SUMMARY
AND
CONCLUSION
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The present investigation deals with the evaluation of antimicrobial activity of plants. Fifty-four plants samples were collected either in form of tuber, root, leaf, stem inflorescence, flower, fruit, peel, pulp, seed, latex, juice and whole plant from different areas of Gujarat and extracts were prepared in n-Hexane, ethyl acetate, methanol and distilled water.

Six Gram positive and six Gram-negative and seven fungi were selected for the examination of antimicrobial properties of crude plant extracts. The antimicrobial activity was determined by agar well diffusion method and measured the zone of inhibition and by two-fold serial broth dilution method to find out MIC. Plant extracts at a concentration of 100mg/ml for bacteria and fungi were taken for agar well diffusion method. The concentration range for the MIC was tested at 8mg/ml to 0.062mg/ml. MBC was also performed to check the potential of plant extract against the bacterial growth. Here the MIC lowest concentration of the compound at which microorganisms tested does not demonstrate visible growth, from that MBC were determined by subculturing the test dilutions on to a fresh solid medium and incubated further for 18-24hrs. The highest dilution that yielded no bacterial growth on solid medium was taken as MBC.

Most of the plant extracts showed a broad range of activity against tested bacterial strains but found least effective against fungi. In this study, about 17% n-hexane plant extracts, 36% ethyl acetate plant extracts, 51% methanolic extracts and 11% distilled water extracts inhibited the growth of gram positive bacteria. Among select gram positive bacteria *Bacillus cereus, Enterococcus faecalis* and *Micrococcus luteus* were found to be most sensitive organisms against tested plant extracts. About 12% n-hexane, 43% ethyl acetate, 49% methanolic and 23% distilled water plant extracts affected the growth of gram negative bacteria in which *Escherichia coli, Serratia marcescens* and *Klebsiella pneumonia* were found to be most sensitive organisms while *Salmonella paratyphi* was found to be a more resistant organisms.

The over all inhibitory activity of different plant extracts against tested bacteria was in decreasing order: In n-Hexane extract SE>ST>SA=EN=SA>PS>EC>KP> SM=BS>BC>SP, Ethyl acetate extract the order was EN=EC>KP>SM>BC> SA=SE>ML> PS>BS=ST>SP, while in methanol extract

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EC>SM>KP=BC=EN> ST>ML>SA>BS>PS= ML >SP and in distilled water extract ML>EN=EC>SA=SM> KP=ST>SE=BC>BS>SP.

The overall inhibitory activity of different plant extracts against tested fungi was in decreasing order: In n-Hexane extracts AF>AP>AN>TH>CA>FO>AB, in ethyl acetate extracts AP>AF>CA>AN>FO>TH>AB, in methanol extracts FO>AF>AP>AN>TH=CA>AB where as in distilled water extract AF>AP>AN>CA >FO=TH>AB.


Among different plant extracts *Piper betle* varieties, *Citrus limon*, *C. medica*, *Lavandula bipinnata* extracts exhibited good antifungal activity against *Fusarium oxysporum*, *Tichoderma harzanium*, *Candida albicans*, *Aspergillus flavus* and *A. niger* whereas *Mangifera indica*, *Psidium guajava*, *Manilkara hexandra*, *Pitheceliobium dulce*, *Salvadora persica*, *Mitragyna parvifolia*, *Radermachera xylocarpa*, *Lagerstroemia parviflora*, *Moringa oleifera* and *Phanera integrifolia* showed less antifungal activity against *Fusarium oxysporum*, *Tichoderma harzanium*, *Candida albicans* and *Aspergillus niger*. Among selected fungi *Aspergillus niger* found were found to be most sensitive organisms and *Alternari burnsi* found to be more resistant against tested plant extracts.

Based on the preliminary results, plant extracts were selected to find out the minimum inhibitory concentration (MIC) for particular sensitive strain which was observed in the range of 8mg/ml to 0.0625mg/ml. The MIC value was observed at 8mg/ml for the most of plant extracts against the tested bacterial strains. However, *Citrus limon* and *C. medica* inhibited all tested organisms in MIC range of 1 to 0.125mg/ml, whereas *Piper betle* varieties, *Rosa indica*, *Lavandula bipinnata* and *Psidium guajava* extracts inhibited all tested organisms in MIC range of 8 to 0.125mg/ml. *Woodfordia fruticosa* and *Trapa natans* extracts showed the MIC range between 4mg/ml to 0.0625mg/ml against all tested organisms. *Citrus limon*, *C. medica*, *Piper betle* varieties, *Woodfordia fruticosa* and *Trapa natans* extracts...
exhibited bactericidal activity even at lower concentrations (MIC values of 0.125 mg/ml and 0.0625 mg/ml) against *Bacillus cereus*, *B. subtilis*, *Staphylococcus aureus*, *S. epidermidis*, *Micrococcus luteus* and *Echerichia coli*.

Among the various extracts ethyl acetate and methanolic extracts of different plant extracts have shown lower MBC activities but varied and mostly against Gram positive bacteria i.e. BC, BS, EN, ML and SE and Gram negative bacteria i.e. EC and KP which were found to be susceptible.

The obtained antibacterial results of most active plant extracts (see Table 5-8) are comparable with reference antibiotics Ciprofloxacin and Doxycycline as well as fungicides Ketacozole, flucazole at 20μg/ml used in the study. This approach revealed that the compounds synergistically act against the growth of the drug resistant bacteria probably may be a good candidates for isolation and characterization of active compounds present in them. These active compounds may be tested for their safety and efficacy to uncover their therapeutic potential in modern medicine against infectious diseases.

The Phytochemical analysis was done for nineteen plant extracts showing highest antibacterial activity for qualitative estimation and observed the presence of alkaloids, tannins, phenols, carotenes, flavonoids and glycosides in ethyl acetate, methanol and distilled water extracts. The HPTLC analysis of ethyl acetate and methanol leaf, stem and fruit extracts revealed the presence of terpenoids and phenols and their confirmation was done by using different spray reagents. Quantitative phytochemical estimations of ethyl acetate and methanol leaf extracts of selected plants showed the highest amount of phenols and flavonoids.

Bioautography and HPTLC fingerprinting was done to screen the presence of active compounds in the selected ethyl acetate and methanol plant extracts with effective antimicrobial activity against selected bacteria. *Piper betle* varieties (Banarasi, Bengali, Malbari, Calcati and Kapoori), *Pithecellobium dulce*, *Mangifera indica*, *Manilkara hexandra*, *Psidium guajava*, *Salvadora persica*, *Gmelina arborea*, *Lavandula bipinnata*, *Trapa natans*, *Woodfordia fruticosa* and *Mitragyna parvifolia* extracts showed significant antibacterial activity. However, among different extracts tested *Piper betle* varieties extracts also showed good antifungal activity. Based on the HPTLC fingerprinting *Lavandula bipinnata*, Banarasi and Bengali varieties of *Piper betle*, *Trapa natans* and *Woodfordia fruticosa* extracts were selected for further
purification and characterization of active compounds. Bioassay guided fractionation method was used for the purification of active compounds.

The fractions were analyzed to find out the nature and structure of active compounds by using FTIR and NMR spectrophotometry and compared with spectra of MS library revealed the presence of cortisol acetate, quinine and Ethyl(R)-3-(6-amino-9H-purin-9-yl)-2-hydroxypropionate in *Lavandula bipinnata* leaf and inflorescence extracts, the presence of Hydroxy cheviol, Chavibetol and Eugenol in selected *Piper betle* varieties leaf extract, presence of Quercitin in *Trapa natans* leaf extract as well as presence of Oreintin in *Woodfordia fruticosa* leaf and stem extract. All these extracts showed broad spectrum activity against most of the selected organisms in the present study.

**Conclusion**

The present study concludes that among different plant extracts *Piper betle* varieties Banarasi and Bengali (ethyl acetate and methanol leaf extract), *Woodfordia fruticosa* (ethyl acetate of leaf and stem extract), *Trapa natans* (ethyl acetate leaf extract) and *Lavandula bipinnata* (n-hexane and ethyl acetate leaf and inflorescence extracts) possessed active compounds which showed broad spectrum antimicrobial activity. The other plant extracts which are showing significant antibacterial activities may also be good candidates for isolation of active compounds from them. The results of the present study revealed that the active compounds synergistically act against the growth of the bacteria and fungi. These plant extracts possessed active compounds with antimicrobial property can be used as a substitute either alone or in combination to combat infectious diseases caused by some of the resistant organisms. The data generated in this study helped in understanding the presence of active phytochemicals in medicinal plants and their probable potential use in treatment of microbial induced ailments. These active compounds may be further tested for their safety and efficacy to uncover their therapeutic potential in modern medicine against infectious diseases. The data generated in this study adds information to the scientific knowledge and useful to the humanity.