STUDY OF MEDICINAL HERBS AND ITS ANTIBACTERIAL ACTIVITY: A REVIEW

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ABSTRACT
The beneficial medicinal effects of plant materials typically result from the secondary products present in the plant although, it is usually not attributed to a single compound but a combination of the metabolites. The medicinal actions of plants are unique to a particular plant species or group, consistent with the concept that the combination of secondary products in a particular plant is taxonomically distinct. The screening of plants usually involves several approaches; ethno botanical approach is one of the common methods that are employed in choosing the plant for pharmacological study. In the present review paper, antimicrobial properties of various medicinal plants were reviewed. The present review deals with the antibacterial activity of various medicinal plants.

Keywords: Antimicrobial, Herbal Drugs, WHO, Cup-plate Method, Anti-bacterial Activity.

INTRODUCTION
Medicinal plants are finding their way into pharmaceuticals, cosmetics along with nutraceuticals. In pharmaceutical field, medicinal plants are mostly used for the wide range of constituents present in plants which have been used to treat chronic as well as infectious diseases. Long before mankind discovered the existence of microbes, the idea that certain plants had healing potential, indeed, that they contained what we would currently characterize as antimicrobial principles, was well accepted. Man has used plants to treat common infectious diseases and some of these traditional medicines are still included as part of the habitual treatment of various diseases. Medicinal plants are rich sources of antimicrobial agents. According to World Health Organization (WHO) medicinal plants would be the best source to obtain a variety of drugs and 80% of world population is dependent on traditional medicine and a major part of traditional therapies involves the use of plant extracts or their active constituents. Yet a scientific study to determine their antimicrobial active compounds is a comparatively new field.

Infectious diseases, particularly skin and mucosal infections, are common. An important group of these skin pathogens are the fungi and bacteria. Infectious dermatological conditions are of common occurrence including dermal inflammation, folliculitis, skin abuses, acne, dermatitis, rosacea etc. Multidrug resistant bacteria have become important cause for higher skin care products. Multiple drug resistance has developed due to the indiscriminate use of commercial antimicrobial drugs commonly used in the treatment of infectious disease. Immuno compromised individuals are frequently found suffering from skin infections that are difficult to cure. A novel compound with difference in mode of activity of antibiotics against microbes is an attractive alternative against multidrug resistant bacteria. The drugs already in use to treat infectious disease are of concern also because drug safety remains an enormous global issue. Most of the synthetic drugs
cause side effects. To alleviate this problem, antimicrobial compounds from potential plants should be explored. These drugs from plants are less toxic; side effects are scanty and also cost effective. They are effective in the treatment of infectious diseases while simultaneously mitigating many of the side effects that are often associated with synthetic antimicrobials. Topical drug administration is a localized drug delivery system anywhere in the body through ophthalmic, rectal, vaginal, and skin as topical routes. Skin is one of the most accessible organ of human body for topical administration and main route of topical drug delivery system. Number of medicated products is applied to the skin or mucous membrane that either enhances or restores a fundamental function of a skin or pharmacologically alters an action in the underlined tissues. Such products are referred as topical or dermatological products. At the skin surface, drug molecules come in contact with cellular debris, microorganisms, and other materials, which effect permeation. The applied medicinal substance has three pathways to the viable tissue- 1) through hair follicles, 2) via sweat ducts and 3) across continuous stratum corneum between the appendages (hair follicles, sebaceous glands, eccrine, apocrine glands and nails). This route of drug delivery has gained popularity because it avoids first-pass effect, gastrointestinal irritation and metabolic degradation associated with oral administration. The topical route of administration has been utilized either to produce local effect for treating skin disorder or to produce systemic drug effects.

Plant based antimicrobials represent a vast untapped source of medicines and further exploration of plant antimicrobials is the need of the hour. Antimicrobials of plant origin have enormous therapeutic potential. Plant-derived antimicrobials have a long history of providing the much needed novel therapeutics. Although hundreds of plants species have been tested for antimicrobial properties, the majority of these have not been adequately evaluated. Considering the vast potentiality of plant as sources for antimicrobial drugs the present study is based on the review of such plants.

**ANTIBACTERIAL ACTIVITY OF MEDICINAL PLANTS**

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. 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 Janovyska et al. tested the antimicrobial activity of crude ethanolic extracts of ten medicinal plants used in traditional medicine against five species of microorganisms: Bacillus cereus, Escherichia coli, Staphylococcus aureus, Pseudomonas aeruginosa and Candida albicans. Of the 10 plants tested, 5 showed antimicrobial activity against one or more species of microorganisms. The most active antimicrobial plants were Chelidonium majus, Sanguisorba officinalis and Tussilago farfara. Nair et al. screened nine plants for potential antibacterial activity. The plants screened were Sapindus marginatus, Hibiscus rosa sinensis, Mirabilis jalapa, Rheo discolor, Nycanthes arbor-irisits, Colocasia esculenta, Gracilaria corticata, Dictyota sp. and Pulicaria wightiana. Antibacterial activity was tested against 6 bacterial strains, Pseudomonas testosteroni, Staphylococcus epidermidis, Klebsiella pneumoniae, Bacillus subtilis, Proteus morgani and Micrococcus flavus. Two methods, Agar disc diffusionand Agar disc diffusion, were used to study the antibacterial activity of all these plants. Pseudomonas testosteroni and Klebsiella pneumoniae were the most resistant bacterial strains. Sapindus marginatus showed strong activity against the tested bacterial strains.

Ramasamy and Charles Manoharan found the antibacterial activity of valuable compounds from various solvent extracts of Anosomele indica, Blumea lacera and Melia azadirachta against Escherichia coli, Pseudomonas aeruginosa, Serratia marcescens and Staphylococcus aureus by tube diffusion method. Acetone and methanol extracts of all plants showed strong antibacterial effect, whereas petroleum ether and aqueous did not exhibit any effect. Pseudomonas aeruginosa and Serratia marcescens were relatively moresensitive.

Voravuthi kunchai et al. investigated the aqueous and ethanolic extract of ten traditional Thai medicinal plants for their ability to inhibit 35 hospital isolates of MRSA. Nine medicinal plants displayed activity against all isolates tested. Ethanolic extracts of Garcinia mangostana, Pucinia granatum and Quercus infectoria were more effective, with MICs for MRSA isolates of 0.05 -0.4, 0.2- 0.4 and 0.2 –0.4 mg/ml and for Staphylococcus aureus of 0.1, 0.2 and 0.1mg/ml. MBCs for MRSA isolateswere 0.1-0.4, 1.6-3.2 and 0.4-1.6 mg/ml for Staphylococcus aureus were 0.4, 3.2 and 1.6 mg/ml.

Astral et al. tested the aqueous extracts of sage and thyme had action against microorganisms. Phenolic extract of sage and thyme showed antibacterial activity against Staphylococcus aureus and Enterococcus sp. Escherichia coli was more affected by the ethanolic extract of parsley. While, that extract does not elicit pronounce effect on the tested Gram positive organisms. The results of commercial oils of sage, thyme and parsley displayed no antimicrobial activity against Escherichia coli, Proteus mirabilis and Salmonella typhi. The dataobtained revealed that, among the 10 tested microorganisms, Staphylococcus aureus was the most susceptible microbe to most extract of the three plants.

Kabir et al. stated that both water and ethanol extracts of Terminalia avicennioides, Phyllanthus discoideus,
Ocimum gratissimum and Acalypha wilkesiana were effective on MRS A. The MIC and MBC of the ethanol extract of these plants range from 18.2 to 24.0 mcg/ml were recorded for ethanol and water extracts of Bridella ferruginea and Ageratum conyzoides. Higher MBC values were obtained for the two plants. All the four active plants contained at least trace amounts of Anthraquinones.

Poonko thai et al. pointed out that petroleum ether, benzene ethyl acetate and acetone extract of Galinisoga ciliate leaves displays higher activity against Gram positive bacteria (Staphylococcus aureus and Bacillus subtilis) rather than Gram the negative bacteria (Pseudomonas aeruginosa and Escherichia coli). The toxicity against microorganisms may be done to the high amount of phenolic compounds present.

Deshpande et al. isolated that petroleum ether, acetone and methanol extracts of Abrus precatorius, Boswellia serrata, Careya arborea, Emblica officinalis, Syzygium cumini, Woodfordia fruticosa and Sphaeranthus indicus shows appreciable antibacterial activity against Gram positive bacteria (Staphylococcus aureus and Bacillus cereus) and Gram negative bacteria (Escherichia coli, Proteus vulgaris and Pseudomonas aeruginosa). Extracts of some other plants were active only against Gram positive bacteria.

According to Tambekat and Kharate et al. Ocimum sanctum showed inhibitory effect on Escherichia coli, Staphylococcus aureus, Proteus mirabilis, Salmonella typhi, Enterococcus faecalis, Pseudomonas aeruginosa and Yersinia enterocolitica. The leaves extract of various plants such as Tulsi, Pudina and Beetle showed antimicrobial activity of Escherichia coli, Staphylococcus aureus, Enterococcus faecalis, Salmonella typhi, Vibrio cholerae, Proteus mirabilis, Pseudomonas aeruginosa, Yersinia enterocolitica while piper betel showed resistance to Streptococcus pneumoniae.

Panthi and Chaudhary et al. tested eighteen plant species used in folklore medicine for their antibacterial activity by the disk diffusion method. The bacteria employed were Gram positive (Staphylococcus aureus) and Gram negative (Escherichia coli, Pseudomonas aeruginosa and Shigella boydii). Extracts of eight plant showed encouraging result against three strains of bacteria, while other showed activity against one or two strains.

Balakrishnan et al. performed antibacterial activity of Mimosapudica, Aegele marmelos and Sida cordifolia against Bacillus subtilis, Staphylococcus aureus, Klebsiella pneumoniae, Pseudomonas aeruginosa, Escherichia coli and Salmonella typhi. The maximum inhibitory zone of inhibition Sida cordifolia was against Bacillus subtilis (35 mm) and Salmonella typhi (26 mm). Mimosapudica and Aegele marmelos were found to be active against all themicroorganisms tested and the maximum activity was noted against Pseudomonas aeruginosa and Salmonella typhi.

Attar Singh Chauhan et al. screened Sea buckthorn (Hippophae rhamnoidees) seeds aqueous extract for antioxidant and antibacterial activities. The antioxidant activities (Reducing power, DPPH and liposome model system) showed a good antioxidant activity. The extract was also found to possess antibacterial activity with a MIC values with respect to Listeria monocytogenes and Yersinia enterocolitica found to be 750 ppm and 1000 ppm respectively. The antioxidant and antimicrobial effects of the extract implicate its potential for natural preservation.

Bupehsh et al. evaluated the antibacterial activity in the leaf extracts of Mentha Piperita against pathogenic bacteria like Bacillus subtilis, Pseudomonas aeruuse, Pseudomonas aeruginosa, Serratia marcescens and Streptococcus aureus. The aqueous as well as organic extracts of the leaves were found to possess strong antibacterial activity against a range of pathogenic bacteria as revealed by in vitro agar well diffusion method. The ethyl acetate leaf extract of Mentha Piperita showed pronounced inhibition than chloroform, petroleum ether and water, leaf extracts being more on Bacillus subtilis, Pseudomonas aeruginosa than Streptococcus aureus, Pseudomonas aeruuse and Serratia marcescens.

Mohammad Ahanjan et al. tested ethanol, methanol, chloroform, petroleum ether and aqueous extracts of leaves of Parrotia persica for antibacterial activity. The zone of inhibition varied from 13 mm to 22 mm. The highest inhibition was obtained with methanol and ethanol. Chloroform and petroleum ether extracts did not show any activity. The MIC value of the methanol extract for the test bacteria ranged between 3.12 mg/ml and 6.25 mg/ml and that of ethanol extract ranged between 6.25 mg/ml and 12.5 mg/ml. The results scientifically validate the use of this plant in the traditional medicine.

Priscila Ikeda Ushimaru et al. evaluated the invitro antimicrobial activity of methanolic extracts of some medicinal plants against Escherichia coli, Salmonella typhimurium, Staphylococcus aureus and Enterococcus sp. The methanolic extract of Caryophyllus aromaticus presented the highest anti-Staphylococcus aureus activity and was effective against all bacterial strains tested.

Sumathi and Pushpa et al. evaluated tested ten bacterial isolates for their sensitivity against standard antibiotics, aqueous and alcoholic extracts of five plant samples and the mixture. Only the growth of Escherichia coli was inhibited by the aqueous extracts of Acalypha indica. Mollangolatoids was found to be effective in inhibiting the growth of Escherichia coli at a concentration of 12.5 mg/ml and 6.25 mg/ml. The MIC of alcoholic extracts of Nelumbo nucifera was found to be 0.390 mcg/ml for Klebsiella pneumoniae. All the plants extracts showed promising antibacterial properties.

Rupanjali Shan et al. tested the antibacterial activity of different solvent extracts of the air dried bark of Parkia javanica, against five antibiotic resistant bacteria viz, Bacillus subtilis, Staphylococcus aureus, Pseudomonas aeruginosa, Micrococcus luteus and Escherichia coli by cup-plate diffusion method. MIC values of each active extract were determined. The results showed dose dependent positive activity against all the bacteria.
except Escherichia coli. Vimala et al. carried out the antimicrobial activity of Ipomea ken trochulus leaf extracts against several pathogenic microorganisms and microbial isolates by disc diffusion method. The crude, cold methanol, distillate and residual extracts of Ipomea ken trochulus were tried on various microorganisms. The crude extract showed zones of inhibition ranging from 0.0 to 21 mm, with maximum activity against isolated Rhizopus sp. and least activity against Serratia marcescens, Yersinia sp. and Salmonella typhimurium. The zone of inhibition to cold methanol, residual extract and distillate ranged between 6-18 mm and 9-19 mm suggesting that the distillate was more effective than the crude, cold and residual extracts of Ipomea ken trochulus leaf extract against various pathogens and microbial isolates.

Kumar et al. evaluated the antimicrobial activities of some Indian medicinal plants against these etiologic agents of Acne vulgaris. Ethanolic extracts of Hemidesmus indicus (Roots), Eclipta alba (Fruits), Coscinium fenestratum (Stems), Curcubit pepo (Seeds), Tephrosia purpurea (Roots), Mentha piperita (Leaves), Pongamia pinnata (Seeds), Symlocos racemosa (Barks), Euphorbia hirta (Roots), Tinospora cordyfolia (Roots), Thespesia populnea (Roots) and Jasminum officinale (Flowers) for antimicrobial activities by disc diffusion and broth dilution methods. The results from the disc diffusion method showed that 07 medicinal plants could inhibit the growth of Propionibacterium acnes. Among those Hemidesmus indicus, Coscinium fenestratum, Tephrosia purpurea, Euphorbia hirta, Symlocos racemosa, Curcubit pepo and Eclipta alba had strong inhibitory effects. Based on a broth dilution method, the Coscinium fenestratum extract had the greatest antimicrobial effect. The MIC values were the same (0.049 mg/ml) for both bacterial species and the MBC values were 0.049 and 0.165 mg/ml against Propionibacterium acnes and Staphylococcus epidermidis.

Bin Shah et al. investigated the in vitro antibacterial activities of a total of 46 extracts from dietary spices and medicinal herbs agar-well diffusion method against five food borne bacteria (Bacillus cereus, Listeria monocytogenes, Staphylococcus aureus, Escherichia coli and Salmonella anatum). Many herb and spice extracts contained high levels of phenolics and exhibited antibacterial activity against food borne pathogens. Gram-positive bacteria were generally more sensitive to the tested extracts than Gram negative ones. Staphylococcus aureus was the most sensitive, while Escherichia coli were the most resistant.

Khalid Mahmood et al. evaluated the antibacterial activity of Ocimum sanctum essential oil against five human pathogenic bacterial species Escherichia coli, Klebsiella sp., Proteus mirabilis, Pseudomonas aeruginosa and Staphylococcus aureus by disc-diffusion method. Six mm discs were impregnated with 5 and 10 µl of undiluted essential oil and seeded over the plates aseptically having test microorganisms. The zones of inhibition were measured after 24 hours at 37ºC. The essential oil exhibited significant antibacterial activity against all the test pathogens, with maximum zone of inhibition against Staphylococcus aureus (20.0 mm and 41.5 mm) and minimum against Escherichia coli (10.2 mm and 17.8 mm) for 5 and 10 µl of essential oil, respectively. Similarly, the inhibition zones recorded in Proteus mirabilis were 15.1 mm and 26.0 mm, in Pseudomonas aeruginosa 10.2 mm and 20.0 mm, in Klebsiella sp. 11.1 mm and 19.4 mm for two given concentrations of essential oil.

Cock et al. reported the antimicrobial activity of Ocimum sanctum leaves against bacteria and yeast. The diameter of inhibition zone recorded in Escherichia coli was 18 mm for 22 µl of oil. These differences may be attributed due to presence of antibacterial component in high concentration in local variety enhancing the medicinal importance of indigenous essential oil.

Hadi Mehrgan et al. collected the aerial parts of the plant from Alv and mountain side. The air-dried plant materials were ground to fine powder and then extracted by Soxhelet apparatus using methanol. The extract was tested at a concentration of 100 mg/ml against a panel of Gram-positive and Gram-negative bacteria using the disk diffusion technique. This methanolic extract demonstrated antibacterial activity against Gram positive bacteria including Staphylococcus aureus, Methicillin resistant Staphylococcus aureus (MRSA), Streptococcus pyogenes, Enterococcus faecalis, Vancomycin - resistant Enterococcus faecalis and Micrococcus luteus and produced inhibition zones with 8-16 mm diameters. It showed no activity against Gram negative bacteria, such as Escherichia coli, Pseudomonas aeruginosa and Salmonella spp. Minimum concentrations (MC) of the extract forming a clear zone were determined against susceptible bacteria.

Roopa Shree et al. studied the antibacterial activity with respect to their traditional use as anti-psoriatic agents. The herbs were subjected to successive extraction using different solvents and the extracts were subjected to antibacterial evaluation against both Gram positive and Gram negative organisms by cup plate technique. Among the various extracts, aqueous extracts were found to be more effective against all the bacteria. Staphylococcus aureus was more susceptible to the aqueous extracts among the tested organisms.

Koshy Philip et al. screened 32 extracts from eight selected medicinal plants, namely Pereskia bleo, Pereskia grandifolia, Curcuma aeruginosa, Curcuma zedoria, Curcuma mangga, Curcuma inodora, Zingiber officinale et al. and Zingiber officinale for their antimicrobial activity against both Gram-positive bacteria and Gram-negative bacteria using agar disc diffusion assay. The efficacy of the extracts was compared to the commercially prepared antibiotic diffusion discs. No inhibition was observed with the water fractions. None of the plants tested showed inhibition against Escherichia coli. Curcuma mangga showed some remarked inhibition against the bacteria.
(Timur), for potential antibacterial activity against 10 medically important bacterial strains, *Bacillus subtilis*, *Bacillus cereus*, *Bacillus thuringiensis*, *Staphylococcus aureus*, *Pseudomonas sp*, *Proteus sp*, *Salmonella typhi*, *Escherichia coli*, *Shigella dysentriae*, *Klebsiella pneumoniae*. The antibacterial activity of ethanol extracts was determined by agar well diffusion method. The plant extracts were more active against Gram positive bacteria than against Gram negative bacteria. The most susceptible bacteria were *Bacillus subtilis*, followed by *Staphylococcus aureus*, while the most resistant bacteria were *Escherichia coli*, followed by *Shigella dysentriae*, *Klebsiella pneumoniae* and *Salmonella typhi*. *Origanum majorana* showed the best antibacterial activity. The largest zone of inhibition was obtained with *Xanthoxylum armatum* against *Bacillus subtilis* (23 mm)33.

Warda et al. tested four plants (*Marrubium vulgare*, *Thymus pallidus*, *Eryngium militicifolium* and *Lavandula stoechas*) against *Streptococcus pneumoniae* responsible for pharyngitis, rhinitis, otitis and sinusitis infections. Aqueous and methanol extracts have been prepared and tested on *Streptococcus pneumoniae* collected in four regions. A significant activity has been observed with methanol extracts of three plants; *Marrubium vulgare*, *Thymus pallidus* and *Lavandula stoechas*33.

Doss et al. isolated compounds of pharmacological interest (Tannins) from the plant species, *Solanum trilobatum* and assayed against the bacteria, *Staphylococcus aureus*, *Streptococcus pyogenes*, *Salmonella typhi*, *Pseudomonas aeruginosa*, *Proteus vulgaris* and *Escherichia coli* using agar diffusion method. Tannins exhibited antibacterial activities against all the tested microorganisms. *Staphylococcus aureus* was the most resistant to tannins isolated from the plant material followed by *Streptococcus pyogenes*, *Salmonella typhi*, *Escherichia coli*, *Proteus vulgaris* and *Pseudomonas aeruginosa*. Minimum inhibitory concentration of the tannins ranged between 1.0 and 2.0 mg/ml while the minimum bactericidal concentration ranged between 1.5 and 2.0 mg/ml35.

Sukanya et al. examined the ethno botanical efficacy of Indian medicinal plants; *Achyranthes aspera*, *Artemisia parviflora*, *Azadirachta indica*, *Calotropis gigantea*, *Lawsonia inermis*, *Mimosas pudica*, *Ixora coccinea*, *Parthenium hysterophorus* and *Chromolaena odorata* using agar disc diffusion method against clinical bacteria (*Escherichia coli* and *Staphylococcus aureus*) and phyto-pathogenic bacteria (*Xanthomonas vesicatoria* and *Ralstonia solanacearum*). Leaves were extracted using different solvents such as methanol, ethanol, ethyl acetate and chloroform. Among treatments, maximum *in vitro* inhibition was scored in methanol extracts of *Chromolaena odorata* which offered inhibition zone of 10, 9, 12 and 12 mm against *Escherichia coli*, *Staphylococcus aureus*, *Xanthomonas vesicatoria* and *Ralstonia solanacearum*, followed by chloroform extract of the same plant leaf with inhibition zone of 8, 4, 4 and 4A significant inhibition of *Escherichia coli* was found in aqueous and in all tested solvent extracts of *Acalypha indica*. In case of *Staphylococcus aureus*, maximum inhibition of 8 mm was obtained in aqueous extracts of *Acalypha indica* and 6 mm from methanol extract of *Lawsonia inermis*36.

Swati Chauhan et al. assessed the antibacterial activity of standard routine antibiotics along with 23 plant extracts by disc diffusion procedure (Bauer-Kirby method) against *Klebsiella pneumoniae* isolated from nasal samples of pneumonic Barbari goats. The isolate was characterized using biochemical methods and was identified as *Klebsiella pneumoniae*. The organism was found to be resistant against Amoxicillin, Erythromycin, Cephadroxil, Cefaclor, Roxithromycin and Cephalexin. *Terminalia catappa* (Leaves), *Punica granatum* (Bark), *Syzygium cumini* (bark) and *Azadirachta indica* (leaves) showed potential activity with MICs at 62.5 mg/ml, 31.2 mg/ml, 62.5 mg/ml and 125 mg/ml respectively37.

Sheeba et al. detected the antibacterial activity against *Staphylococcus aureus*, *Streptococcus sp.*, *Bacillus subtilis*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Salmonella typhi*, *Shigella dysenterae* and *Vibrio cholerae*. The highest antibacterial activity was observed in 500 µg concentration of leaf extracts of all bacteria screened except *Shigella dysenterae*. The minimum zone of inhibition observed in 25 µg concentration of leaf extract except *Pseudomonas aeruginosa* and *Shigella dysenterae*. These results indicate that the extracts were bacteriostatic at higher concentrations38.

Akinjogunla et al. assessed the antibacterial activity of extracts of the root and leaf of *Phyllanthus amarus* against extend spectrum lactamase (ESBL) producing *Escherichia coli* isolated from the stool samples of HIV sero-positive patients with or without diarrhoea using Bauer disc diffusion method. The phenotypic confirmation of ESBL - *Escherichia coli* were done by Double Disc Synergistic Methods (DDST). The phytochemical analysis of both root and leaf revealed the presence of alkaloids, flavonoids, saponins, tannins, cardiac glycoside, terpenes and anthraquinones. The strains isolated from both HIV sero-positive patients were susceptible to various concentrations of the extracts (5 mg ml-1, 10 mg ml-1, 20 mg ml-1, 40 mg ml-1 and 80 mg ml-1)39.

Adegoke et al. investigated the phytochemical screening and antimicrobial potentiality of *Phyllanthus amarus* against multidrug resistant pathogens using standard microbiological techniques. The extracts were tested by agar well diffusion method for activity against *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Klebsiella sp*. isolated from clinical samples. The susceptibility patterns of the test isolates against the crude extract was determined at extract concentrations of 10 mg/ml, 50 mg/ml, 100 mg/ml and 150 mg/ml respectively. The results revealed that the extracts did not inhibit the growth of *Escherichia coli*, *Pseudomonas sp* and *Klebsiella* at 10mg/ml but the largest zones of growth inhibition for the Ethanolic extract was recorded with *Staphylococcus aureus*, *Escherichia coli* and *Klebsiella* sp. with a mean zone diameter of 20 mm concentrations. The minimum inhibitory concentration (MIC) of the ethanolic plant extracts on *Escherichia coli*, *Staphylococcus aureus*,...
**CONCLUSION**

In conclusion, various studies on antimicrobial activity of herbal plant extracts showed that the various solvent extracts showed promising antimicrobial activity against bacterial and fungal human pathogens. The results of various herbal researchers also indicated that scientific studies carried out on medicinal plants having traditional claims of effectiveness might warrant fruitful results. These plants could serve as useful source of new antimicrobial agents.
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