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International Journal of Current Research
Vol. 9, Issue, 11, pp.60163-60172, November, 2017

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

ANTIBACTERIAL ACTIVITY OF MEDICINAL PLANTS AGAINST URINARY TRACT INFECTIOUS PATHOGENS

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ARTICLE INFO

Article History:
Received 17th August, 2017
Received in revised form
29th September, 2017
Accepted 06th October, 2017
Published online 30th November, 2017

Key words:
Antibacterial activity, Extract,
Medicinal plants, Biochemical analysis.

ABSTRACT

The antibacterial activity of extract of medicinalplants, namely, *Rhizophora apiculata*, *Phyllanthus emblica*, *Avicennia marina*, *Acalypha indica* and *Withania somnifera* was evaluated against urinary tract infectious pathogens *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Enterococcus faecalis*, *Pseudomonas aeruginosa* and Escherichia coli. As compared to ethanol, acetone extract showed broad-spectrum activity. The multidrug-resistant (MDR) bacteria *Enterococcus faecalis* was inhibited by the acetone extract of *Phyllanthus emblica* fruit whereas the other two resistant bacteria *Staphylococcus aureus* and *Escherichia coli* were inhibited by both ethanol and acetone extract of all the species. Biochemical analysis revealed the presence and confirmation of the organism. Further studies using different solvents for extraction are necessary to confirm that medicinal plants are a better source for the development of novel antibiotics.

Citation: Suganthi, P., Akshaya, T. S., Latha, V. and Swathi, M. 2017. "Antibacterial activity of medicinal plants against urinary tract infectious pathogens", *International Journal of Current Research*, 9, (11), 60163-60172.

INTRODUCTION

Urinary Tract Infections (UTI) are the second most common bacterial infections that occurs anywhere in the urinary tract which includes like kidneys, ureters, bladder and urethra. UTI occur in patients of all ages, but is more frequent among women when compare to men due to their physiology. A 2010 report indicated that 3.1% of urgent care visits for UTIs. It has been estimated that 150 million people were infected with UTI per annum worldwide. It may involve only the lower urinary tract or may involve both upper and lower tract. The term cystitis (bladder infection) has been used to describe lower UTI, which is characterized by a syndrome involving dysuria, frequency, urgency and occasionally suprapublic tenderness. The term phylonephritis (kidney infections) has been uses to describe upper UTI, which includes high fever and flank pain in addition to the symptoms of lower UTI (Gibson, 2012). The bowel movement is act as the main source of floral organism to colonize the urinary system and later it results into the infection. Urinary instrumentation such as catheters serves as a major source of infection. Most of the pathogens follow the ascending route of transmission from the lower urinary tract (urethra) to the upper urinary tract (kidneys). UTI"s are more common during pregnancy because of changes in the urinary tract. The uterus sits directly on top of the bladder. As the uterus grows, its increased weight can block the drainage of urine from the bladder, causing an infection. Antimicrobials of plant origin have enormous therapeutic potential. They are effective in the treatment of infectious diseases while simultaneously mitigating many of the side effects that are often associated with synthetic antimicrobials (Nair *et al*., 2005) The beneficial medicinal effects of plant materials typically result from the combinations of secondary products present in the plant. In plants, these compounds are mostly secondary metabolites such as alkaloids, steroids, tannins and phenol compounds, flavonoids, steroids, resins fatty acids gums which are capable of producing definite physiological action on body. Compounds extracted from different parts of the plants can be used to cure diarrhea, dysentery, cough, cold, cholera, fever, bronchitis, etc (Dagmar Janovska *et al*., 2003). Mangroves are shrubs or small trees that grow in coastal saline or brachish water. The term "mangrove" refers to an assemblage of tropical trees and shrubs that grows in the intertidal zone. Mangroves include approximately 16 families and 40 to 50 species (Chapman *et al*., 1976). Mangroves serve as nursery habitats for many species of fish and invertebrates that spend their adult lives on coral reefs, Sediment trapping to sustain offshore water quality for coral reefs, Protection for inland sites from storm surges and flooding, Building materials, Traditional medicines, Firewood and Food (Kathiresan *et al*., 2001)

Avicennia marina

Avicennia marina, commonly known as grey mangrove or white mangrove, is a species of mangrove tree classified in the

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plant family Acanthaceae (formerly in the Verbenaceae or Avicenniaceae). As with other mangroves, it occurs in the intertidal zones of estuarine areas (Rippey *et al*., 2004)

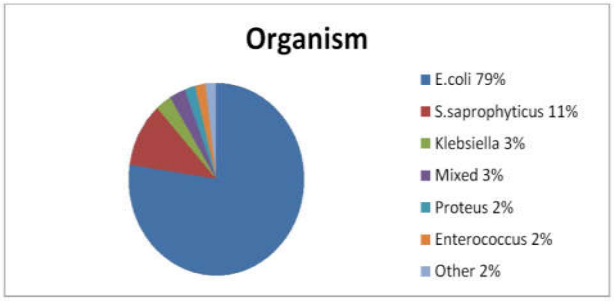

Fig. 1. Common uropathogens in UTI

Fig. 2. ***Avicennia marina***

Classification:

Kingdom	:	Plantae
Subkingdom	:	Tracheobionta
Superdivision	:	Spermatophyta
Division	:	Magnoliophyta
Class	:	Magnoliopsida
Subclass	:	Asteridae
Order	:	Lamiales
Family	:	Acanthaceae
Genus	:	Avicennia
Species	:	marina

Rhizophora apiculata

Rhizophora apiculata is called “bakhawlalaki”, in the Philippines, "Randho" in the Maldives, 'Duroc' in Vietnam, Garjan in India, as well as other vernacular names (Premanathan, 1999).

Fig. 3. ***Rhizophora apiculata***

Classification:

Kingdom	:	Plantae
Subkingdom	:	Tracheobionta
Superdivision	:	Spermatophyta
Division	:	Magnoliophyta
Class	:	Magnoliopsida
Subclass	:	Rosidae
Order	:	Rhizophorales
Family	:	Rhizophoraceae
Genus	:	Rhizophora
Species	:	apiculata

Withania somnifera

Withania somnifera, knowncommonly as ashwagandha, Indian ginseng, or wintercherry, isa plant inthe Solanaceae or nightshade family. *Ashwagandha* isused for arthritis, anxiety, trouble sleeping (insomnia), tumors, tuberculosis, asthma, a skin condition marked by white patchiness (leukoderma), bronchitis, backache, fibromyalgia, menstrual problems, hiccups, and chronic liver disease (Mishra *et al*., 2000).

Fig. 4. ***Withania somnifera***

Classification:

Kingdom	:	Plantae
Subkingdom	:	Tracheobionta
Superdivision	:	Spermatophyta
Division	:	Magnoliophyta
Class	:	Magnoliopsida
Subclass	:	Asteridae
Order	:	Solanales
Family	:	Solanaceae
Genus	:	Withania
Species	:	somnifera

Phyllanthus emblica

Phyllanthusemblica, also known as emblic, emblicmyrobalan, myrobalan, Indiangooseberry, Malacca tree, or amlafrom Sanskrit amalika is a deciduous tree of the family Phyllanthaceae (Krishnaveni *et al*., 2010). It is one of the most important plants in the traditional Ayurvedic medical system as well as in other traditional health systems for immunomodulatory, anti-inflammatory, antiulcer, hepatoprotective, and anticancer actions. However, there is very limited clinical evidence to support the use of emblica for any indication (Pole and Sebastian, 2006).

Classification:

Kingdom	:	Plantae
Subkingdom	:	Tracheobionta
Superdivision	:	Spermatophyta
Division	:	Magnoliophyta
Class	:	Magnoliopsida
Subclass	:	Rosidae
Order	:	Euphorbiales
Family	:	Euphorbiaceae
Genus	:	Phyllanthus
Species	:	emblica

Fig. 5. ***Phyllanthus emblica***

Acalypha indica

It is also known as Indian acalypha, Indian nettle, Indian Copper leaf or three-seeded mercury. It is known in various names across regions – Kuppikhokli (Hindi), Kuppigida (kannada), Kuppameni (Malayalam), Kuppaimeni (tamil), araotong (Philippines) (Jagatheeswari, 2013). *Acalypha indica* has been used widely in Indian Ayurvedic medicine for treating various ailments. The leaves, roots and young shoots of *Acalypha indica* are found to have powerful medicinal value and used in various alternative medicinal form in Philippines (Khare, 2003).

Fig 6. ***Acalypha indica***

Classification:		
Kingdom	:	Plantae
Subkingdom	:	Tracheobionta
Superdivision	:	Spermatophyta
Division	:	Magnoliophyta
Class	:	Magnoliopsida
Subclass	:	Rosidae
Order	:	Euphorbiales
Family	:	Euphorbiaceae
Genus	:	Acalypha

Aim

The study involves in the evaluation of antibacterial activity of selected medicinal plants against multidrug resistant isolates of urinary tract infection. The main objective 1. To determine the solvent for extraction by using various solvents. 2. To perform biochemical test to identify the organism. 3. To identify the multidrug resistant isolates of urinary tract infectious pathogens. 4. Study of antibacterial effect of plant crude extract on isolates of UTI.

MATERIALS AND METHODS

Chemicals and Media

Chemicals and solvents used in this study were of laboratory and analytical grade. Growth media for antimicrobial screening were obtained from Hi-Media.

Sterilization

Growth media and glasswares used in the study were autoclaved at 121^{o}C at 15 lbs/sq.inch pressure for 70 minutes (Hugo *et al*., 1999).

Ethyl acetate: Cleaning of glass wares

All the glasswares (Borosil and Corning) were immersed in cleaning solution for 3 hr. Then, the glassware were washed thoroughly with tap water, followed by detergent solution and finally rinsed with distilled water. The cleaned glassware were dried in hot air oven and stored. Cleaning solution (Mahadevan and Sridhar, 1996)

Selection of medicinal plants for antibacterial study

Five plants with known medicinal properties such as *Avicennia marina* (stem), *Rhizophora apiculata* (leaf, root), *Withania somnifera* (root), *Acalypha indica* (leaf) and *Phyllanthus emblica* (fruits).

Collection of plant materials

The leaves of mangroves plants, viz., *Avicennia marina* and *Rhizophora apiculata* were collected from Ramnad District (Latitude: 9.4071343 Longitude: 78.7022678), Tamilnadu India. *Phyllanthus emblica*, *Withania somnifera* and *Acalypha indica* were collected from the Country medicine shop, Chennai. The plant materials were washed thoroughly with running water and finally rinsed with sterile distilled water. Then they were shade dried at room temperature for one week. The dried plant was crushed into fine powder with the help of a mechanical grinder and refrigerated in sealed vials until further use.

Preparation of the plant extracts

The collected medicinal plants leaves were dried under shade and then powdered with mechanical grinder. The obtained plant powder (10gram) was soaking with four organic solvents (100ml) viz., ethyl acetate, hexane, acetone and ethanol successively to get ethyl acetate, hexane, acetone and ethanol extracts for 72hrs (Rios *et al*., 2007). The suspension was then filtered through Whatmann (No.1) filter paper. The filtrate was transferred into vials and allowed to evaporate using rotory evaporator until completely dried (Parekh and Chanda, 2006). Finally the filtered extract was air dried and then it was stored at -20^{0}C until further use. The crude extract weres weighed and dissolved in 10% dimethyl sulfoxide (DMSO). It was stored at 4 °C in airtight for further studies (Sharma, *et al*., 2009).

Study design: UTI patients showing symptoms of lower and

upper urinary tract infection above 20 years of age.

Isolation of Bacteria

Collected isolates were inoculated into MaCconkey agar plates followed by blood agar plate and identified in UTI agar plate after that incubated at 37^0c for 24 hours. The isolates were identified by using standard protocol (Kersters, 2005). Identified and pure isolates were maintained in nutrient agar slants and incubated at 37^0c for 24 hours. The isolates were subculture periodically in UTI agar. They were stored in LB broth for further studies.

Biochemical test for identification of bacteria

Grams Staining

Gram staining is a common technique used to differentiate two large groups of bacteria based on their different cell wall constituents. The Gram stain procedure distinguishes between Gram positive and Gram negative groups by coloring these cells red or violet. Gram positive bacteria stain violet due to the presence of a thick layer of peptidoglycan in their cell walls, which retains the crystal violet these cells are stained with. Alternatively, Gram negative bacteria stain red, which is attributed to a thinner peptidoglycan wall, which does not retain the crystal violet during the decoloring process (Lockhart, 1995).

Motility

A method for microscopic examination of organisms suspended in a drop on a special concave microscope slide. Cells exhibit a wide range of movement. These movements include migration of cells along a surface or through a tissue, or movement of components within cells (Tittsler and Reese, 1936).

Citrate Utilization Test

Citrate utlilization test is used to determine the ability of bacteria to utilize sodium citrate as its only carbon source and inorganic (NH4H2PO4) is the sole fixed nitrogen source. Streak the Simmon"s Citrate Agar (SIM medium) slant back and forth with a light inoculum picked from the center of a well-isolated colony (Vaughn *et al*., 1950).

Mannitol Sorbitol Test

This type of medium is both selective and differential. The MSA will select for organisms such as Staphylococcus species which can live in areas of high salt concentration. An inoculum from a pure culture is transferred aseptically to a sterile tube of phenol red mannitol broth. The inoculated tube is incubated at 35-37 C for 24 hours and the results are determined (Holding and Collee, 1971).

Triple Sugar Iron Test

Triple sugar iron agar test is used to determine whether gram negative bacilli utilize glucose and lactose or sucrose fermentatively and produce hydrogen sulfide (H_2S). It contains 10 parts of lactose: 10 parts of sucrose: 1 part of glucose and peptone. Inoculate culture by first stabbing through the centre of the TSI medium to the bottom of the tube and then streak the surface of the slant (McKee *et al*., 2012).

Urease Test

The urease test identifies those organisms that are capable of hydrolyzing urea to produce ammonia and carbon dioxide. It is primarily used to distinguish urease-positive bacteria from other Enterobacteriaceae (Baird-Parker, 1963). The broth medium is inoculated with a loopful of a pure culture of the test organism; the surface of the agar slant is streaked with the test organism.

Methyl Red Test

Methyl Red (MR) test determines whether the microbe performs mixed acids fermentation when supplied glucose. Types and proportion of fermentation products produced by anaerobic fermentation of glucose is one of the key taxonomic characteristics which help to differentiate various genera of enteric bacteria. An inoculum from a pure culture is transferred aseptically to a sterile tube of MRVP broth. The inoculated tube is incubated at 35-37^0 C for 24 hours (Ljutov, 1961).

Voges–Proskauer Test

Voges-Proskauer is a double eponym, named after two microbiologists working at the beginning of the 20^{th}century. They first observed the red color reaction produced by appropriate culture media after treatment with potassium hydroxide. It was later discovered that the active product in the medium formed by bacterial metabolism is acetyl methyl carbinol (A product of the butylenes Glycol Pathway (Ljutov, 1963). An inoculum from a pure culture is transferred aseptically to a sterile tube of MRVP broth. The inoculated tube is incubated at 35-37^0 C for 24 hours.

Indole Test

The indole test screens for the ability of an organism to degrade the amino acid tryptophan and produce indole. An inoculum from a pure culture is transferred aseptically to a sterile tube of SIM or tryptone broth. SIM should be stabbed all the way to the butt carefully to disturb the medium as little as possible. The inoculated tube is incubated at 35-37 ^{0}C for 24 hours (Powers *et al*., 1977).

Oxidase Test

This test is used to identify microorganisms containing the enzyme cytochrome oxidase (important in the electron transport chain). It is commonly used to distinguish between oxidase negative Enterobacteriaceae and oxidase positive Pseudomadaceae. A nutrient medium is streaked with bacteria. After colonies have arisen, individual colonies are removed using a sterile, non-metallic instrument (pre-sterilized plastic loop or sterile wooden splint). The cells are rubbed into a moistened strip impregnated with oxidase reagent. This chemical takes the place of oxygen as a recipient for the electrons from the oxidasecytochrome. The additional electrons turn the oxidase reagent from colorless to purple. If oxidase is not present, no color change is observed (Tarrand *et al*., 1982).

Catalase Test

This test is used to identify organisms that produce the enzyme, catalase. This enzyme detoxifies hydrogen peroxide

by breaking it down into water and oxygen gas. The bubbles resulting from production of oxygen gas clearly indicate a catalase positive result. A small inoculum is introduced into hydrogen peroxide, and the rapid elaboration of oxygen bubbles occurs. The lack of catalase is evident by a lack of or weak bubble production (Taylor *et al*., 1972).

Coagulase test

The coagulase test differentiates strains of *Staphylococcus aureus* from other coagulase-negative species. *S. aureus* strains are capable of coagulating plasma in the tube test and will produce clumps of cells in the slide test. Emulsify one or two colonies of Staphylococcus on blood agar plate on each drop to make a smooth suspension. The test suspension is treated with a drop of citrated plasma and mixed well with a needle. Clumping of cocci within 5-10 seconds is taken as positive (Sperber *et al*., 1975).

Antibiotic susceptibility test

Identified isolates were tested for antimicrobial susceptibility test by the standard Kirby Bauer′s disc diffusion method Standard inoculums adjusted to 0.5 McFarland was swabbed on Mueller Hinton agar(Hi-media) and the antibiotic disc were placed and the plates were incubated at 37^0c for 24 hours. After 24 hours, the inhibition zones were measured and interpreted by the recommendations of clinical and laboratory standard Institute guidelines (CLSI-2016). *Escherichia coli* ATCC 25922, *Pseudomonas aeruginosa* ATCC 27853, *Enterococci* ATCC 29212, *Staphylococcus* ATCC 25923 and *Klebsiella pneumoniae* ATCC 700603 were used for quality control. The following standard antibiotic discs were used for the isolates.

Assessment of antibacterial activity of the medicinal plant extracts

Disc diffusion method

Disc diffusion method was followed to detect antibacterial activity of leaves extracts prepared from *Avicennia marina* and *Rhizophora apiculata*, *Phyllanthus emblica*, *Acalypha indica*, *Withania somnifera* (Bauer, 1966) The disc size of 6mm and they were loaded with 0.01mg of crude ethanol dissolved in 5% Dimethyl Sulphoxide (DMSO) at the concentration of 0.01mg/ml to obtain 1µg/disc. 0.05mg of crude ethanol dissolved in 5% Dimethyl Sulphoxide (DMSO) at the concentration of 0.05mg/ml to obtain 5µg/disc. 0.1mg of crude ethanol dissolved in 5% Dimethyl Sulphoxide (DMSO) at the concentration of 0.1mg/ml to obtain 10µg/disc. 0.5mg of crude ethanol dissolved in 5% Dimethyl Sulphoxide (DMSO) at the concentration of 0.5mg/ml to obtain 50µg/disc (Sharma *et al*., 2009).

RESULTS

21 bacterial isolates were recovered and the biochemical tests revealed that, these isolates belong to 5 species. Of these *E.coli* is the predominant one (28%), *S. aureus* (23%), *K. pneumonia* (19%), *E. faecalis* (19%) and *P. aeruginosa* (9%).

Antimicrobial susceptibility

Results of antimicrobial susceptibility test showed marked differences among bacterial isolates in their susceptibility and resistance patterns to a particular antibiotic. *Pseudomonas aeruginosa* strain 1 is resistant to all the antibiotics except amikacin, *Staphylococcus aureus* strain3 is sensitive to vancomycin, gentamycin and chloramphenicol, *Klebsiella pneumoniae* strain 3 are sensitive to ciprofloxacin, *Enterococcus faecalis* strain 2 is resistant to all the antibiotics except vancomycin and norfloxacin. *Escherichia coli* strain 5 is sensitive to only ampicillin. The result of the present study reveals that, the *Staphylococcus aureus*, shows total susceptibility of 32% of all the acetone extract of plants and 4% susceptibility of all the ethanol extract of plants. *Escherichia coli* showed 63% total suceptability of all the acetone extract of plants and 33% susceptibility of all the ethanol extract of plants. *Klebsiella pneumoniae* showed 40% of all the acetone extract of plants and 3% susceptibility of all the ethanol extract of plants. *Pseudomonas aeruginosa* showed 65% of all the acetone extract of plants and 5% susceptibility of all the ethanol extract of plants. *Enterococcus faecalis* showed 3% of susceptibility of all the acetone extract of plants

Table 1. Botanical information of medicinal plants

Plant name	Family	Common name	Parts used
Avicennia marina	Acanthaceae	Grey mangrove	Stem
Rhizophora apiculata	Rhizophoraceae	Garjan	Root
Withania somnifera	Solanaceae	Ashwagandha	Root
Acalypha indica	Euphorbiaceae	Kuppameni	Leaf
Phyllanthus emblica	Phyllanthaceae	Amla	Fruit

Table 2. Selection of solvents for extraction

Polar	Non-Polar
Acetone	Hexane
Ethanol	Ethyl acetate

Table 3. List of antibiotics used

Antibiotics	Symbol	Disc Content
Cephotaxime	Ce	30 mcg
Erythromycin	E	15 mcg
Gentamycin	G	10 mcg
Piperacilin	Pi	10 mcg
Chloramphenicol	C	30 mcg
Ciprofloxacin	Cf	5 mcg
Co-trimoxazole	Co	23 mcg
Tetracycline	T	30 mcg
Amikacin	Ak	30 mcg
Ceftazidime	Ca	30 mcg
Imipenem	I	10 mcg
Ampicillin	A	10 mcg
Nitrofurantoin	Nf	300 mcg
Vancomycin	Va	30 mcg
Penicillin G	P	10 units
Norfloxacin	Nx	10 mcg

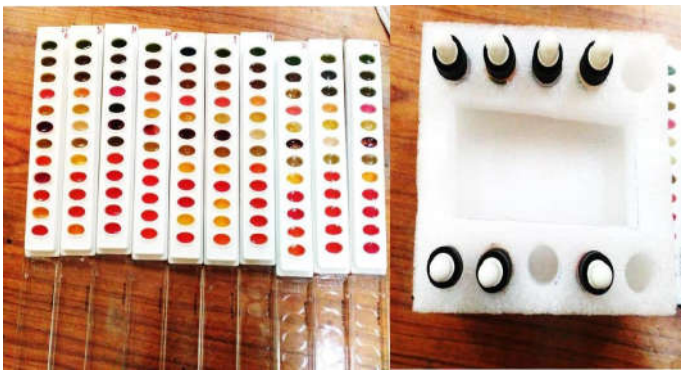

Fig 7. Biochemical kit (HIMEDIA)

Fig 8. Antibiotic sensitivity test

Fig 9. Antibacterial activity of plant extract against UTI isolates

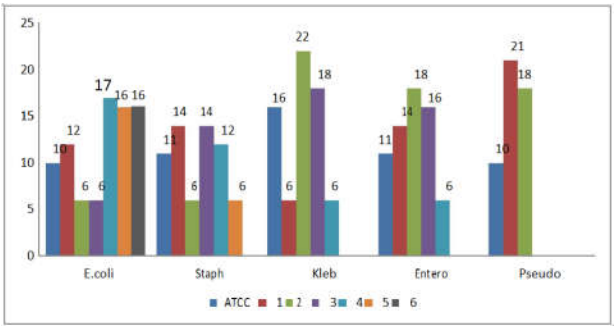

Fig 10. Activity of *Phyllanthus emblica* (Acetone) against UTI pathogen

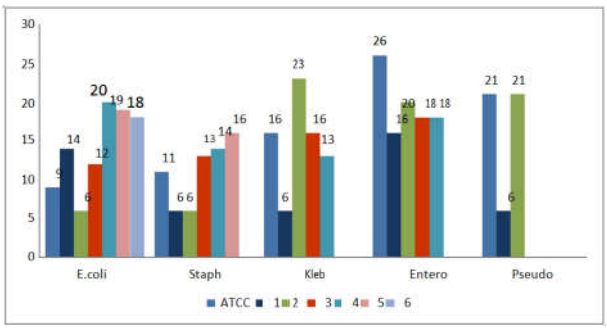

Fig 11. Activity of *Phyllanthus emblica* (Ethanol) against UTI pathogens

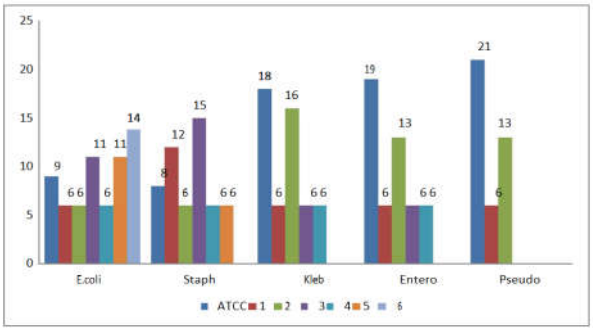

Fig 12. Activity of *Withania somnifera* (Acetone) against UTI pathogens

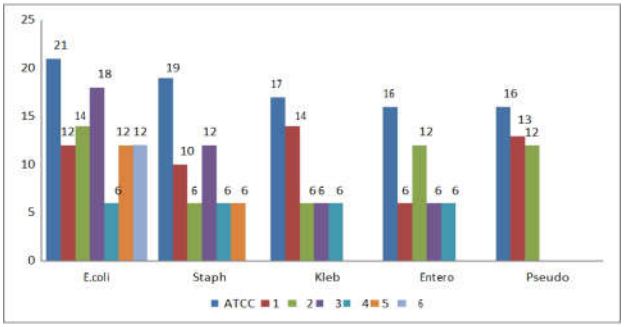

Fig 13. Activity of *Withania somnifera* (Ethanol) against UTI pathogens

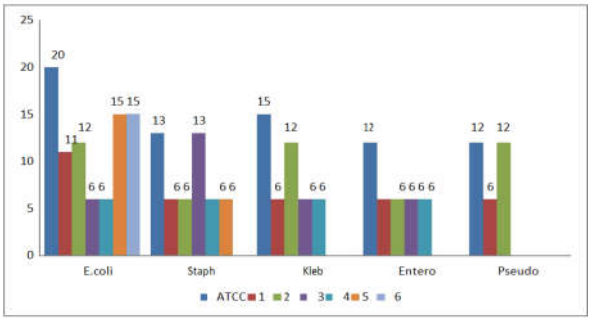

Fig 14. Activity of *Acalypha indica* (Acetone) against UTI pathogens

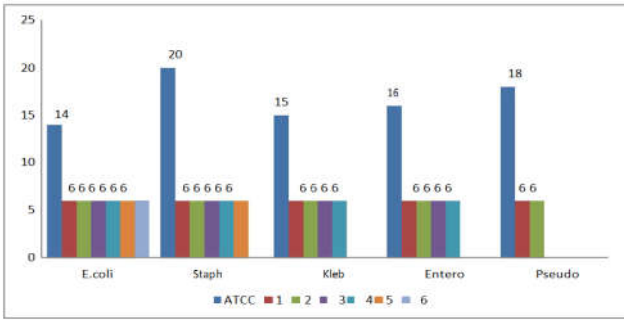

Fig 15. Activity of *Acalypha indica* (Ethanol) against UTI pathogens

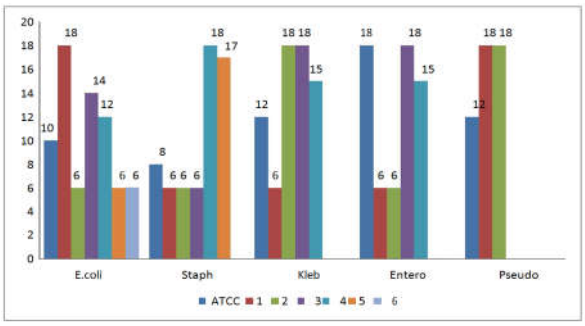

Fig 16. Activity of *Avicennia marina* (Acetone) against UTI pathogens

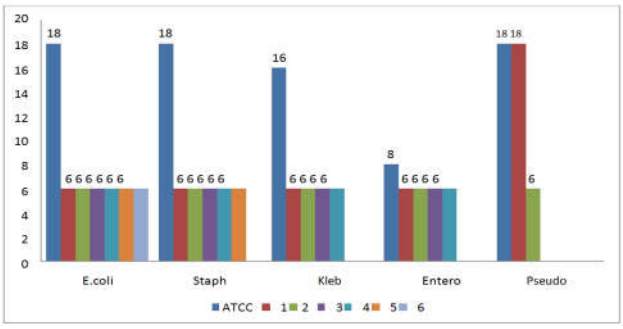

Fig. 17. Activity of *Avicennia marina* (Ethanol) against UTI pathogens

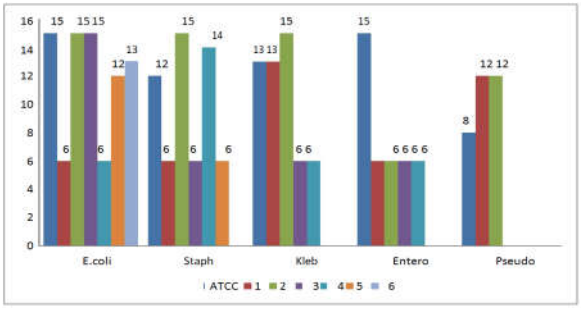

Fig. 18. Activity of *Rhizophora apiculata* (Acetone) against UTI pathogens

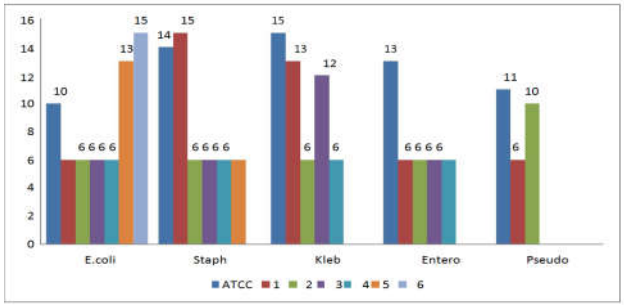

Fig. 19. Activity of *Rhizophora apiculata* (Ethanol) against UTI pathogens

and 2% susceptibility of all the ethanol extract of plants. Thus, it is clearly understood from the result *Pseudomonas aeruginosa* showed higher susceptibility among other UTI pathogens. The leaf extract was tested for the antimicrobial activity against the antibiotic resistant pathogens. The fruit extract of *P. emblica* (26±0.84mm) followed by root extract of *W. Somnifera* (22±0.11mm) f , leaf extract of *A. indica* (20.02 ± 0.02mm), stem extract of *A. marina* (18±0.04) and root extract of *R. apiculata* (15±0.05). Acetone and ethanol extracts of *Phyllanthus emblica* showed antimicrobial activity against all the isolates *E.coli*, *Pseudomonas aeruginosa* and *Klebsiella pneumoniae*, *Enterococcus faecalis* and *Staphylococcus aureus* while hexane and ethyl acetate extract was not found to be active against any of the isolates.

Antibacterial susceptability pattern (plant extract)

Sensitivity pattern of *Phyllanthus emblica*

The zone of inhibition obtained from the extract of *P.emblica* acetone and ethanol was plotted in the Fig.10 and Fig.11 respectively.

Sensitivity pattern of *Withania somnifera:* The zone of inhibition obtained from the extract of *W. somnifera* acetone and ethanol was plotted in the Fig.12 and Fig.13 respectively.

Sensitivity pattern of *Acalypha indica:* The zone of inhibition obtained from the extract of *A. indica* acetone and ethanol was plotted in the Fig.14 and Fig.15 respectively.

Sensitivity pattern of *Avicennia marina:* The zone of inhibition obtained from the extract of *A. marina* acetone and ethanol was plotted in the Fig.16 and Fig.17 respectively.

Sensitivity pattern of *Rhizophora apiculata:* The zone of inhibition obtained from the extract of *R. apiculata* acetone and ethanol was plotted in the Fig.18 and Fig.19 respectively.

DISCUSSION

The results of the present study clearly showed that, extracts from *Phyllanthus emblica* showed antimicrobial activity against tested pathogenic strains including antibiotic resistant strains. The effectiveness of the active compounds present in the plant extracts showed growth inhibition. Most of the urinary tract infection isolates are resistant to the CLSI recommended drugs. *Pseudomonas aeruginosa* UTI isolates was resistant to all the recommended drugs except Amikacin. The side effect of amikacin includes kidney dysfunction, hearing loss when taken high dose (Neuman *et al*., 1982). *Staphylococcus aureus* UTI isolates was resistant to all the recommended drugs according to CSLI guidelines except Vancomycin, Gentamycin and Chloramphenicol. The side effects of Gentamycin include kidney dysfunction secondary to acute tubular necrosis, neuromuscular blockade and ototoxicity (Yunis, 1989). Serious and fatal blood dyscrasias are known to occur after the administration of Chloramphenicol. *Klebsiella pneumoniae* UTI isolates were resistant to all the recommended drugs except Ciprofloxacin, which causes stomach upset, diarrhea, vomiting, headache and restlessness (Johansson *et al*., 2014). *Enterococcus faecalis* UTI isolates were resistant to all recommended drugs except Vancomycin and Norfloxacin. Side effect of Norfloxacin are dizziness, fainting, fast and pounding heartbeat, sudden pain or swelling near joints, dark coloured urine, sore throat and skin rash (Mellor *et al*., 1985). *Escherichia coli* UTI isolates were resistant to all the recommended drugs except Ampicillin. Side effects of Ampicillin includes Diarrhea, nausea and vomiting, swelling of the tongue, thrush or yeast infection (Bachev *et al*., 1974). All plants studied showed antibacterial activity. This could justify their use in treatment of microbial infections in man and livestock. Acetone extracts showed higher activity compared to ethanol extracts on bacteria. *Phyllanthus emblica* extracts showed broad spectrum antibacterial activity against all the UTI isolates under study. Similarly Parekh and Chanda, 2006 observed that aqueous extract of A. indicum was not effective against K. pneumoniae, *E.coli* and *P. pseudoalkaligens*.

It has been reported that Amla possesses spasmolytic (relieves cramps and spasms), purgative (laxatives), expectorant (brings up mucus and relieves cough or congested chest), anti-bacterial, hypoglycemic (lowers high blood glucose levels), hypolipidemic (lowers high cholesterol levels), anti-pyretic

(treats fever) and protects liver. (Singh and Sharma, 2012). Hence it is clearly found that *Phyllanthus emblica* has no toxic effect and it can be extraploted to humans. Because of its cooling nature, amla is a common ingredient in treatments for a burning sensation anywhere in the body and for many types of inflammation and fever; these are manifestations of pitta (fire) agitation (Singh *et al*., 2012). Amla has been considered the best of the Ayurvedicrejuvenative herbs, because it is tridosaghna.

Conclusion

Among the five plants *Avicennia marina*, *Rhizophora apiculata*, *Withania somnifera*, *Acalypha indica* and *Phyllanthus emblica*, best antibacterial activity against Urinary tract infection isolates and control strains was observed in Acetone extracts of *Phyllanthus emblica*. Extracts of *Withania somnifera* also showed appreciable activity against UTI isolates and control strains. Rest of the three plant extracts was showed very mild activity. *Phyllanthus emblica* is highly regarded as a universal panacea in the Ayurvedic medicine. It is one of the most versatile plants having a wide spectrum of medicinal activities. This versatile medicinal plant is the unique source of various types of compounds has diverse chemical structure. As the global scenario is now changing towards the use of nontoxic plant products having traditional medicinal use, development of modern drugs from *Phyllanthus emblica* could be considered for the control of various diseases including urinary tract infections, since it showed better activity in comparison to synthetic drugs.

Acknowledgement

I wish to express my gratitude to the Chairman Prof. J. Karthikeyan and the Principal Dr. Prof. V. R. Sampath, Sree Sastha Institute of Engineering and Technology, who have enlightened our life quality and discipline along with academic focus. I express my earnest and deep sense of gratitude to Dr. C. Mathan Periasamy, Head of the Department, Department of Biotechnology, who have always stood as a moral support and guided me tirelessly with their valuable ideas along with constant encouragement to shine as a good technologist throughout the period of study. I sincerely thank to our project guide, Dr. D. Saravanan, Assistant Professor, Sree Sastha Institute of Engineering and Technology, for his complete support, guidance and encouragement throughout the process of carrying out this project. I take privilege in thanking Dr. P. Suganthi, Assistant Professor at PG Institute of Basic Medical Science, University Of Madras, Taramani Campus, Chennai for allowing us to work in his lab and providing all facilities to complete the project. I am very grateful for her supportive guidance, timely suggestions and instructive supervision. I wish to avail myself of this opportunity to thank our beloved parents T. V. Shankar and S. Sumathy and friends M.Jaithoun bivi and R. Sandhya for their continuous interest in our progress and constant support. Above all, my prayers to Lord Almighty for having showered his blessings on me to make all our endeavors bear fruit.

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