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Antibacterial and Antifungal Survey in Plants used in Indigenous Herbal-Medicine of South East Regions of Iran

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Abstract: Methanol plant-extracts of 221 species from 98 families which had documented uses in Iranian herbal-medicine were screened for antibacterial and antifungal activity against 11 standard bacterial strains and 3 fungal species at 20 mg ml^{-1}. Eighty one samples in 39 families showed antibacterial and/or antifungal activity against at least on one of the tested microorganisms. Antimicrobial activities were evaluated by measuring the diameter of inhibition zones in agar well diffusion method. *Dianthus coryophyllus* was active against all tested G-ve and G+ve bacteria except *Micrococcus luteus*. Most susceptible G-ve bacteria were *Klebsiella pneumoniae* and *Bordetella bronchiseptica* and least susceptible was *Escherichia coli*. In G+ve bacteria, most and least susceptible were *Staphylococcus aureus* and *Micrococcus luteus*, respectively. Plants with high antifungal activity included *Alpinia officinarum*, *Chrozophora verbasafalia*, *Cinnamomum zeylanicum*, *Dianthus coryophyllus*, *Helleborus nigra*, *Heracleum persicum*, *Myrtus communis*, *Terminalia chebula* and *Trachysermum copticum* which were effective mostly against *Candida albicans* and *C. utilis*.

Key words: Antimicrobial, plant extracts, iranian herbal-medicine

INTRODUCTION

Resistance in pathogens to the common therapeutic agents is increasing in recent years[1,2]. Methicillin-resistant *Staphylococcus aureus* (MRSA) has been troubling hospital services all over the world[3,4]. Isolation of microbial agents less susceptible to regular antibiotics and recovery of increasing resistant isolates during antibacterial therapy is rising throughout the world[1,5-12]. Problem of antibiotic resistance, in both hospital-acquired (nosocomial) and community- acquired bacterial infections have made many antibiotics virtually obsolete. As the reports show, no antibiotic can last effective too long. Some workers express the situation very dramatic, Smith *et al.*[4] expresses that "The emergence of *S. aureus* resistance threatens to return us to the era before the development of antibiotics".

It is mentioned that about two decades ago *Candida albicans* was commonly regarded as little more than culture contaminant; however, because of developed resistance, in recent years this organism has become a major human pathogen[13]. Frequency of *C. albicans* infections has risen dramatically and the development of drug-resistant *C. albicans* is a major concern worldwide[14,15]. Kieren *et al.*[16] reported that Fluconazole-resistant *C. albicans*, a cause of oropharygeal candidiasis in patients with human immunodeficiency virus infection has recently emerged as a cause of candidiasis in patients receiving cancer chemotherapy and marrow transplantation. In their studies they found *C. albicans* isolates became resistant to fluconazole and amphotericin B after two weeks of antifungal drug exposure.

Through investigations for new agents, many workers have presented antimicrobial activities of plant extracts. Golan-Goldhirsh *et al.*[17] tested extracts of 66 desert plants for antimalarial activity. They found 12 extracts demonstrated strong growth inhibition (>96%) of the malarial parasite, *Plasmodium falciparum*. In south eastern regions of Iran, Mansouri[18] tested ethanol extracts of 11 plants against 489 samples of *S. aureus* and noticed *Myrtus communis* leaves had the greatest activity, inhibiting the growth of 99% of the isolates. Antibacterial activity of crude extract of *M. communis* against 10 laboratory strains of bacteria was tested by Mansouri *et al.*[19] They noticed that the crude extract inhibited the growth of all tested bacteria except *Campylobacter jejuni*. Cavin *et al.*[20] screened 204 crude extracts of Indonesia plants on *C. albicans* and found nine actives. Crockett *et al.*[21] noticed anticandidal

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activity in *Cassia alata* and expressed that water extract of the plant is used in Ivory Coast, West Africa to treat fungal infections caused by *C. albicans* and dermatophytes.

Herbal remedies play a fundamental role in traditional medicine in some rural regions of Iran where the plants are often used as the therapeutic agents as antiseptic, anti-inflammatory and in treatment of infectious diseases including candidiasis and dermatophytes[22]. In the present study, methanol plant-extracts of 221 species from 98 families which had documented uses in Iranian herbal medicine, were screened for antibacterial and antifungal activity against 11 standard bacterial strains and 3 fungal species at 20 mg ml^{-1}. Fungal yeasts used in this study were chosen primarily based on their importance as opportunistic human-pathogens. *Saccharomyces cerevisiae,* commonly known as brewer's yeast, has been reported as the cause of both superficial and invasive infections[23] and *Candida albicans* while naturally occurring in the intestinal flora, can cause oral thrush and systemic infections[13]. *C. utilis*, nonpathogenic fungus also incorporated into the screening survey in order to attain more comprehensive conclusion about the anti-fungal spectral activity of the plants.

MATERIALS AND METHODS

Plant material: According to information gathered from ethno pharmacologists, herbal-drug sellers and rural native-healers, plant samples of 221 species of 98 families were collected from southern regions and herbal-drug stores of Iran. The plants were identified in the Plant Systematic Laboratory, College of Agricultural Sciences, Bahonar Univ. of Kerman, Iran, where voucher specimens were deposited.

Extraction procedure: Plant parts commonly used in herbal medicine were dried under shade for about one week and then at 40°C in an incubator for 2-3 days. Dried plants were pulverized with mortar and pestle or electric mill. The fine powder of plant parts were extracted three times with boiled methanol[24] and the extracts were then concentrated under reduced pressure using rotary evaporator (Buchi, Switzerland) to yield a dense dark-residue. Each sample was then transferred to glass vials and lyophilized overnight before use.

Test organisms: The test organisms used in the study were obtained from Persian Type Culture Collection, Tehran, Iran (PTCC), namely: *E. coli* (PTCC No. 1330), *Pseudomonas aeruginosa* (PTCC No. 1074), *P. fluorescens* (PTCC No. 1181), *Klebsiella pneumoniae* (PTCC No. 1053), *Bordetella bronchiseptica* (PTCC No. 1025), *Staphylococcus aureus* (PTCC No. 1112), *S. epidermidis* (PTCC No. 1114), *M. luteus* (PTCC No. 1170), *Bacillus cereus* (PTCC No. 1015), *B. pumilis* (PTCC No. 1319), *Saccharomyces cerevisiae* (PTCC No. 5052), *Candida albicans* (PTCC No. 5027) and *Candida utilis* (PTCC No. 5065). The bacteria rejuvenated in test tube-slants of Mueller Hinton Agar medium (MH, E. Merk, Germany) at 37°C for pathogenic and at 29°C for saprophytic bacteria for 48 h and then stocked at 4°C. The fungal yeasts were cultured on Sabouraud dextrose medium at 30°C for 48 h and stocked at 4°C. Subcultures were prepared from the stocks for bioassays.

Agar well diffusion bioassay: For bioassays, a bacterial/yeast suspension of approximately $1.5x10^6$ cells ml^{-1} in sterile normal saline was prepared as described by Forbes *et al.*[25]. An aliquot of 1.5 ml was uniformly seeded on the solid media (15 ml, 4 cm thickness) in Petri dishes, left aside for 15 min and excess was then drained and discarded properly. Wells of 6 mm in diameter and about 2 cm apart were punctured in the culture media using sterile cork borers[25]. Concentration of 20 mg ml^{-1} of each of the plant methanol-extracts was prepared in dimethyl sulfoxide (DMSO): methanol (1:1, v/v) solvent (DM solvent) and administered to fullness in each well (approximately 0.1 ml). The plates were then incubated at 37°C for pathogenic and at 29°C for saprophytic bacteria and fungal yeasts for 48 h. After incubation, bioactivity was determined by measuring the diameter of inhibition zones (DIZ) in mm. All samples were tested in triplicate. Controls included solvent without plant extracts, although no antibacterial activity was noted in the solvent employed for the test.

RESULTS

From plant samples of 221 species used in herbal medicine, 81 samples of 39 families showed antibacterial and/or antifungal activities at 20 mg ml^{-1} as shown in Table 1. The largest DIZ (26 mm) was shown by *Myrtus communis* leaf extract against *B. bronchiseptica*, *S. epidermidis* and *B. cereus*. Of all the plants tested, *Dianthus coryophyllus* showed the broadest spectrum of antibacterial activity, inhibiting the growth of all bacterial strains except *M. luteus*. The leaves of *M. communis* and *Zingiber officinale* were effective against all of the G+ve bacterial strains. *K. pneumoniae* and *B. bronchiseptica* were the most susceptible G-ve bacteria and *S. aureus* was the most susceptible G+ve bacterium. In general, the active plants were more effective against G+ve than G-ve

Table 1: Results of antibacterial/antifungal activity of herbal medicinal-plants used in South East regions of Iran, indicated by diameter of inhibition zones (DIZ, mm) at 20 mg ml^{-1}. Blanks represent zero activity

Plant families	Plant species	PT	Ec	Pa	Pf	Kp	Bb	Sm	Sa	Se	Ml	Bc	Bp	Sc	Ca	Cu
Aceraceae	*Acer* sp.	FR														
Acoraceae	*Acorus calamus* L.	RO														
Actinidiaceae	*Actinida rubus* Lev.	LE														
Agavaceae	*Sansevieria trifasciata* Prain	RO														
Agavaceae	*Yucca* sp.	RO														
Alismataceae	*Sagittaria* sp.	LE														
Alismataceae	*Alisma* sp.	LE														
Aloeaceae	*Aloe* sp.	LE														
Amaranthaceae	*Amaranthus paniculatus* L.	FL			10					10						
Amaryllidaceae	*Narcissus tazetta* L.	LE														
Anacardiaceae	*Rhus coriaria* L.	FR				18	18		19	18		18	19			
Anacardiaceae	*Semicarpus anacardium*	SB												10	11	13
Anacardiaceae	Semecarpus anacardium L. f.	LE				10	11			12						
Apiaceae	*Apium graveolens* L.	LE	9				10		9			9				
Apiaceae	*Coriandrum sativum* L.	SE							10	10		9				
Apiaceae	*Petroselinum sativum* (P. Mill.) Nyman ex A.W. Hill	SE						10	9							
Apiaceae	*Pimpinella anisum* L., Syn. Anisum vulgare	SE												-	10	15
Apiaceae	*Trachyspermum ammi* (L.) Link	SE	9	10		9	9		18	17			10			
Apocynaceae	*Vinca rosea* L.	FL														
Araceae	*Anthurium* sp.	LE														
Araceae	*Monsetra deliciosa* Liebm.	RO														
Araceae	*Scindapsus pictus* Hassk.	RO														
Araliaceae	*Aralia* sp.	FL														
Araliaceae	*Hedera helix* L.	LE														
Araliaceae	*Schefflera* sp.	FL														
Asteliaceae	*Cordyline* sp.	LE														
Berberidaceae	*Berberis vulgaris*	FR												-	14	-
Betulaceae	*Alnus incana* (L.) Moench	SE														
Bignoniaceae	*Tecoma capensis* (Thunb.) Lindl.	FL														
Boraginaceae	*Borago officinalis* L.	FL			9									-	12	-
Boraginaceae	*Cynoglossum officinale* L.	LE														
Boraginaceae	*Heliotropium arborescens* L.	LE														
Boraginaceae	*Myosotis asiatica* (Vesterg.)	LE														
Brassicaceae	*Eruca vesicaria* ssp. *Sativa* P. Mill.	SE														
Buxaceae	*Buxus sempervirens* L.	RO														
Calycanthaceae	*Calycanthus floridus* L.	LE														
Calycanthaceae	*Chimonanthus praecox* L.	LE														
Cannaceae	*Canna* sp.	LE														
Capparidaceae	*Capparis spinosa* L.	LE														
Caprifoliaceae	*Lonicera fragrantissima* Lindl. and Paxton	LE														
Caryophyllaceae	*Dianthus caryophyllus* L.	WP				12	18			18				-	24	20
Chenopodiaceae	*Atriplex subspicata* (Nutt.) Rydb.	LE														
Chenopodiaceae	*Haloxylon persicum* Bunge.	FR														
Chenopodiaceae	*Salsola kali* L.	WP														
Colchicaceae	*Colchicum luteum* Bak.	WP							10		10	9				
Combretaceae	*Terminalia chebula* (Gaertner) Retz.	RS					25			24				-	32	18
Combretaceae	*Terminalia chebula* (Gaertner) Retz.	US				10	13			30				-	31	17
Commelinaceae	*Commelina* sp.	FR														
Compositae	*Anacyclus pyrethrum* (L.)Link.	ST														
Compositae	*Anthemis arvensis* L.	FL										10				
Compositae	*Anthemis nobilis* L.	FL							10		9		10			
Compositae	*Arctium lappa* L.	RO										9				
Compositae	*Aster divaricantus* L.	FL														
Compositae	*Bellis perennis* L.	FL														
Compositae	*Calendula officinalis* L.	FL							9		9	9	9			
Compositae	*Carthamus tinctorius* L.	SE										16				
Compositae	*Carthamus tinctorius* L.	FL														
Compositae	*Centaurea dealbata* Willd.	FL														
Compositae	*Cichorium* sp.	FL							10	9						
Compositae	*Cynara cardunculus* L.	FL														
Compositae	*Dahlia* sp.	RO														
Compositae	*Echinops rito* L.	RO														
Compositae	*Echinops* sp.	LE					9					10				

Table 1: Continue

Plant families	Plant species	PT	Ec	Pa	Pf	Kp	Bb	Sm	Sa	Se	Ml	Bc	Bp	Sc	Ca	Cu
Compositae	*Gaillardia aristata* Pursh	FL														
Compositae	*Lappa major* L.	FL														
Compositae	*Matricaria chamomilla* L.	FL			10				10			9	10			
Compositae	*Senecio articulatus* (L. f.) Schultz-Bip.	LE														
Compositae	*Tagetes pusilla* Kunth	FL														
Compositae	*Taraxacum vulgare* (Lam.) Schinz and R. Keller	RO				9	8									
Compositae	*Tragopogon pratensis* L.	LE														
Compositae	*Tussilago farfara* L.	ST							10			10				
Compositae	*Xanthium strumarium* L.	FL														
Convolvulaceae	*Cuscuta epithymum* L.	SE					11							-	-	10
Convolvulaceae	*Ipomoea alba* L.	ST														
Coryllaceae	*Corylus avellana* L.	LE														
Cruciferae	*Alyssum alyssoides* L.	SE														
Cruciferae	*Capsella bursa-pastoris* L.	SE														
Cruciferae	*Lepidium campestre* L.	LE							9			10				
Cruciferae	*Raphanus sativus* L.	SE							10				10			
Cucurbitaceae	*Citrullus coloccynthis* (L.) Schrad. *Syn. Colocynthis* vulgaris; Cucumis colocynthis	FR				9	10		10	9	16	9				
Cucurbitaceae	*Cucurbita pepo* L.	FL														
Cucurbitaceae	*Lagenaria vulgaris* (Molina) Standl.	FL														
Cucurbitaceae	*Luffa operculata* L.	FL														
Cyperaceae	*Cyperus esculentus* L.	LE														
Dipsacaceae	*Dipsacus sativus* L.	FR														
Ehretiaceae	*Cordia sulcata* DC.	FR														
Elaeagnaceae	*Elaeagnus angustifolia* L.	FR														
Ephedraceae	*Ephedra intermedia* Schrenk. ex C.A.Mey.	LE				13				16				-	16	15
Euphorbiaceae	*Croton* sp.	FR														
Euphorbiaceae	*Chrozophora verbasafalia*	LE												-	21	13
Fabaceae	*Cassia angustifolia* P. Mill.	LE														
Fabaceae	*Glycyrrhiza glabra* L.	RO				16	9		17	18		16				
Fagaceae	*Quercus acerifolia* (Palmer) Stoynoff & Hess	SE														
Fagaceae	*Quercus macrolepis* Kotschy	SG														
Fumariaceae	*Fumaria officinalis* L.	LE														
Fumariaceae	*Fumaria parviflora* Lam.	WP														
Geraniaceae	*Erodium gruinum* L.	RO														
Gramineae	*Cynodon dactylon* L.	WP														
Gramineae	*Panicum miliaceum* L.	RO														
Juglandaceae	*Juglans regia* L.	FL					10		9			9				
Labiatae	*Coleus barbatus* (Andrews) Benth.	RO														
Labiatae	*Lavandula stoechas* L.	LE														
Labiatae	*Melissa officinalis* L.	SE														
Labiatae	*Mentha longifolia* L.	FL					9			10						
Labiatae	*Mentha longifolia* L.	LE										10				
Labiatae	*Ocimum basilicum* L.	SE														
Labiatae	*Origanum majorana* L.	LE							9	10		10				
Labiatae	*Origanum maru* L.	LE														
Labiatae	*Salvia officinalis* L.	WP				11	11							-	10	12
Labiatae	*Satureja hortensis* L.	LE														
Labiatae	*Teucrium polium* L.	FL														
Labiatae	*Thymus vulgaris*	WP												-	15	14
Lauraceae	*Cinnamomum zeylanicum* BL.	SB				14	14			15				-	22	18
Lauraceae	*Laurus nobilis* L.	RO														
Leguminosae-Caesalpinioideae	*Cassia fistula* L.	FR					10		17			16				
Leguminosae-Caesalpinioideae	*Cercis* sp.	RO														
Leguminosae-Mimosoideae	*Mimosa pudica* L.	LE														
Leguminosae-Mimosoideae	*Prosopis* sp.	RO														
	Alhagi maurorum Medik.	SG	17			12	10		18			15				

Table 1: Continue

Plant families	Plant species	PT	Ec	Pa	Pf	Kp	Bb	Sm	Sa	Se	Ml	Bc	Bp	Sc	Ca	Cu
Leguminosae-Papilionoideae	Syn. *A. camelorum; A. pseudalhagi*															
Leguminosae-Papilionoideae	*Astragalus falcatus* Lam.	SG														
Leguminosae-Papilionoideae	*Lathyrus sativus* L.	RO														
Leguminosae-Papilionoideae	*Melilotus officinalis* L.	RO														
Leguminosae-Papilionoideae	*Onobrychis sativa* Scop.	RO														
Leguminosae-Papilionoideae	*Onobrychis viciaefolia* Scop. Syn. *Hedysarum onobrychis; O. sativa; O. viciaefolia*	SE														
Leguminosae-Papilionoideae	*Robinia hispida* L.	SE														
Leguminosae-Papilionoideae	*Sophora* sp.	SE														
Leguminosae-Papilionoideae	*Spartium* sp.	RO														
Leguminosae-Papilionoideae	*Trifolium paratens* L.	RO														
Leguminosae-Papilionoideae	*Trifolium repens* L.	RO														
Leguminosae-Papilionoideae	*Trigonella foenum-graecum* L.	SE	18			9	9		17	10		19				
Liliaceae	*Hyacinthus orientalis* L.	LE														
Liliaceae	*Lilium candidum* L.	RO	9													
Lythraceae	*Lawsonia inermis* L.	LE	17		17		18		16	10	10	26				
Malvaceae	*Althaea officinalis* L.	FL			10		9		10	10	9	10				
Malvaceae	*Althaea officinalis* L.	RO					10					9				
Malvaceae	*Hibiscus cannabinus* L.	RO														
Malvaceae	*Malva sylvestris* L.	FL					10									
Malvaceae	*Malva sylvestris* L.	FR														
Martyniaceae	*Proboscidea parviflora* (Woot.) Woot. and Standl.	FR														
Meliaceae	*Melia azedarash* L.	LE														
Moraceae	*Ficus benghalensis* L.	LE														
Moraceae	*Ficus elastica* Roxb. ex Hornem.	ST														
Moraceae	*Morus alba* L.	LE														
Moraceae	*Morus nigra* L.	LE														
Myristicaceae	*Myristica fragrans* Houtt.	SE				10	12							-	-	12
Myrtaceae	*Eucalyptus globules* Labill.	LE					10		9	9		16	10			
Myrtaceae	*Myrtus communis* L.	SE					16			20				-	22	14
Myrtaceae	*Myrtus communis* L.	LE					26			20				-	24	22
Nyctaginaceae	*Mirabilis jalapa* L.	SE														
Nymphaeaceae	*Nymphaea alba* L.	FL		10		9	10		17	10		9				
Oleaceae	*Ligustrum sinense* Lour.	LE														
Oleaceae	*Syringa vulgaris* L.	FR														
Oxalidaceae	*Oxalis crassipes* Urb.	LE														
Papaveraceae	*Papaver somniferum* L.	SE														
Passifloraceae	*Passiflora caerulea* L.	FL														
Pedaliaceae	*Sesamum orientalae* L.	RO														
Peganaceae	*Peganum harmala* L.	SE							18	9		18				
Pinaceae	*Cedrus deodara* (Roxb. ex D. Don) G. Don f.	LE														
Plantaginaceae	*Plantago major* L.	SE														
Plantaginaceae	*Plantago ovata* Forsk.	SE														
Polygonaceae	*Calligonum aphyllum* (Pallas.)Gürke.	FR														
Polygonaceae	*Polygonum amphibian* L.	WP														
Polygonaceae	*Rheum ribes* L.	RO				18	10		17	17		19	18			
Polygonaceae	*Rumex acetosa* L.	LE							18	9		10				
Portulacaceae	*Portulaca oleracea* L.	SE					9		10			9				
Primulaceae	*Cyclamen hederifolium* Ait.	FL														
Punicaceae	*Punica granatum* L.	FL					9		17			18				

Table 1: Continue

Plant families	Plant species	PT	Ec	Pa	Pf	Kp	Bb	Sm	Sa	Se	Ml	Bc	Bp	Sc	Ca	Cu
Ranunculaceae	*Anemon ranunculoides* L.	FR														
Ranunculaceae	*Aquilegia vulgaris* L.	FL														
Ranunculaceae	*Clematis virginiana* L.	FR														
Ranunculaceae	*Helleborus nigra*	RO												-	24	10
Ranunculaceae	*Nigella arvensis* L.	SE														
Ranunculaceae	*Nigella sativa* L.	SE							8		9	16				
Ranunculaceae	*Paeonia anomala* L.	FL														
Ranunculaceae	*Ranunculus aestivalis* (L. Benson) Van Buren and Harper	WP					13			18						
Rhamnaceae	*Ziziphus ziziphus* (L.) Karst.	FR	10					10	15	9	10		10			
Rhamnaceae	*Ziziphus ziziphus* (L.) Karst.	LE						10	10	9		9	10			
	Amygdalus davidiana (Carr.)Franch.	FL														
Rosaceae	Syn. *Amygdalus davidiana; Persica davidiana*															
Rosaceae	*Chaenomeles speciosa* (Sweet) Nakai	FL														
Rosaceae	*Cydonia oblonga* P. Mill.	SE					10					9				
Rosaceae	*Prunus domestica* L.	FL														
Rosaceae	*Rosa gallica* L.	SE							9			9				
	Rubus idaeus L.	LE					13							-	12	12
Rosaceae	Syn. *R. greeneanus*															
Rubiaceae	*Richardia* sp.	LE														
Rutaceae	*Citrus medica* L.	SE					9		16			15				
Rutaceae	*Ruta graveolens* L.	LE							10		9	10	9			
Salicaceae	*Papolous nigra* L.	LE														
Salicaceae	*Populus alba* L.	LE														
Salicaceae	*Salix aegyptiaca* L.	FL					10		9			10				
Salicaceae	*Salix babylonica* L.	LE														
Sambucaceae	*Sambucus chinensis* Lindl.	ST														
Scorphulariaceae	*Verbascum chaixi* Vill.	LE														
	Veronica persica Poir.	LE														
Scorphulariaceae	Syn. *Pocilla persica*															
Simaroubaceae	*Ailanthus altissima* Swingle	FR														
Smilaceae	*Smilax china* L.	ST					10							10	15	18
Solanaceae	*Capsicum annum*	FR												10	10	14
Solanaceae	*Hyoseyamus niger*	SE												-	10	-
Solanaceae	*Petunia axillaris* (Lam.) B.S.P.	RO														
Solanaceae	*Solanum dulcamara* L.	FL														
Solanaceae	*Solanum nigrum* L.	FR														
Sterculiaceae	*Helicteres isora*	FR												-	10	-
Strelitziaceae	*Strelitzia regianae* Banks ex Dryand.	LE														
Tamaricaceae	*Tamarix gallica* L.	LE					9		16	9		10				
Taxaceae	*Taxus baccata* L.	LE														
Theaceae	*Camellia sinensis* L.	LE					10		10	10	9	10	10			
Tropaeolaceae	*Tropaeolum majus* L.	FL														
Typhaceae	*Typha latifolia* L.	RO														
Ulmaceae	*Ulmus* sp.	FR														
Umbelliferae	*Cuminum cyminum* L.	SE	17			10	10		18	9		18	9			
Umbelliferae	*Foeniculum vulgare*	RO												-	-	13
Umbelliferae	*Heracleum persicum*	FR												-	24	10
Umbelliferae	*Trachyspermum copticum* Link	SE				12	12			12				-	18	10
Urticaceae	*Urtica dioica* L.	LE														
Verbenaceae	*Verbena cloverae* Moldenke	RO														
Violaceae	*Viola odorata* L.	FL					10		9			10				
Vitidaceae	*Ampelopsis orientalis* Lam.	LE														
Vitidaceae	*Cissus* sp.	LE														
Zingiberaceae	*Alpinia officinarum*	RH												-	20	15
Zingiberaceae	*Amomum subulatum*	SE												-	-	14
	Zingiber officinale Roscoe	RH					14							-	10	17
Zingiberaceae	Syn. *Amomum zingiber; Z. zingiber*															
Zygophyllaceae	*Tribulus terrestris* L.	FR														
Zygophyllaceae	*Zygophyllum fabago* L.	ST														

PT= Plant parts tested, as FL: Flower, FR: Fruit, LE: Leaves, RH: Rhizome, RO: Roots, RS: Ripe Seeds, SB: Stem Bark, SE: Seeds, SG: Stem Gum, ST: Stem, US: Unripe seeds and WP: Whole Plant. Ec: *Escherichia coli* (PTCC No. 1330), Pa: *Pseudomonas aeruginosa* (PTCC No. 1074), Pf: *Pseudomonas fluorescens* (PTCC No. 1181), Kp: *Klebsiella pneumoniae* (PTCC No. 1053), Bb: *Bordetella bronchiseptica* (PTCC No. 1025), Sm: *Serratia marcescens* (ATCC No. 27117), Sa: *Staphylococcus aureus* (PTCC No. 1112), Se: *Staphylococcus epidermidis* (PTCC No. 1114), Ml: *Micrococcus luteus* (PTCC No. 1110), Bc: *Bacillus cereus* (PTCC No. 1115), Bp: *Bacillus pumilus* (PTCC No. 1319), Sc: *Saccharomyces cerevisiae* (PTCC No. 5052), Ca: *Candida albicans* (PTCC No. 5027), Cu: *Candida utilis* (PTCC No. 5065).

bacteria, among which 32.6% were activate against some G-ve bacteria, 62% against some G+ve bacteria and 47.3% activate against some of both G-ve and G+ve bacteria. Plants with high antifungal activity included *Alpinia officinarum*, *Chrozophora verbasafalia*, *Cinnamomum zeylanicum*, *Dianthus coryophyllus*, *Helleborus nigra*, *Heracleum persicum*, *Myrtus communis*, *Terminalia chebula* and *Trachysermum copticum* which were effective mostly against *Candida albicans* and *C. utilis*. *Saccharomyces cerevisiae* was the least susceptible fungus since no plant showed high level of activity against it.

DISCUSSION

Even the nature and number of active antibacterial principles involved in each plant extract of the present research are not clear, but the broad spectra of activity of several plant extracts especially on *S. aureus*, however, is promising. The present study suggest consideration of the plants with the highest antibacterial activity of the present survey for evaluation against methicillin-resistant *S. aureus*[11,26] and vancomycin-resistant enterococci[10,27], two of the most problematic bacteria.

The results of the present study may form the basis for further investigation to isolate active compounds, elucidate the structures and evaluate them against wider range of drug-resistant bacterial strains with the goal to find new therapeutic principles.

Development of drug-resistant pathogens demands new strategies and the native people's ethno pharmacological-knowledge which has received less emphasis, is a valuable resource which should be utilized to advance health-oriented objectives.

According to Tshibangu *et al.*[28] plants have given western pharmacopoeia about 7000 different pharmaceutically important compounds and a number of top-selling drugs of modern time, e.g. quinine, artemisinin, taxol, camptothecin, etc. Many reports show the effectiveness of traditional herbs against microorganisms, as a result, plants are one of the bedrocks for modern medicine to attain new principles[29]. Conclusively, plants are valuable sources for new compounds and should receive special attention in research strategies to develop new antimicrobials urgently required in the near future.

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