

Physicochemical, phytochemical and antibacterial studies of few medicinal plants of Visakhapatnam region against bacterial clinical isolates

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Abstract: The present study was conducted to evaluate the physicochemical and preliminary phytochemical studies, antimicrobial studies on sixteen medicinal plants collected in and around regions of Visakhapatnam district using methanol as a solvent. Phytochemical screening revealed that methanolic extracts, contained, steroids, alkaloids, phenol, flavonoids, polyphenols and glycosides. The physicochemical parameters like ash and extractive values were determined. The highest percentage of total ash, was found in *Catharanthus roseus*. The extractive values can be used as a reliable aid for detecting quality of drug adulteration. Antimicrobial efficiency of studies plants was tested against four bacterial clinical pathogens including *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumoniae* and *Proteus vulgaris*. The diameter of zone of inhibition (ZOI) was measured and it was found that *C. roseus* showed maximum zone of inhibition against gram+ve *S. aureus* and minimum zone of inhibition against gram-ve *E. coli*. Also the zone of inhibition was increased on increasing concentration. Results observed in the present study help to distinguish the plant extracts from its adulterants and quality and it may be indicative of the methanol extracts of studied plants could be a possible source to obtain new and effective herbal medicines to treat infections, which justify the ethnic uses of *C. roseus* against various infectious diseases apart from its anticancer properties.

Key words: Phytochemical; antimicrobial; phenols

Introduction

Throughout the ages, humans have relied on nature for their basic needs for the production of foodstuffs, shelters, clothing, means of transportation, fertilizers, flavors and fragrances, and, not least, medicines. Nature has been a source of medicinal agents for thousands of years and an impressive number of modern drugs have been derived from natural resources, many of these isolations were based on the uses of the agents in traditional medicine (Cragg GM, Newman DJ, 2001). The widespread use of herbal remedies and healthcare preparations, such as those described in ancient texts like the Vedas and the 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. Higher plants, as sources of medicinal compounds, have continued to play a dominant role in the maintenance of human health since ancient times (Farombi EO. 2003). Since time immemorial, the traditional medicinal practices have been known for the treatment of various ailments in India. Researchers are increasingly turning their attention to the medicinal plants and it is estimated that, plant materials are present in, or have provided the models for 25-50% of drugs [Khan R, *et al.*, 2009; Robbers J, *et al.*, 1996.]

to survive after exposure to one or more antibiotics. In other word, the term “antibiotic resistance” is refers to the ability of a microorganism to withstand the effect of an antibiotic. The problem of resistance has been exacerbated by the use of antibiotics as prophylactics, intended to prevent infection before it occurs. Indiscriminate and inappropriate use of antibiotics for the treatment of the common cold and other common viral infections, against which they have no effect, removes antibiotic-sensitive bacteria and allows the development of antibiotic-resistant bacteria [D'Costa VM, *et al.*, 2011].

In considering the antibiotic resistance as a major problem in the treatment of bacterial infections, there is need to find alternative way of treating infectious diseases using plants which are abundant in our environment and their extracts may overcome the antibiotic resistance so as to serve as a source of novel drugs for the treatment of these diseases. Hence, more studies pertaining to the use of plants as therapeutic agents should be emphasized, especially those related to the control of antibiotic resistant microbes. The objective of this research was to evaluate the potential of plant extracts and phytochemicals on infectious bacteria, which were isolated from clinical samples.

Antibiotic resistance is a form of drug resistant whereby some sub-populations of a microorganism, usually a bacterial species, are able

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Materials and Methods

Plant Materials

Sixteen different medicinal plants free from diseases were collected from the regions of Visakhapatnam, Andhra Pradesh, South India. The plant parts were cleaned of residual soil and air-dried at room temperature.

Table 1: List of plant names

Plant Name	Common Name	Family	Part Studies
<i>Senna alexandrina</i>	Senna	Fabaceae	Leaf
<i>Cinnamomum zeylanicum</i>	Cinnamon, Dalchina	Lauraceae	Bark
<i>Vitex negundo</i>	Vavili, Nirgundi	Lamiaceae	Leaf
<i>Curcuma longa</i>	Turmeric	Zingiberaceae	Rhizome
<i>Mentha arvensis</i>	Pudina	Lamiaceae	Leaf
<i>Catharanthus roseus</i>	Periwinkle, Billaganneru	Apocynaceae	Aerial Parts
<i>Ocimum sanctum</i>	Tulasi	Lamiaceae	Aerial Parts
<i>Withania somnifera</i>	Ashwagandha	Solanaceae	Root
<i>Gymnema sylvestre</i>	Podapatri	Apocynaceae	Whole Plant
<i>Symplocos racemosa</i>	Lodhra	Symplocaceae	Bark
<i>Rosmarinus officinalis</i>	Rosemary	Lamiaceae	Aerial Parts
<i>Camellia sinensis</i>	Tea plant	Theaceae	Leaves
<i>Mucuna gigantea</i>	Enugu dulagondi, Elephant cow itch	Fabaceae	Leaves
<i>Caralluma adscendens</i>	Kundatikommulu	Asclepiadaceae	Aerial Parts
<i>Bauhinia purpurea</i>	Devakanchanam, Camels foot tree	Leguminosae	Bark
<i>Punica granatum</i>	Pomegranate	Lythraceae	Peel

Preparation of plant extracts

The collected plant materials were dried with active ventilation at ambient temperature ($25 \pm 1^\circ\text{C}$) and chopped into small pieces, shade dried and coarsely powdered in Willy mill. The coarsely powdered material weighed and extracted with Methanol using a soxhlet extractor for five to six hours at temperature not exceeding the boiling point of the solvent. For each 100 grams of dry material 2 litres of solvent was used. The extracted solvents were concentrated under reduced pressure (in vacuo at 40°C) using a rotary evaporator. The residue obtained were designated as crude extracts and stored in a freezer at -20°C until assayed. All the extracts were subjected to qualitative and Quantitative chemical investigation (Kokate CK, 2005). Details of various tests performed for the presence of physiochemical and phytoconstituents in the extracts are as under.

Physicochemical parameters

The physico-chemical parameters were used to analyze the purity and quality of the extract. The extracts were evaluated for parameters like loss on drying, total ash, acid insoluble ash, water insoluble ash and different extractive values. Ash value is useful in determining authenticity and purity of drugs and also these values are important for quantitative standards. Studied plant materials were evaluated by following physicochemical parameters were given below.

Loss on Drying (LOD)

Loss on drying is the loss in weight in percent w/w resulting from loss of water and volatile matter of any kind that can be driven off under specific conditions. 5 gm of air-dried plant material (extract) was placed in a crucible of silica. The

extract was spread in a thin uniform layer. The crucible was then placed in the oven at 105°C . The extract was dried for 4 hours and cooled in a dessicator to room temperature and weight of the cooled crucible plus powder was noted.

Ash values

Ash values are indicative to some extent of care taken in collection and preparation of extract of study and for foreign matter content of extract. The object of ashing is to remove all traces of organic material interfering in an analysis of inorganic elements.

Total ash value: This method is designed to measure total amount of material remaining after ignition. 5 gm of extract was taken in tarred platinum crucible. Extract was spread in fine even layer at bottom of the platinum crucible. This platinum crucible with drug material was kept in muffle furnace for ignition at high temperature. Temperature of furnace increased gradually up to 450°C . The material was kept at this temperature for 6 hours till complete ignition of extract occurred, that is till complete white coloured ash was obtained, intermittent weighing was also done and heating continued till constant weight of crucible. Crucible was then taken out from furnace, cooled and weighed. The total ash was calculated by subtracting the weight of crucible with ash of extract after ignition from weight of crucible with drug powder before ignition. Percentage of total ash was calculated with reference to air-dried drug.

$$\% \text{ Total ash value} = \frac{\text{Wt of total ash}}{\text{Wt of crude drug taken}} \times 100$$

Preliminary phytochemical investigation

The plant extract was taken in a test tube and distilled water was added to it such that plant powder soaked in it and shaken well. The solution then filtered with the help of filter paper and filtered extract of the selected plant samples were taken and used for further phytochemical analysis. Phytochemical screening of all the selected medicinal plants was qualitatively tested for the presence of chemical constituents.

The extracts of phytochemical analysis for identification of bioactive chemical constituents were carried out by using standard methods of Sofowora, Trease & Evans, Kokate, Harbone and Raman (Sofowora A, 1993; Trease GE & Evans WC, 1994; Kokate CK, 2005; Harbone JB, 1984 and Raman N, 2006).

Detection of Alkaloids

Mayer's Test: Plant extracts were treated with Mayer's reagent (1.36 mercuric chloride and 5gms of potassium iodide was dissolved in 100ml distilled H₂O). The formation of yellow cream precipitate indicates the presence of alkaloids.

Wagner's Test: Plant extracts were treated with Wagner's reagent (1.27g iodine, 2gm potassium iodide in 100ml distilled H₂O). The formation of brown or reddish precipitate indicates the presence of alkaloids.

Detection of Flavonoids

Ferric chloride Test: Test solution when treated with few drops of FeCl₃ would result in the formation of blackish red colour indicating the presence of flavonoids.

Alkaline Reagent Test: Plant extracts were treated with few drops of NaOH solution. Formulation of intense yellow colour, which becomes color less on addition of dilute acid indicates the presence of flavonoids.

Lead Acetate Test: Plant extracts were treated with few drops of lead acetate solution. Formation of a yellow precipitate indicates the presence of flavanoids.

Detection of Steroids

2ml of acetic anhydride was added to 0.5g ethanolic extract of each sample with 2ml of H₂SO₄. The colour changes from violet to blue or green indicates the presence of steroids.

Detection of Tannins

To the 1ml of plant extract, few drops of 1% FeCl₃ solution were added. The appearance of blue, black, green or blue green precipitate indicates the presence of tannins.

Detection of Terpenoids

Salkowski Test: To the 1ml of plant extract, 2ml of chloroform was added. Then 3ml of conc. H₂SO₄ was added carefully to form a layer. A reddish brown coloration of the interface indicates the presence of terpenoids.

Detection of Phenols

Ferric Chloride Test: To the 1ml of plant extracts, 3ml of distilled H₂O was added. To this few drops of neutral 5% FeCl₃ solution were added. A dark green colour indicates the presence of phenols.

Detection of Saponins

Foam Test: About 2ml of distilled H₂O and 1ml of plant extract were mixed and shaken vigorously. A stable persistent froth indicates the presence of Saponins.

Froth Test: Plant extracts were diluted with distilled water to 20ml and this was shaken in a graduated cylinder for 15minutes. Formation of 1cm layer of foam, which is stable for 15 minutes indicates the presence of Saponins.

Detection of Cardiac Glycosides

Kella – Killani Test: Plant extract was dissolved in glacial acetic acid containing traces of FeCl₃. Then the tube was held at an angle of 45°, 1ml of conc. H₂SO₄ was added down the side purple ring at the interface indicates cardiac glycosides.

Bacterial Clinical Isolates

Isolation and Maintainance: Blood samples were taken from patients with clinical positive cases and the samples were then transferred in culture bottles of brain heart infusion broth (Hi Media, Mumbai, India). Bottles were incubated at 36.7°C for 7 days. Bottles showing positive growth index were Gram stained and sub cultured on nutrient agar plates, all media were taken from Hi Media, Mumbai, India. These plates were aerobically incubated for 24-48 h at 37° in B.O.D.

Oral swab was taken by gently rubbing a sterile cotton swab over the infected parts. The swabs were incubated in nutrient agar, and other selective media for primary isolation of the pathogens. These plates were then aerobically incubated for 24-48 h at 37°C.

When growth was appeared on sub cultured plates of blood and oral swab, all bacterial pathogens were identified by standard microbiological and biochemical procedures. These biochemical tests include carbohydrates fermentation test, urease test, oxidase test, haemolysis of blood, catalase test, motility test and growth of pathogens on specific media etc. [Shimeld LA. 1998; Hawkey P, Law D, 2004; Ryan KJ. 2004; Mukherjee KL.

2006.].

Determination of Antibacterial activity

Isolated test bacteria were grown overnight on nutrient agar plates. Bacterial inoculums were prepared from overnight grown cultures (24 h) in peptone water (Hi Media, Mumbai, India), and the turbidity was adjusted equivalent to 0.5 McFarland units (approximately 10^8 CFU/ml). The microorganisms were inoculated into peptone water and incubated at $35 \pm 2^\circ\text{C}$ for 4 h. The positive control was taken ciprofloxacin (10 $\mu\text{g/ml}$).

The crude extracts of different plants were subjected to antibacterial assay using the Agar Well Diffusion Method of Murray P.R. *et al.*, modified by Olurinola P.F. 20ml of nutrient agar was dispensed into sterile universal bottles these were then inoculated with 0.2ml of cultures mixed gently and poured into sterile petridishes. After setting a number 3-cup borer (6mm) diameter was properly sterilized by flaming and used to make four uniform wells in each petridish. A drop of molten nutrient agar was used to seal the base of each cup. To test the antibacterial activity all extracts were dissolved in DMSO to make a final concentration of 100mg/ml and the wells are filled with 20 μl of the extract and allow diffusing for 45 minutes. These plates were incubated for a period of 24 h at 37°C in incubator. The zones of inhibition were measured with antibiotic zone scale in mm and the experiment was carried out in duplicates. The average value of inhibition and standard deviation were calculated. The zone of inhibition was compared with that of standard ciprofloxacin 10 $\mu\text{g}/1000\mu\text{l}$.

Determination of MIC

Minimum Inhibitory Concentration (MIC) were determined by broth dilution assay method. For the determination of MIC, the reconstituted extract in DMSO was serially diluted in Muller Hinton broth medium to get the concentrations of mg/1000 μl .

The MIC values of extracts were determined based on a microbroth dilution method in 96 multi-well microtitre plates with slight modifications. The crude plant extracts were first diluted to the highest concentration, 500 to 25 mg/ml, to be tested, and 50 μl of normal saline was distributed from the second to the ninth well. A volume of 50 μl from each extracts was pipetted into the first test well of each microtitre line which acts as sterility control, and then 50 μl of scalar dilution of plant extract was transferred from the second to the ninth well. To each well was added 10 μl of resazurin indicator solution (prepared by dissolving a 270mg tablet in 40 ml of sterile distilled water). Using a pipette 30 μl of Muller Hinton broth was added to each well to ensure

that the final volume was of single strength of the normal saline. Finally, 10 μl of the bacterial suspensions were added to each well. In each plate, a column with a broad-spectrum antibiotic was used as the positive control (Ciprofloxacin in serial dilution 500 to 25 mg/ml).

The plates were wrapped loosely with cling film to ensure that bacterium did not become dehydrated, and were prepared in triplicate. Subsequently, they were placed in an incubator at 37°C for 24 h. Any color change from purple to pink or to colorless was recorded as positive. The lowest concentration at which the color change occurred was taken as the MIC value. The average of three values was calculated to determine the MIC of the test material.

Results and Discussion

Physicochemical properties

Analysis of Physicochemical constants of the medicinal plants has studied to evaluate the quality and purity of the extracted compounds from plant materials. Various physicochemical parameters like Ash and Extractive values were calculated as per WHO guidelines. The information collected from these tests was useful for standardization and obtaining the quality standards. The results of the physicochemical constants of medicinal plants lie within the limit which is mentioned in below table signifies that the quality and purity of raw material was good enough. The total ash is particularly important in the evaluation of purity of drugs, i.e. the presence or absence of foreign matter such as metallic salts or silica.

Loss on drying

The loss of weight was calculated as the content in mg per g of air-dried material. The percent loss on drying was then calculated for each plant powder. The results obtained were reported in fig. 1. Percentage of loss on drying was highest in *Rosmarinus officinalis* (18.22 ± 1.05) and least in *Punica granatum* (5.28 ± 1.05).

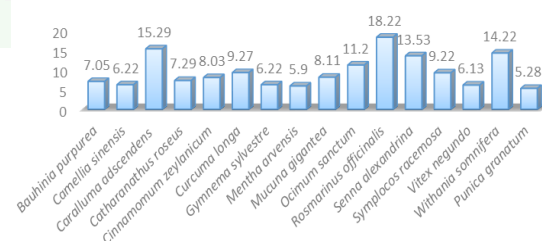


Figure 1: Physicochemical analysis of % of loss on drying

Ash values

The total ash is particularly important in the evaluation of purity of extract, the ash values of medicinal plants of studied were determined and

the results were shown in fig. 2. The amount and composition of ash remaining after combustion of plant material varies considerably according to the part of the plant, age, treatment etc. The constituents of the ash also vary with time and from organ to organ. Ash usually represents the inorganic part of the plant. It contains inorganic material of the plant because ashing destroys all the organic material present in the sample. Ash values mainly reflects the presence of high inorganic content. However, the ash content is possibly due to the Na⁺ and Ca²⁺ salts which are not harmful. Heavy metals are being spoken out vary widely in the global scenario, due to the recent episodes of a few Indian Ayurvedic formulations which have been found to have heavy metals more than that of the permissible level as advised by W.H.O. and F.A.O. The percentage of macronutrients like sodium, potassium and magnesium were within the stipulated limits. Toxic heavy metals like arsenic, lead, palladium and mercury were within the limit and ensure the safety of the study.

At present investigation we found that the percentage of total ash content was highest in *Senna alexandrina* with value 9.23 ± 1.02 and least value is 2.42 ± 0.12 for *Catharanthus roseus*.

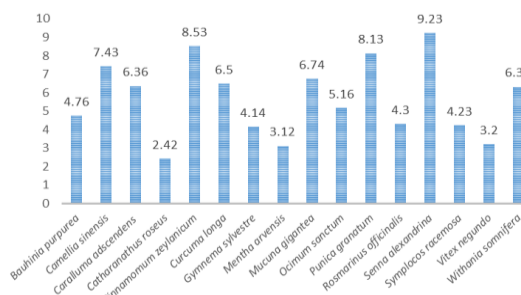


Figure 2: Physicochemical analysis of plants ash

Preliminary phytochemical screening

Medicinal properties of plants are perhaps due to the presence of various secondary metabolites such as alkaloids, flavonoids, glycosides, phenols, saponins, sterols etc. The results of preliminary phytochemical analysis are shown in Table 2. The preliminary phytochemical screening tests may be useful in the detection of the bioactive principles and subsequently may lead to the drug discovery and development. Further, these tests facilitate their quantitative estimation and qualitative separation of pharmacologically active chemical compounds.

Table 2: Qualitative phytochemical analysis of sixteen medicinal plants of methanol extract

Pant Name	Terpenoid	Flavinoid	Alkaloid	glycoside	phenol	Cardiac glycoside	Tannins	Coumarins	Quinone	Saponin
<i>Baubinia purpurea</i>	+	+	+	+	+	+	+	+	+	+
<i>Camellia sinensis</i>	+	+	+	+	+	+	+	+	+	+
<i>Caralluma adscendens</i>	+	-	-	-	+	-	+	-	-	+
<i>Catharanthus roseus</i>	-	-	+	+	+	-	+	+	+	+
<i>Cinnamomum zeylanicum</i>	+	-	+	+	+	-	+	+	+	+
<i>Curcuma longa</i>	+	-	+	+	-	+	+	-	+	+
<i>Gymnema sylvestre</i>	+	+	+	+	+	+	+	+	+	+
<i>Mentha arvensis</i>	+	+	+	-	+	-	+	-	-	+
<i>Mucuna gigantea</i>	+	+	+	+	+	+	-	+	+	+
<i>Ocimum sanctum</i>	+	+	+	+	+	+	+	+	+	+
<i>Punica granatum</i>	+	+	-	+	+	+	+	+	+	-
<i>Rosmarinus officinalis</i>	+	+	-	-	+	-	-	-	-	-
<i>Senna alexandrina</i>	+	+	+	+	+	+	+	+	+	+
<i>Symplocos racemosa</i>	+	+	+	+	+	+	+	+	+	+
<i>Vitex negundo</i>	+	+	+	+	+	+	+	+	+	+
<i>Withania somnifera</i>	+	+	+	+	+	+	+	+	+	+

(+), presence. (-), Absence.

Antibacterial activity

In the present study the predominant bacterial pathogens isolated were *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumoniae* and *Proteus vulgaris*. The methanol extracts of sixteen medicinal plants were screened against four bacterial strains. The antimicrobial activity of different extracts on different bacterial clinical isolates has been shown in Table 3. *K. pneumoniae* exhibited good susceptibility to all the extracts studied. *Catharanthus roseus*, *Camellia sinensis*, *Rosmarinus officinalis*, *Baubinia*

purpurea, *Ocimum sanctum*, *Punica granatum*, *Senna alexandrina* and *Withania somnifera* revealed significant antibacterial activity. Our study revealed *P. vulgaris* as most resistance bacterial species due to very limited activity observed in all plant extracts. *K. pneumoniae* which is considered as susceptible to all studied extracts. Out of selected medicinal plants *C. roseus* exhibited good antibacterial activity against all clinical pathogens studied.

Table 3: Antibacterial activity of methanol extracts on Clinical isolates

Plant Name	<i>E. coli</i>	<i>P. vulgaris</i>	<i>K. pneumoniae</i>	<i>S. aureus</i>	MIC
zone of inhibition in mm					
<i>Bauhinia purpurea</i>	15	14	15	9	75±1.25 mg/ml
<i>Camellia sinensis</i>	17	15	15	12	50±0.65 mg/ml
<i>Caralluma adscendens</i>	7	8	15	12	75±1.05 mg/ml
<i>Catharanthus roseus</i>	18	22	19	24	25±0.55 mg/ml
<i>Cinnamomum zeylanicum</i>	7	8	10	7	100±0.50 mg/ml
<i>Curcuma longa</i>	11	12	8	8	100±1.25 mg/ml
<i>Gymnema sylvestre</i>	14	15	16	12	75±1.10 mg/ml
<i>Mentha arvensis</i>	7	8	9	9	100±0.25 mg/ml
<i>Mucuna gigantea</i>	16	9	12	15	100±0.50 mg/ml
<i>Ocimum sanctum</i>	16	10	19	12	75±0.15 mg/ml
<i>Punica granatum</i>	15	16	15	15	50±2.25 mg/ml
<i>Rosmarinus officinalis</i>	16	18	17	18	25±3.50 mg/ml
<i>Senna alexandrina</i>	15	12	16	14	75±2.25 mg/ml
<i>Symplocos racemosa</i>	11	7	11	10	100±2.00 mg/ml
<i>Vitex negundo</i>	12	9	10	9	100±1.50 mg/ml
<i>Withania somnifera</i>	8	15	15	15	75±0.15 mg/ml
Antibiotic	22	29	32	28	10µg/ml

*zone of inhibition in mm; 6mm borer size

The MIC studied extracts against clinical isolates has been listed in Table 3. The MIC ranges from 25 to 100 mg/ml. The potency of the extract based on the zones of inhibitions, was compared with standard commercial available antibiotics such as ciprofloxacin (10µg/ml) observed that the antimicrobial activity of crude extracts was less than those of the standard drugs.

Discussion

From the research it was observed that all extracts exhibited antibacterial activity against clinical isolate bacteria and inhibition zone was observed ranged from 7 to 25 mm. As it is well known that *P. vulgaris* is notorious for its resistance to antibiotics and is, therefore particularly dangerous and dreaded pathogen. The bacterium is naturally resistance to many antibiotics due to the permeability barriers afforded by its outer membrane composed of lipopolysaccharide (LPS). One method to reduce the resistance to antibiotics is by using antibiotics resistance inhibitors from plant origin (Inuma M, *et al.*, 1994; Kim H, *et al.*, 1995). We have observed very significant antibacterial activity of *C. roseus* and *O. sanctum* extracts, against *K. pneumoniae*. These results revealed that the antibacterial activity of *C. roseus* extracts hold the most promise for further work.

In our study various phytochemicals compounds alkaloids, cardiac glycosides, flavonoids, saponins, terpenes, tannins, phenols, coumarins and quinones were identified from sixteen medicinal plants. The antimicrobial susceptibility of studied medicinal plants could be attributed to the presence of these antimicrobial compounds, which is also proved by other studies [Ahmed AA, *et al.*, 1993; Batista O, *et al.*, 1994; Tsuchiya H, *et al.*, 1996; Rabe T, Van Stadin VJ, 1997; Barre JT, *et al.*, 1997; Amaral JA, *et al.*, 1998; Cowan CC. 1999; Santhi R, *et al.*, 2006].

The results of our research highlights, the fact that the methanol extracts exhibited greater antimicrobial activity because the antimicrobial principles were either polar or non-polar and they were extracted only through the organic solvent medium [Mohanasundari C, *et al.*, 2007; Britto JS, 2001]. So the present observation suggests that the methanol solvent extraction was suitable to verify the antimicrobial properties of medicinal plants which are also supported by many other investigators [Krishna KT, *et al.*, 1997; Singh I, Singh VP., 2000; Natarajan E, *et al.*, 2003; Natarajan D, *et al.*, 2005].

Conclusion

The present investigation reported that Indian-herbal medicine may possess antimicrobial activity against the clinical isolates. These research findings can form the basis for further studies to isolate active compounds, elucidate the structures, and also evaluate them against wider range of resistance bacterial and fungal strains with the goal to find new therapeutic principles. In conclusion, the results of this study have provided scientific justification for the use of *Catharanthus roseus*, *Camellia sinensis*, *Rosmarinus officinalis*, *Bauhinia purpurea*, *Ocimum sanctum*, *Punica granatum*, *Senna alexandrina* and *Withania somnifera* extracts as antimicrobial agents. The extracts of these medicinal plants possess a broad spectrum of activity against a panel of bacteria responsible for the most common bacterial diseases. These promissory extracts open the possibility of finding new clinically effective antibacterial compounds, thereby decreasing the burden of drug resistance and cost of management of diseases. The result shows that the use of *C. roseus* plant in treating microbial infections apart from its anticancer properties could be exploited for new potential antibiotics. However, the effect of the above plants on more pathogenic organisms, toxicological investigations and further purifications, needs to be carried out.

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