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EVALUATION OF ANTIBACTERIAL AND ANTIFUNGAL ACTIVITIES OF ETHANOLIC EXTRACT OF *OCIMUM SANCTUM*

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Abstract:

*Various diseases are caused by different pathogenic microorganisms. Antibiotics are being used for treatmen of these infectious diseases, yet unpredictable utilization of it leads towards antibacterial resistance. It is required to discover better approaches to battle against antibacterial and antifungal resistance. Therefore, the study aimed to detect antibacterial sensitivity of extracts of Ocimum sanctum, and against E.Coli, Streptococcus aureus, S.cerevisiae and C.albicans. The percentage yield and physical status of the methanolic leaf extract (MEOS) and chloroform (CSC) and aqueous fractions Ocimum sanctum are showed. The antibacterial activity of a compound is expressed in terms of its ability to inhibit the growth of bacteria in nutrient broth or agar media. The bacterial growth inhibition can be measured by two methods Cup plate method and Serial dilution method. Nutrient broth has been used for the preparation of inoculum of the bacteria and nutrient agar is used for the evaluation of antibacterial activity. All the Extracted compounds (BMC & BMQ), were found to be effective antibacterial agents. Antifungal activity evaluation against C. albicans showed that compound **BMH** also did not possess significant antifungal properties. The study confirms that Ocimum sanctum and all possess antimicrobial activity with different potency against variety of selected microorganisms.*

The results demonstrated that the plant extract exhibited considerable antifungal activity against the tested fungal strains, with the inhibitory effect increasing with concentration. The maximum zone of inhibition of 26.1 mm was observed against Candida albicans at a concentration of 3 mg/disc, which was comparable to the standard drug Amphotericin B (27 mm). The lowest antifungal activity was observed against Saccharomyces cerevisiae. Furthermore, the minimum inhibitory concentration (MIC) and minimum fungicidal concentration (MFC) were evaluated to determine the antifungal potency of the extract. The MIC values varied among the tested fungal species, indicating differences in their susceptibility to the extract.

The findings suggest that the plant extract possesses promising in-vitro antifungal activity and may serve as a potential source of natural antifungal agents. Further studies are required to identify the active phytochemical constituents and establish their safety, efficacy, and mechanism of action.

Therefore, spices have a great potential to be developed as new and safe antimicrobial agents. This review summarizes scientific studies on the antibacterial and antifungal activities of several spices and their derivatives.

Keywords: *Ocimum sanctum, antimicrobial activity and Antifungal activity.*

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INTRODUCTION:

Medicinal plants are part and parcel of human society to combat diseases, from the dawn of civilization [1, 2]. They usually contain many biologically active ingredients and are used primarily for treating mild or chronic ailments. According to World Health Organization (WHO), about 80% of the world population relies chiefly on the plant based traditional medicine especially for their primary healthcare needs. Herbal medicines are in great demand in the developed as well as developing countries for primary healthcare because of their wide biological and medicinal activities, higher safety margins and lesser costs [3, 4]. Infectious diseases are a major cause of morbidity and mortality worldwide. The number of multi-drug resistant microbial strains and the appearance of strains with reduced susceptibility to antibiotics are continuously increasing. This increase has been attributed to indiscriminate use of broad-spectrum antibiotics, immunosuppressive agents, intravenous catheters, organ transplantation and ongoing epidemics of human immunodeficiency virus (HIV) infections [5, 6]. This situation provided the impetus to the search for new antimicrobial substances from various sources like medicinal plants. Synthetic drugs are not only expensive and inadequate for the treatment of diseases but are also often with adulterations and side effects. Therefore, there is a need to search for new infection-fighting strategies to control microbial infections [7].

Plant medicines are used on a worldwide scale to prevent and treat infectious diseases [8]. Plants are rich in a wide variety of secondary metabolites such as tannins, alkaloids, terpenoids and flavonoids having been found in vitro since they have antimicrobial properties and may serve as an alternative, effective, heap and safe antimicrobial for the treatment of microbial infections [9]. Plant based antimicrobial compounds have great therapeutic potential as they have lesser side effects as compared with synthetic drugs and also little chance of development of resistance. Therefore an attempt has been made to study the antibacterial activity of ten medicinally important plants viz. Artocarpus heterophyllus, Berberis aristata, Chromolaena odorata, Embelia ribes, Jasminum angustifolia, Mahonia leschenaultii, Pluchea lanceolata, Plumbago indica, Terminalia chebula, Vitex negundo.[10]

INTRODUCTION OF BACTERIA

Clinical isolated bacteria used in the study are *Escherichia coli, Pseudomonas aeruginosa and Staphylococcus aureus.*

Escherichia coli

Classification

Escherichia coli is the most commonly encountered member of the family Enterobacteriaceae in the normal colonic flora and the most common cause of opportunistic infections. All members of the family Enterobacteriaceae are facultative, all ferment glucose and reduce nitrates to nitrites and all are oxidase negative.[11]

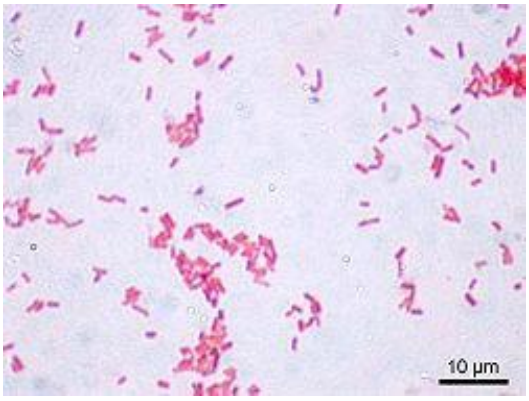


Figure -1 Gram stain of *E. coli*.

Table-1 Classification of *E. coli*

Domain	Bacteria
Phylum	Proteobacteria
Class	Gammaproteobacteria
Order	Enterobacteriales
Family	Enterobacteriaceae
Genus	*Escherichia*
Species	*coli*

Morphology and identification

Escherichia coli is gram-negative, non-sporing bacilli with most strains being motile and generally possessing both sex pili and adhesive fimbriae.[12] Because most strains rapidly ferment lactose, colonies grown on MacConkey media are smooth, glossy, and translucent and are rose-pink in colour. Some strains grown on on blood agar result in colonies being surrounded by zones of haemolysis. Colonies are smooth, circular, 1 – 1,5mm in diameter and yellow opaque if lactose fermenting (blue, if non-lactose fermenting) when grown on cystine-lactose-electrolyte deficient (CLED) mediu.[13]

Epidemiology

Strains of *Escherichia coli* predominate among the aerobic commensal bacteria present in the healthy gut.[14]

***Escherichia coli* Infections**

Escherichia coli was initially considered a non-harmful member of the colon flora, but is now associated with a wide range of diseases and infections including meningeal, gastrointestinal, urinary tract, wound and bacteremia infections in all age groups.[15]

Other infections caused by *Escherichia coli* include peritonitis, cholecystitis, septic wounds and bedsores. They may also infect the lower respiratory passages or cause bacteraemia and endotoxic shock especially in surgical or debilitated patients.[16]

Antimicrobial Susceptibility

Within the community, *Escherichia coli* strains are commonly susceptible to all agents active against the Enterobacteriaceae. However, because of the frequent occurrence of R plasmids, strains acquired in hospitals may be resistant to any combination of potentially effective antimicrobics and therapy must therefore be guided by susceptibility testing.[17]

Staphylococcus aureus

Classification

Members of the genus Staphylococcus (staphylococci) are Gram-positive cocci that tend to be arranged in grape-like clusters.[18]

6. MATERIALS AND METHODS:

Plant material collection

The leaves of *Ocimum sanctum* were collected from the Warangal, Telangana, India, during month of December and authenticated by botanist Prof. Mustafa, Department of Botany, Kakatiya University, Warangal, Telangana, India.

Extraction

The collected leaves/root/bark of *Ocimum sanctum* were shade dried, powdered and extracted with ethanolic solvent by using Soxhlet apparatus. Further, the ethanolic extracts of leaves/root/bark of *Ocimum sanctum* were fractionated with ethyl acetate, n-Hexane, chloroform and water as solvents. The extract of MEBM, BME, BMC, BMH, and BMQ were dispersed in 1 L of distilled water separately and fractionated with ethyl acetate, n-Hexane, chloroform and water as solvent in succession. The obtained fractions were concentrated under reduced pressure to yield corresponding extracts. The obtained extracts and fractions were kept in a desiccator to remove moisture and stored properly until used. Yield of each extract and fraction is noted in terms of w/w of dry material.

STUDIES ON EXTRACT AND FRATIONS OF *OCIMUM SANCTUM*

Physical nature and percentage yield of extracts

The percentage yield and physical status of the ethanolic leaf extract (MECS) and chloroform (CSC) and aqueous fractions ***Ocimum sanctum*** *are* showed in the table Yield of the extracts calculated with reference of the weight raw material used. For fractions, the yield was calculated with respect to corresponding ethanolic extract.

Table-: Percentage yield and physical status of the ethanolic extract and fractions of *Ocimum sanctum*

Extract/Fraction	Code	Yield (%)
Ethanolic	MEBM	9.1
Ethyl acetate	BME	8.2
Chloroform	BMC	4.2
n-hexane	BMH	9.3
Aqueous	BMQ	4.9

Antibacterial and anti-fungal action:

Antibacterial activity

Generally, the antibacterial activity of a compound is expressed in terms of its ability to inhibit the growth of bacteria in nutrient broth or agar media. The bacterial growth inhibition can be measured by two methods.

a). Cup plate method

b) Serial dilution method

Bacterial Culture medium:

Nutrient broth has been used for the preparation of inoculum of the bacteria and nutrient agar is used for the evaluation of antibacterial activity.

Antifungal Activity

Fungal strains and growth medium: Fungal cultures of Candida albicans (MTCC 227), Saccharomyces cerevisiae (MTCC 463), Trichophyton mentagrophytes (MTCC 183), Trichophyton rubrum (MTCC 296), Aspergillus fumigatus (MTCC 343), Aspergillus niger (MTCC 277), Aspergillus flavus (MTCC 418), Penicillium chrysogenum (MTCC 886) were used in the present study. The fungal strains were all standard laboratory strains obtained from the stock cultures of the Division of Microbiology, CAS in Botany, University of Madras, Chennai and maintained on slopes of Sabouraud Dextrose Agar (SDA) at 28°C.

Preparation of inoculums:

The fungal strains were subcultured on slants of SDA at 28°C for 7 days and the colonies were suspended in 1 ml of sterile normal saline. The resulting mixture of conidia and hyphal fragments was vortexed and the turbidity of each homogenous suspension was adjusted to match that of a 0.5 McFarland standard, as read at 530 nm. At this turbidity, the fungi density was 3×106 - 5×106 CFU/ml.

Preparation of the McFarland standard: Add 0.5 ml of 0.048M BaCl2 to 99.5 ml of 0.18M H_2SO_4 with constant stirring. Distribute the standard into screw cap tubes of the same size and with the same volume as those used in growing the broth culture. Seal the tubes tightly to prevent loss by evaporation. Store protected from light at room temperature. Vigorously agitate the turbidity standard on a vortex mixture before use. Standards may be stored for up to 6 months, after which time they should be discarded.

Determination of antifungal activity: Antifungal activity of the ethanolic extract of *Ocimum sanctum* was evaluated by disc diffusion method. The inoculate with respective fungi were homogenously seeded onto the 90mm Petri dishes containing 20 ml cooled molten SDA medium using sterile swab in such a way as to ensure thorough coverage of the plates and a uniform lawn of growth following incubation. These inoculated plates were left to dry for at least 15 min. The lyophilized latex extract was dissolved in distilled water to obtain the different concentrations of 300, 150, 75, 37.5 and 18.75 mg/ml. Amphotericin B at concentration 10 µg/disc was used as positive control and was dissolved in dimethyl sulphoxide (DMSO). Sterile filter paper disc (6mm in diameter) was impregnated with 10 µl of each different concentration of latex extract. The discs were allowed to dry and then placed on the agar surface of each Petri dish. DMSO was used as negative control. Zone inhibitions (in mm) were measured after 48-72 h at 28o C. The complete antifungal analysis was carried out under strict aseptic conditions. Each assay was repeated three times.

Minimum inhibitory concentration (MIC):

The minimum inhibitory concentration (MIC) of *Ocimum sanctum* extract was determined by using broth microdilution method as described by the National Committee for clinical laboratory standards for fungi (M27-A2) 20. The stock solutions of *Ocimum sanctum* extract was diluted suitably as required from stock solution. The ranges should be prepared one step higher than the final dilution range required that if a final dilution range of 0.5, 1, 2, 4, 8, and 16 mg/ml is required then a range of 1, 2, 4, 8, 16 and 32 mg/ml should be prepared to compensate for the addition of an equal volume of inoculum.

Two rows of 12 capped test tubes were arranged in the rack. In a sterile 30 ml (universal) screw capped bottle, 8 ml of SD broth containing the required concentration of C. gigantea latex extract for the first tube in each row was prepared from the appropriate stock solution already made. The contents of the universal bottle were mixed using a sterile pipette and transferred 2 ml to the first tube in each row. Using a fresh sterile pipette, 4 ml of broth was added to the remaining 4 ml in the universal bottle, mixed well and transferred 2 ml to the second tube in each row. Dilutions were continued in this way to as many as 10 tubes. 2 ml of broth free from C. gigantea latex extract was added to the last tube in each row. The density of the suspension was adjusted (3×106 to 5×106 CFU/ml) to equal that of the 0.5 McFarland standard by adding sterile distilled water as detailed above. Amphotericin B was included in the assays as positive control 10 µg/disc. After incubation at 28o C for 42-78 h, turbidity of the tubes was assessed visually by comparison to uninoculated control. MIC was determined as the lowest concentration of C. gigantea latex extract with no visible growth after incubation. All assays were carried out in triplicates.

Minimum fungicidal concentration (MFC):

The MFC was determined by plating a 100 µl volume on SDA from the tubes showing no visible growth. The plates were incubated as described above in MIC. The MFC was defined as the lowest concentration of substance that did not allows any visible growth on the agar plate.

8. RESULTS:

Table 7.1: Zone of inhibition of solvent extract of CSM against *E.Coli:*

Compounds	50µg/ml (mm)	100µg/ml (mm)	1000µg/ml (mm)
MEBM	8	14	14
BME	9	16	18
BMC	10	14	16
BMH	9	13	16
BMQ	**10**	**20**	**22**
CPN	9	14	18
MXN	10	15	18

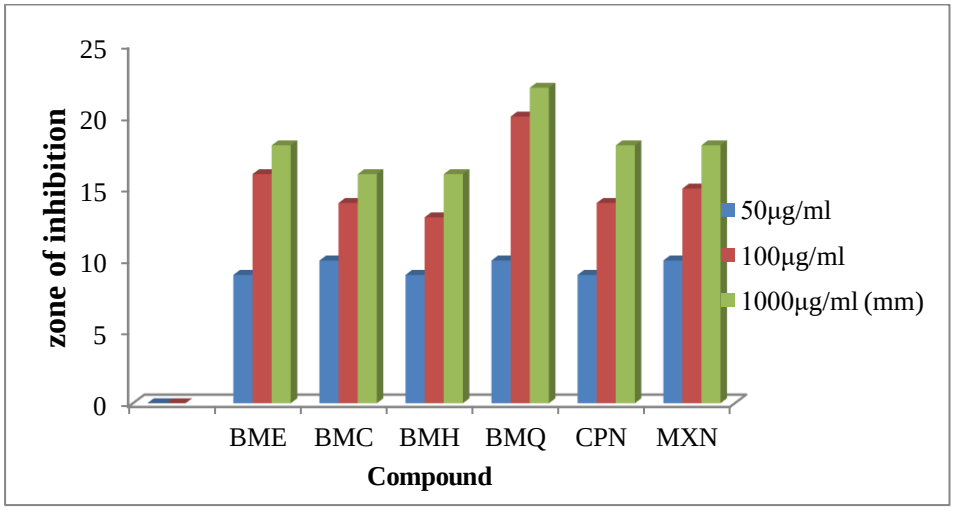
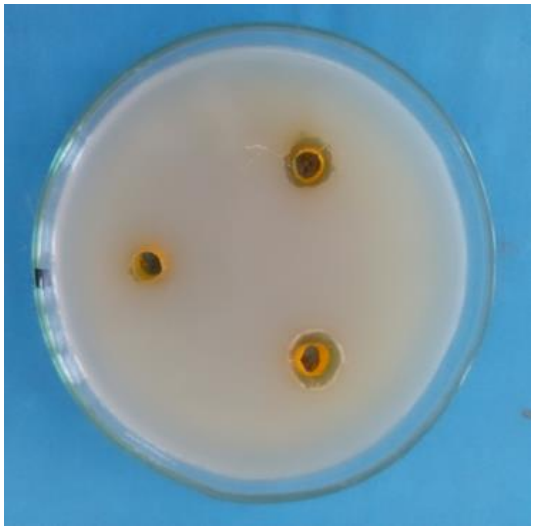


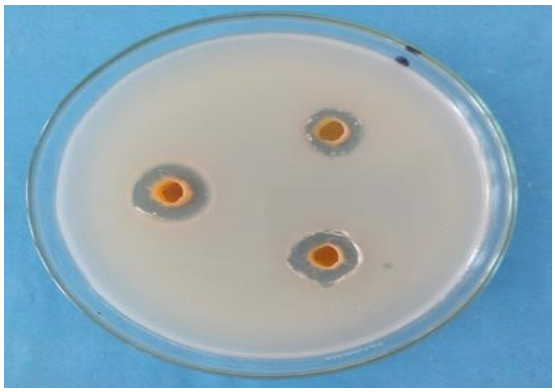
Figure 7.1: Zone of inhibition of solvent extract of CSM against *E.Coli*

Anti-Bacterial Activity of Compound against E.Coli

MEBM



BME



BMC

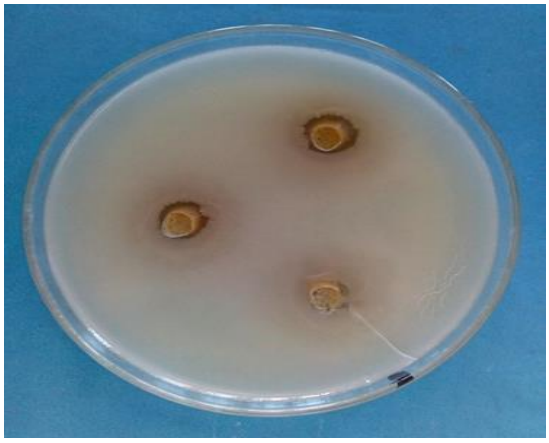


Figure 7.2: Zone of inhibition of solvent extract of CSM against *E.Coli*

Table 7.2: Zone of inhibition of CSM against on *Streptococcus aureus*:

Compounds	50µg/ml	100µg/ml	1000µg/ml
MEBM	4 mm	12 mm	16 mm
BME	13 mm	14 mm	20 mm
BMC	8 mm	12 mm	18 mm
BMH	**12 mm**	**15 mm**	**16 mm**
BMQ	8 mm	10 mm	15 mm
CPN	12 mm	19 mm	20 mm
MXN	14 mm	18 mm	22 mm

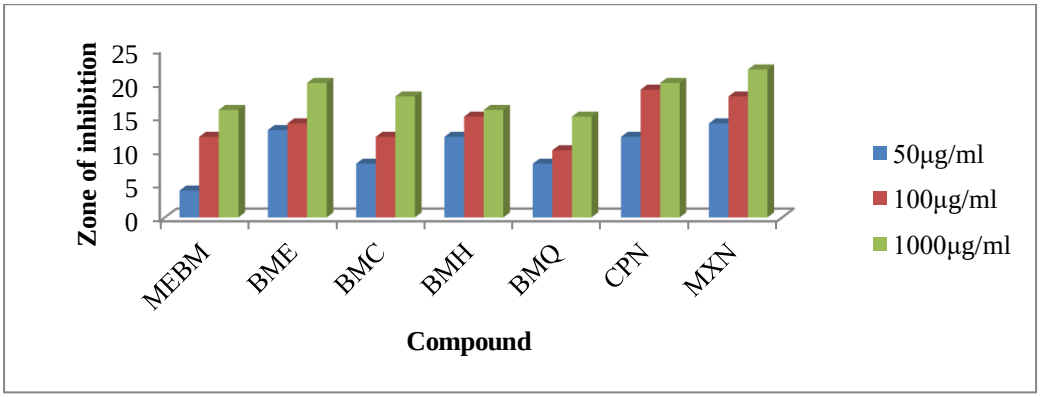
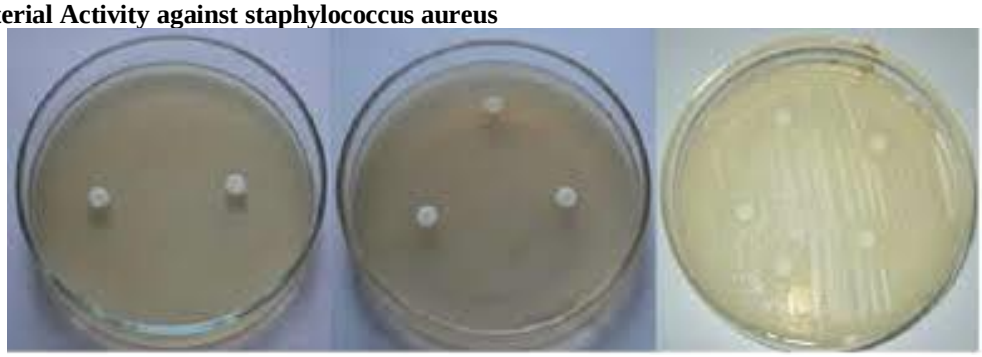


Figure 7.3: Zone of inhibition of CSM against on *Streptococcus aureus*:

Anti Bacterial Activity against staphylococcus aureus



MEBM BME BMC

Figure 7.4: Zone of inhibition of CSM against on *Streptococcus aureus*:

7.1. Results and discussions of Antimicrobial Activity:

The Extracted compounds **MEBM, BME, BMC, BMH, BMQ** has been evaluated for their antimicrobial activity against Gram-positive (*Staphylococcus aureus, Bacillus subtilis*) and Gram-negative (*Escherichia coli, Pseudomonas aeruginosa*) bacteria by measuring the zone of inhibition. The results have been compared with a broad-spectrum antibacterial agent ciprofloxacin as standard drug.

- All the Extracted compounds (BMC &BMQ), were found to be effective antibacterial agents.
- The compounds MEBM showed minimum activity against *E.coli* with zone of inhibition 6mm,10mm, 12mm.
- The compounds BMC showed maximum activity against Gram positive bacteria *E. Coli* at 100µg/ml with zone of inhibition 15mm. Among all those compounds, MEBM, BMC and BMQ showed Poor activity against Gram-positive (*Staphylococcus aureus)* with zone of inhibition of 5mm, 6mm and 5mm.

7.2. Anti-fungal activity:

In the present study, the ethanolic extract of *Ocimum sanctum* yield was 15.5%. Table shows the antifungal activity of ethanolic extract of *Ocimum sanctum* against eight different fungal species. The antifungal potency of *Ocimum sanctum* extract was evaluated by the presence or absence of inhibition zones and zone diameters (mm). From the results, it is evident that the ethanolic extract of *Ocimum sanctum* showed a maximum inhibitory zone in a dose dependent manner. However, there was no significant difference between the levels of zone of inhibition at the concentration of 150 mg and 300 mg. The antifungal potency of *Ocimum sanctum* extract on the C. albicans showed a larger diameter of clearance than that of other strains. Moreover, the zone of clearance achieved by C. gigantea latex extract is comparable to that of standard drug, Amphotericin B.

TABLE 7.3: Antifungal Activity of Calotropis Gigantea Latex Extract Against Fungal Species Tested by Disc Diffusion Assay

Strains	Control	0.175 mg/disc	0.375 mg/disc	0.75 mg/disc	1.5 mg/disc	3 mg/disc	Amphotericin B
Candida albicans	-	11.0	14.1	15	25	26.1	27
Saccharomyces cerevisiae	-	-	8.9	11	16.9	18	20.8
Trichophyton mentagrophytes	-	9.8	15.1	16.0	21	22.6	24
Trichophyton rubrum	-	10	13.0	19	24	25	26
Aspergillus fumigatus	-	13	16.2	18.0	23	24.7	25
Aspergillus flavus	-	12	15	17.9	21	23	25.1
Aspergillus niger	-	8	11.0	15	22	22.9	24
Penicillium chrysogenum	-	9	13	16	20.1	22	23

The increasing incidence of invasive fungal infections is the result of many factors, including increasing number of patients with severe immunosuppressant. Although new drugs have been introduced to combat this problem, the development of resistance to antifungal drugs has become increasingly apparent, especially in patients who require long-term treatment or who are receiving antifungal prophylaxis, and there is growing awareness of shifts of flora to more-resistant species.

Plants are important source of potentially useful structures for the development of novel chemotherapeutic agents. Plant extract has been used traditionally to treat a number of infectious diseases including those caused by bacteria, fungi, protozoa and viruses. Only the Ethanolic extract was used in the present study, as ethanol was reported to be a better solvent for extracting the antimicrobial active substances from Calotropis compared to other solvents. The fungal strains used in the present study were selected on the basis of their clinical importance.

Agar-based methods are not recommendable for testing azoles because these drugs can diffuse poorly in the agar. However, the disk diffusion and E-test methods have shown a good correlation with the broth-based reference methods for testing yeasts. Hence, agar disc diffusion method was performed in the present study to investigate the antifungal activity of *Ocimum sanctum* extract. The highest activity (diameter of zone of inhibition 26 mm) was demonstrated by the ethanolic extract of Ocimum *sanctum* against C.
albicans while the lowest activity was observed against S. cervisiae. The results of the in vitro antifungal assay revealed that the growths of fungal strains were affected by the *Ocimum sanctum* extract by forming clear inhibition zones. The minimum inhibitory concentration and minimum fungicidal concentration of *Ocimum sanctum* extract and the standard antifungal drug, Amphotericin B was depicted in Table. The MIC value of *Ocimum sanctum* extract against fungal strains varies from 1 mg to 8 mg and the results are comparable with the standard antifungal agent, Amphotericin B.

Minimum inhibitory concentrations are considered the “gold standard” for determining the susceptibility of microorganisms to antimicrobials and are therefore used to judge the performance of all other methods of susceptibility testing. MICs are used in diagnostic laboratories to confirm unusual resistance, to give a definite answer when a borderline result is obtained by other methods of testing, or when well diffusion methods are not appropriate. Results of MICs and MFCs showed that S. cerevisiae had the highest MIC (8 mg/ml) and MFC (8 mg/ml) while the lowest MIC of 1 mg/ml.
was demonstrated by C. albicans. The fungistatic or fungicidal effect of natural products and the mechanisms involved are cytoplasm granulation, cytoplasmic membrane rupture and inactivation and/or inhibition of intracellular and extracellular enzymes. These biological events could take place separately or concomitantly culminating with mycelium germination inhibition and it is also reported that plant lytic enzyme act in the fungal cell wall causing breakage of β-1,3 glycan, β-1, 6, glycan and chitin polymer. Studies on the antifungal activity of *Ocimum sanctum* are scanty in the literature.

Table 7.4: Antifungal Activity of Calotropis Gigantea Latex Extract Against Fungal Species Tested by MIC And MFC

Fungal species		**MIC**		**MFC**
	***C.gigantea* (mg/ml)**	**Amphotericin B (mg/ml)**	***C.gigantea* (mg/ml)**	**Amphotericin B (mg/ml)**
Candida albicans	2	0.6	3	3
Saccharomyces cerevisiae	9	5	9	5
Trichophyton mentagrophytes	5	2.9	5	3
Trichophyton rubrum	3.1	5	6	9
Aspergillus fumigatus	3	2	5	3
Aspergillus flavus	3	2	3	3
Aspergillus niger	3.2	3	6	6
Penicillium chrysogenum	3	5	5	3

CONCLUSION:

In the last few decades, there has been a significant surge in research into phytochemicals from foods for illness prevention. We have concluded that the extract of *Ocimum sanctum* could be used to treat microbial (fungus and bacterial strain) infection. It can be used either in combination with traditional medication or used alone as an antibiotic. The antibacterial and antifungal activities of commonly used spices have been summarized. An ethnobotanical approach is a viable way for improving the results of phytochemical research. There has been little research into the health benefits of native Indian plants. The large number of edible plants utilized as food and medicine by the Indian population opens the door to the discovery of novel physiologically active chemicals. They clearly justify research along modern methodological lines such as phytochemical analysis, biological assessment using experimental animal models, toxicity studies, molecular mechanism of action(s) of isolated Phyto principles, and clinical trials. It's a tried-and-true method for finding new lead compounds for treating a variety of diseases. A thorough review of the literature on *Ocimum sanctum* shows that it is a popular medicine among diverse ethnic groups and ayurveda practitioners for a variety of diseases.

As the majority of the studies focused on the in vitro activities of spices against human pathogenic bacteria, *in vivo* studies and clinical trials are needed to be conducted in future. The mechanisms of antimicrobial action of spices remain to be clarified in order to make the best use of spices. Furthermore, the potential toxicity of spices on humans should be evaluated.

The antifungal activity was determined by measuring the zone of inhibition at different concentrations and comparing the results with the standard antifungal drug Amphotericin B.

The results revealed that the plant extract exhibited significant antifungal potential against the tested fungal strains. The maximum zone of inhibition (26.1 mm) was observed against Candida albicans at a concentration of 3 mg/disc, which was comparable to the standard drug Amphotericin B (27 mm). The lowest activity was observed against Saccharomyces cerevisiae, indicating variation in susceptibility among the fungal species.

The MIC and MFC studies further supported the antifungal potential of the extract. The MIC values varied from 2 to 9 mg/ml, while the MFC values ranged from 3 to 9 mg/ml for the tested fungal species. These findings indicate that the extract possesses inhibitory and fungicidal effects against several fungal pathogens.

Overall, the study demonstrates that the plant extract has promising antifungal properties and could be considered a potential source for the development of natural antifungal agents. However, further investigations involving phytochemical characterization, isolation of active constituents, toxicity studies, and in-vivo antifungal evaluation are necessary to establish its therapeutic potential. Induced and aspirin induced ulcers in Albino rats.

REFERENCES:

1. B. Nitha, A.B. Remashree and Indira Balachandran. Antibacterial Activity Of Some Selected Indian Medicinal Plants. IJPSR, 2012; Vol. 3(7): 2038-2042.
2. Chaudhary G, Goyal S, Poonia P. Lawsonia inermis Linnaeus: A Phytopharmacological Review. International Journal of Pharmaceutical Sciences and Drug Research 2010; 2(2): 91-98.
3. Goyal BR, Goyal RK, Mehta AA. Phyto-Pharmacognosy of Archyranthes aspera: A Review. Pharmacognosy Reviews 2008; 1:1.
4. Cragg GM, Newman DJ, Sander KM. Natural products in drug discovery and development. Journal of Natual Products 1997; 60:52-60.
5. Dean DA, Burchard KW. Fungal infection in surgical patients. American Journal of Surgery 1996; 171: 374-382.
6. Gonzalez CE, Venzon D, Lee S et al. Risk factors for fungemia in children infected with human immunodeficiency virus: a case control study. Clinical Infectious Diseases 1996; 23: 515-521.
7. VaghasiyaY, Chanda SV Screening of Methanol and Acetone Extracts of Fourteen Indian Medicinal Plants for Antimicrobial Activity. Turkish Journal of Biology 2007; 31:243-248.
8. Soulsby EJ. Resistance to antimicrobials in humans and animals. Britsh Journal of Medicine 2005; 331: 1219-1220.
9. Cowan MM. Plant products as antimicrobial agents. Clinical Microbiology Reviews 1999; 12: 564-82.
10. Udayan PS, Balachandran I: Medicinal Plants of Arya Vaidya Sala Herb Garden. Department of Publication Arya Vaidya Sala, Firt Edition 2009.