubrina plant root methanol extracts showed more inhibition zones than ethyl acetate and aqueous extracts (Sudhira *et al*., 2015) against *C. perfringens, S.typhi, B.substilis* and *S. aureus.* The phytochemicals present in the root extracts might be contributing to the above activities. In the present investigation, antimicrobial screening of leaf extracts of *S.wallichiana,* chloroform and ethyl acetate extracts exhibited significant activity in terms high zone of inhibition indicating that these extracts contained more amount of phytochemicals. The high zone of inhibition and less zone of inhibition was formed by ethyl acetate and methanol extracts on *Candida albicans, S. aureus* and *K.pneumoniae.* Good activity against *E.coli* was observed with methanol and ethyl acetate extracts. Our current results are in agreement with Mallikarjuna et al., (2010) and disagreement with Sudhira *et al*., (2015) in terms of solvents. Our results and above two reports prove that *S.wallichiana* plants contain good antimicrobial activity.

Antimicrobial screening of stem extracts of *S.wallichiana* indicated good antimicrobial activity with chloroform and methanol extracts followed by ethyl acetate extract. High zone of inhibition was formed by chloroform extract against B. cereus while other extracts displayed no or less activity. All three extracts, except n-hexane has shown good activity against *B. subtilis*. Consistent potential activity against *Bacillus* and *E.coli* indicates that these

extracts can be used against them. Antimicrobial activity using stem and stem bark extracts of S.lucida and S.spinosa were reported (Sarmento et al., 2015; Chukwudi and Stephen, 2013).

Antimicrobial screening of fruit coat of *S. wallichiana* ethyl acetate, chloroform and n-hexane extracts indicated that n-hexane did not display antagonism on microbial growth. Good antimicrobial activity was evidenced with extract of chloroform on *K. pneumoniae*. The three extracts except ethyl acetate has shown less or no activity against *B.cereus*. Our work indicates that fruit coat extracts lack enough quantities of phytochemicals needed for eliciting antimicrobial activity. In contradiction to our work, good antimicrobial activity using methanolic seed extracts of *S. wallichiana* reported (Mallikarjuna *et al*., 2010).

Our present investigation confirms that *S. wallichiana* is a potential source of antimicrobial agents and further work is needed to isolate, identify and characterize the compounds that might be responsible for the observed activity.

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