Journal on New Biological Reports **2**(2): 142-162 (2013) **ISSN 2319 – 1104 (Online)**

Glimpses of antimicrobial activity of fungi from World

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(Received on: 17 April, 2013; accepted on: 12 June, 2013)

ABSTRACT

As we all know that certain mushrooms and several other fungi show some novel properties including antimicrobial properties against bacteria, fungi and protozoan's. These properties play very important role in the defense against several severe diseases caused by bacteria, fungi and other organisms also. In the available recent literature survey, many interesting observations have been made regarding antimicrobial activity of fungi. In particular this study shows total 316 species of 150 genera from 64 Fungal families (45 Basidiomycetous and 21 Ascomycetous families {6 Lichenized, 15 Non-Lichenized and 3 Incertae sedis)} are reported so far from world showing antibacterial activity against 32 species of 18 genera of bacteria and 22 species of 13 genera of fungi. This data materialistically adds the hidden potential of these reported fungi and it also clears the further line of action for the study of unknown medicinal fungi useful in human life.

Key Words: Fungi, antimicrobial activity, microbes

INTRODUCTION

Fungi and animals are more closely related to one another than either is to plants, diverging from plants more than 460 million years ago (Redecker 2000). Diseases of plants typically do not afflict humans whereas diseases of fungi do (Martin 2001). Since humans (animals) and fungi share common microbial antagonists such as *Escherichia coli*, *Staphylococcus aureus* and *Pseudomonas aeruginosa*, humans can benefit from the natural defensive strategies of fungi that produce antibiotics to fight infection from microorganisms. Hence, it is not surprising our most significant antibacterial antibiotics have been derived from fungi. The fact that mushrooms can have both anti-viral and anti-bacterial properties, with low cyto-toxicity to animalian hosts, underscores their usefulness as natural sources of medicine. (Stamets 2002). Gilled mushrooms (Order Agaricales) had more species with antifungal activity than polypores (Suay et al. 2000).

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In recent in vitro study, extracts of more than 75 percent of polypore mushroom species surveyed showed antimicrobial activity and 45 percent of 204 mushroom species (polypore and gilled mushrooms alike) inhibited the growth of a wide variety of microorganisms (Suay et al. 2000). But after extensive literature survey a very significant observation showed that total 316 species of 150 genera from 64 fungal families [45 Basidiomycetous and 21 Ascomycetous families {6 Lichenized, 15 Non-Lichenized and 3 Incertae sedis}] are reported so far from world showing antibacterial activity against 32 species of (18 genera) bacteria and 22 species (13 genera) of fungi. The list of total species with families and genera is provided which gives the idea in details about the species involved in the antimicrobial activities from world. (Table 1 & 2, Fig. 1&2)

As far as the organisms used for the antimicrobial activities are concerned, there are 54 species of organisms including bacteria and fungi were observed. From these organisms bacterial families like Bacillaceae, Enterobacteriaceae and

Staphylococcaceae are found to be more dominantly used for the testing purpose (Table 4, Figure 3). When the species wise dominance is seen for the antibacterial activity of fungi, Polyporaceae, Agaricaceae Hymenochaetaceae, Tricholomataceae, Fomitopsidaceae, Meruliaceae are found more dominantly used for the same respectively (Table 3).

Table 1. List of family, species, genera of fungi and lichens showing the antimicrobial activity against bacteria and fungi

Fungal Group	Family	Genera	Species	Few References
Basidiomycetes	Amanitaceae	*Amanita*	*Amanita foetens*	Mustafa 2006; Yamac & Bilgili 2006; Mustafa 2006; Dighe & Agate 2000
			Amanita muscaria	
			Amanita cesarae	
	Physalacriaceae	*Armillaria*	*Armillaria mellea*	Donnelly et al. 1985, 1986; Yamac & Bilgili 2006, Mustafa 2006, Vahidi & Namjoyan 2004, Ahmed Imtiaj & Tae-Soo Lee, Imtiaj & Lee 2007
			Armillaria ostoyae	
			Armillaria tabescens	
		Cyptotrama	*Cyptotrama asprata*	
		Rhodotus	*Rhodotus palmatus*	
		Strobilurus	*Strobilurus tenacellus*	
		Oudemansiella	*Oudemansiella canarii*	
			Oudemansiella longipes	
			Oudemansiella mucida	
			Oudemansiella sp.	
	Agaricaceae	*Agaricus*	*Agaricus bisporus*	Ndyetabura et al. 2010; Theonest 2010; Yamac & Bilgili 2006; Mustafa 2006, Dighe & Agate 2000; Banarji & Hariprasad 2011; Akyuz et al. 2010; Banerji & Hariprasad 2011; Surekha et al. 2011; Imtiaj & Lee 2007; Akyuz et al. 2010
			Agaricus campestris	
			Agaricus langei	
			Agaricus nigrescentibus	
			Agaricus porosporus	
			Agaricus trinitatensis	
		Leucoagaricus	*Leucoagaricus gongylophorus*	
			Leucoagaricus pudicus	
			Leucoagaricus cinerascens	
			Leucocoprinus longistriatus	
		Macrolepiota	*Macrolepiota rhacodes*	
		Podaxis	*Podaxis pistillaris*	
		Chlorolepiota	*Chlorolepiota* sp.	
		Coprinus	*Coprinus episcopalis*	
			Coprinus cinereus	
		Lepiota	*Lepiota* sp.	
		Bovista	*Bovista plumbea*	
		Crucibulum	*Crucibulum laeve*	

Table 1. contd.....

		Lycoperdon	*Lycoperdon echinatum*	
			Lycoperdon giganteum	
		Calvatia	*Calvatia craniiformis*	
	Cyphellaceae	*Chondrostereum*	*Chondrostereum purpureum*	Pearce 1996
	Entolomataceae	*Claudopus*	*Claudopus byssisedus*	Dighe & Agate 2000
	Fistulinaceae	*Fistulina*	*Fistulina* sp.	Bose 1946; Bannur et al. 1967
	Tricholomataceae	*Clitocybe*	*Clitocybe nebularis*	Yamac & Bilgili 2006; Mustafa 2006; Dighe & Agate 2000; B Florey et al. 1949
			Clitocybe geotropa	
		Lepista	*Lepista nuda*	
		Tricholoma	*Tricholoma auratum*	
			Tricholoma fracticum	
			Tricholoma lobayense	
			Tricholoma portentosum	
		Collybia	*Collybia butyracea*	
			Collybia dryophila	
			Collybia fusipes	
		Leucopaxillus	*Leucopaxillus giganteus*	
			Leucopaxillus lepistoides	
		Lepista	*Lepista luscina*	
			Lepista nuda	
			Lepista personata	
		Pseudoclitocybe	*Pseudoclitocybe expallens*	
	Marasmiaceae	*Crinipellis*	*Crinipellis stipitaria*	Rosa et al 2003
		Marasmius	*Marasmius allocystis*	
			Marasmius androsaceus	
			Marasmius bellus	
			Marasmius cladophyllus	
			Marasmius corbariensis	
			Marasmius oreades	
			Marasmius quercophilus	
		Lentinula	*Lentinula edodes*	
		Nothopanus	*Nothopanus hygrophanus*	
	Coniophoraceae	*Coniophora*	*Coniophora arida*	Iakovlev 2003
	Inocybaceae	*Crepidotus*	*Crepidotus variabilis*	Mtui 2012

Table 1. contd.....

		Pleurotellus	*Pleurotellus hypnophilus*	Zjawiony 2004
	Niaceae	*Cyphellopsis*	*Cyphellopsis anomala*	Weber 1990
	Strophariaceae	*Agrocybe*	*Agrocybe semiorbicularis*	Rosa et al. 2003; Imtiaj & Lee 2007
		Gymnopilus	*Gymnopilus aureobrunneus*	
			Gymnopilus areolatus	
			Gymnopilus chrysopellus	
		Hypholoma	*Hypholoma fasciculare*	
		Pholiota	*Pholiota destruens*	
			Pholiota carbonaria	
			Pholiota adiposa	
		Psilocybe	*Psilocybe semilanceata*	
			Psilocybe venezuelana	
			Psilocybe subcubensis	
		Stropharia	*Stropharia aeruginosa*	
			Stropharia coranilla	
	Pleurotaceae	*Hohenbuehelia*	*Hohenbuehelia mastrucata*	Akyuz et al. 2010; Fagade & Oyelade 2009; Iwalokun et al. 2007; Surekha et al. 2011
		Pleurotus	*Pleurotus cystidiosus*	
			Pleurotus eryngii	
			Pleurotus florida	
			Pleurotus eryngii var. *eryngii*	
			Pleurotus eryngii var. *ferulae*	
			Pleurotus ostreatus	
			Pleurotus sajor-caju	
			Pleurotus fockei	
			Pleurotus pulmonarius	
	Russulaceae	*Lactarius*	*Lactarius deliciosus*	Sterner et al. 1985; Ochoa-Zarzosa et al. 2011; Shittu 2006
			Lactarius vellereus	
			Lactarius indigo	
		Russula	*Russula delica*	

Table 1. contd.....

	Mycenaceae	*Mycena*	*Mycena alcalina*	Rosa et al. 2003; Suay et al. 2000
			Mycena aurantiomarginata	
			Mycena leucogala	
			Mycena maculata	
		Xeromphalina	*Xeromphalina junipericola*	
			Xeromphalina tenuipes	
		Favolaschia	*Favolaschia* sp.	
		Filoboletus	*Filoboletus* sp.	
	Paxillaceae	*Paxillus*	*Paxillus involutus*	Yamac & Bilgili 2006; Mustafa 2006
			Paxillus panuoides	
	Psathyrellaceae	*Psathyrella*	*Psathyrella calcarea*	Ayodele & Idoko 2011
			Psathyrella gracilis	
			Psathyrella lacrymabunda	
			Psathyrella sylvestris	
			Psathyrella atroumbonata	
		Panaeolus	*Panaeolus semiovatus*	
		Coprinellus	*Coprinellus micaceum*	
	Pluteaceae	*Pluteus*	*Pluteus cubensis*	Ayodele & Idoko 2011; Surekha et al. 2011
		Volvariella	*Volvariella* sp.	
			Volvariella volvacea	
	Rhizopogonaceae	*Rhizopogon*	*Rhizopogon luteolus*	Yamac & Bilgili 2006, Mustafa 2006
			Rhizopogon roseolus	
	Suillaceae	*Suillus*	*Suillus luteus*	Yamac & Bilgili 2006; Mustafa 2006
			Suillus variegatus	
			Suillus collitinus	
	Lyophyllaceae	*Lyophyllum*	*Lyophyllum decastes*	Pushpa 2010
	Gomphidiaceae	*Chroogomphus*	*Chroogomphus rutilus*	Yamac & Bilgili 2006; Mustafa 2006
	Hygrophoraceae	*Hygrophorus*	*Hygrophorus agathosmus*	Yamac & Bilgili 2006; Mustafa 2006
	Phallaceae	*Dictyophora*	*Dictyophora indusiata*	Imtiaj & Lee 2007
	Auriculariaceae	*Auricularia*	*Auricularia auricula*	Fagade & Oyelade 2009 Rosa et al. 2003
			Auricularia fuscosuccinea	
			Auricularia polytricha	

Table 1. contd.....

	Meruliaceae	*Bjerkandera*	*Bjerkandera adusta*	Florey et al. 1949
		Cymatoderma	*Cymatoderma dendriticum*	
		Gloeoporus	*Gloeoporus thelephoroides*	
		Hyphoderma	*Hyphoderma definitum*	
		Cerocorticium	*Cerocorticium confluens*	
		Irpex	*Irpex destruens*	
			Irpex lacteus	
		Heteroporus	*Heteroporus biennis*	
		Phlebia	*Phlebia radiata*	
		Abortiporus	*Abortiporus biennis*	
		Merulius	*Merulius tremellosus*	
			Merulius corium	
	Polyporaceae	*Cerrena*	*Cerrena unicolor*	Mizuno 1995; Fowler 2000; Peintner 1998; Anchel et al. 1952, Fagade & Oyelade 2009; Yamac & Bilgili 2006; Mustafa 2006; Takeuchi et al. 1969; Ying et al. 1987; Kim et al 2001; Kavanagh et al. 1950: Imtiaz & Lee 2007; Ayodele & Idoko 2011
		Coriolopsis	*Coriolopsis byrsina*	
			Coriolopsis occidentalis	
			Coriolopsis rigida	
			Coriolopsis tricolor	
		Coriolus	*Coriolus consors*	
			Coriolus sanguineus	
		Dichomitus	*Dichomitus squalens*	
		Fomes	*Fomes fomentarius*	
			Fomes juniperinus	
			Fomes lignosus	
		Hexagonia	*Hexagonia hydnoides*	
		Lentinus	*Lentinus bertieri*	
			Lentinus crinitus	
			Lentinus edodes	
			Lentinus squarrosulus	
			Lentinus striatulus	
			Lentinus strigellus	
			Lentinus strigosus var. strigosus	
			Lentinus subnudus	
			Lentinus villosus	
		Lenzites	*Lenzites elegans*	
			Lenzites thermophila	
			Lenzites betulina	
		Trametes	*Trametes cubensis*	
			Trametes pubescens	
			Trametes versicolor	
			Trametes villosa	
			Trametes betulina	
			Trametes gibbosa	
			Trametes saepiara	
			Trametes versicolor	

Table 1. contd.....

		Panus	*Panus fulvus*	
		Coriolus	*Coriolus versicolor*	
		Daedaleopsis	*Daedaleopsis confragosa*	
			Daedaleopsis flavida	
			Daedaleopsis tricolor	
		Perenniporia	*Perenniporia fraxinea*	
		Polyporus	*Polyporus arcularius*	
			Polyporus benzoinus	
			Polyporus betulinus	
			Polyporus biformis	
			Polyporus borealis	
			Polyporus cinnabarinus	
			Polyporus igniarius	
			Polyporus meridionalis	
			Polyporus ostriformis	
			Polyporus palustris	
			Polyporus rhizophilus	
			Polyporus sulphureus	
			Ployporus umbellatus	
		Poria	*Poria corticola*	
			Poria monticola	
			Poria subacida	
			Poria tenius	
			Poria vaillantii	
			Poria xantha	
		Pycnoporus	*Pycnoporus cinnabarinus*	
			Pycnoporus sanguineus	
			Pycnoporus coccineus	
		Trichaptum	*Trichaptum biforme*	
		Tyromyces	*Tyromyces duracinus*	
		Dendropolyporus	*Dendropolyporus pseudolacteus*	
			Dendropolyporus umbellatus	
	Phanerochaetaceae	*Climacodon*	*Climacodon pulcherrimus*	Rosa et al. 2003

Table 1. contd.....

	Fomitopsidaceae	*Daedalea*	*Daedalea dickinsii*	Bose 1946; Bannur et al. 1967; Fagade & Oyelade 2009; Ofodile et al. 2010; Naranmandakh et al. 2008; Suay et al. 2000
			Daedalea elegans	
			Daedalea microzona	
			Daedalea quercina	
		Fomitopsis	*Fomitopsis officinalis*	
		Leptoporus	*Leptoporus* sp.	
			Leptoporus mollis	
		Ischnoderma	*Ischnoderma benzoinum*	
		Laetiporus	*Laetiporus sulphureus*	
		Fomitopsis	*Fomitopsis pinicola*	
			Fomitopsis officinalis	
		Phaeolus	*Phaeolus schweinitzii*	
		Piptoporus	*Piptoporus betulinus*	
	Gloeophyllaceae	*Gloeophyllum*	*Gloeophyllum odoratum*	Kahlos 1994
			Gloeophyllum sepiarium	
	Stereaceae	*Aleurodiscus*	*Aleurodiscus botryosus*	Imtiaj & Lee 2007
			Aleurodiscus mirabilis	
		Gloeocystidiellum	*Gloeocystidiellum porosum*	
		Stereum	*Stereum complicatum*	
			Stereum frustulosum	
			Stereum hirsutum	
			Stereum insignitum	
			Stereum ostrea	
	Bankeraceae	*Hydnellum*	*Hydnellum ferrugineum*	Yamac & Bilgili 2006; Mustafa 2006
		Sarcodon	*Sarcodon imbricatus,*	
	Meripilaceae	*Hydnopolyporus*	*Hydnopolyporus fimbriatus*	Rosa et al. 2003
		Meripilus	*Meripilus giganteus*	Kalyoncu et al. 2010
	Schizoporaceae	*Hyphodontia*	*Hyphodontia subalutacea*	Suay et al. 2000
	Hymenochaetaceae	*Inonotus*	*Inonotus hispidus*	Balakumar et al. 2011; Florey et al. 1949; Cavill 1953, Bose & Chaudhury 1944; Lamrood 2004
		Onnia	*Onnia tomentosa*	
		Phellinus	*Phellinus* sp.	
			Phellinus adamantinus	
			Phellinus aureobrunneus	
			Phellinus badius	

Table 1. contd.....

			Phellinus coffeatoporus	
			Phellinus crocatus	
			Phellinus fastuosus	
			Phellinus gilvus	
			Phellinus grenadensis	
			Phellinus griseoporus	
			Phellinus linteus	
			Phellinus lividus	
			Phellinus lloydii	
			Phellinus merrillii	
			Phellinus minutiporus	
			Phellinus rimosus	
			Phellinus sublinteus	
			Phellinus swieteniae	
		Polystictus	*Polystictus sanguineus*	
	Ganodermataceae	*Ganoderma*	*Ganoderma apense*	Smania 2001; Bhosale et al. 2010; Yoon et al. 1994; Wasser & Weis 1997a; Coletto et al 1981; Sheena et al. 2003; Fagade & Oyelade 2009; Quereshi et al. 2010; Bhosale et al. 2010; Mothana et al. 2000; Wilsely 2008; Yamac & Bilgili 2006
			Ganoderma applanatum	
			Ganoderma chalceum	
			Ganoderma lipsiense	
			Ganoderma lucidum	
			Ganoderma lucidum var. *lucidum*	
			Ganoderma multicornum	
			Ganoderma multiplicatum	
			Ganoderma oregonense	
			Ganoderma perzonatum	
			Ganoderma pfeifferi	
			Ganoderma pfeifferi var. *borneense*	
			Ganoderma poonensis	
			Ganoderma praelongum	
			Ganoderma resinaceum	
			Ganoderma stipitatum	
			Ganoderma carnosum	
	Auriscalpiaceae	*Lentinellus*	*Lentinellus omphalodes*	Běhal 2003

Table 1. contd.....

	Peniophoraceae	*Peniophora*	*Peniophora cinerea*	Rosa et al. 2003
			Peniophora incarnata	
			Peniophora quercina	
			Peniophora utriculosa	
	Gomphaceae	*Ramaria*	*Ramaria flava*	Gezer et al. 2006
	Schizophyllaceae	*Schizophyllum*	*Schizophyllum commune*	Chang et al. 1978; Fagade & Oyelade 2009.
	Sparassidaceae	*Sparassis*	*Sparassis crispa*	Lindequist et al. 2005
	Clavaridelphaceae	*Clavaridelphus*	*Clavaridelphus truncatus*	Yamac & Bilgili 2006; Mustafa 2006
	Hydnaceae	*Hydnum*	*Hydnum repandum,*	Yamac & Bilgili 2006; Mustafa 2006
	Dacrymycetaceae	*Calocera*	*Calocera viscosa*	Suay et al. 2000
Ascomycetes (Lichenised)	Arthoniaceae	*Arthothelium*	*Arthothelium awasthii*	Behera et al. 2007
	Physciaceae	*Heterodermia*	*Heterodermia podocarpa*	Behera et al. 2007
	Umbilicariaceae	*Lasallia*	*Lasallia pustulata*	Rankovic et al. 2007
		Umbilicaria	*Umbilicaria crustulosa*	
			Umbilicaria cylindrica	
	Parmeliaceae	*Parmelia*	*Parmelia sulcata*	Rankovic et al. 2007; Branislav et al. 2010; Behera et al. 2007; Dulger et al.1998, 1997
		Parmotrema	*Parmotrema tinctorium*	
		Parmeliopsis	*Parmeliopsis hyperopta*	
		Usnea	*Usnea ghattensis*	
	Lecanoraceae	*Lecanora*	*Lecanora frustulosa,*	Branislav et al. 2010
	Ramalinaceae	*Ramalina*	*Ramalina farinacea*	Turgay et al. 2004
Ascomycetes (Non-Lichenised)	Cordycipitaceae	*Cordyceps*	*Cordyceps sobolifera*	Imtiaj & Lee 2007
	Morchellaceae	*Morchella*	*Morchella conica*	Torkoglu et al. 2006
	Xylariaceae	*Daldinia*	*Daldinia concentrica*	Gbolagade & Fasidi 2005
	Chaetomiaceae	*Chaetomium*	*Chaetomium atrobrunneum*	Srimathi et al. 2011
			Chaetomium globossum	
			Chaetomium funicola	
			Chaetomium strumarium	

Table 1. contd.....

	Pezizaceae	*Terfezia*	*Terfezia boudieri*	Akyuz et al. 2010; Ding T. 2010
		Tirmania	*Tirmania* sp.	
		Sordariomycetes	*Sordariomycetes*	
	Nectriaceae	*Fusarium*	*Fusarium solani*	Tayung et al. 2011; Praveena & Palem 2011
			Fusarium graminearum	
	Diaporthaceae	*Diaporthe*	*Diaporthe* sp.	Ding 2010
	Pleosporaceae	*Alternaria*	*Alternaria* sp.	Ding 2010
	Glomerellaceae	*Colletotrichum*	*Colletotrichum* sp.	Ding 2010
	Amphishaeriaceae	*Pestalotiopsis*	*Pestalotiopsis* sp.	Ding 2010
	Botryosphaeriaceae	*Guignardia*	*Guignardia vaccinii*	Ding 2010
	Trichocomaceae	*Penicillum*	*Penicillum* sp.	Ding 2010; Praveena & Palem 2011
			Penicillium expansum	
		Aspergillus	*Aspergillus niger*	
			Aspergillus flavus	
Incertae sedis	Incertae sedis	*Rickenella*	*Rickenella fibula*	Ding 2010
		Zythia	*Zythia* sp.	
		Nigrospora	*Nigrospora* sp.	

Table 2. Total count of families, genera and species showing antimicrobial properties

Fungal Group	**Total Families**	**Total Genera**	**Total Species**
Basidiomycetes	45	122	281
Ascomycetes (Lichenised)	06	10	11
Ascomycetes (Non-Lichenised)	12	15	21
Incertae sedis	01	03	03
Total	**64**	**150**	**316**

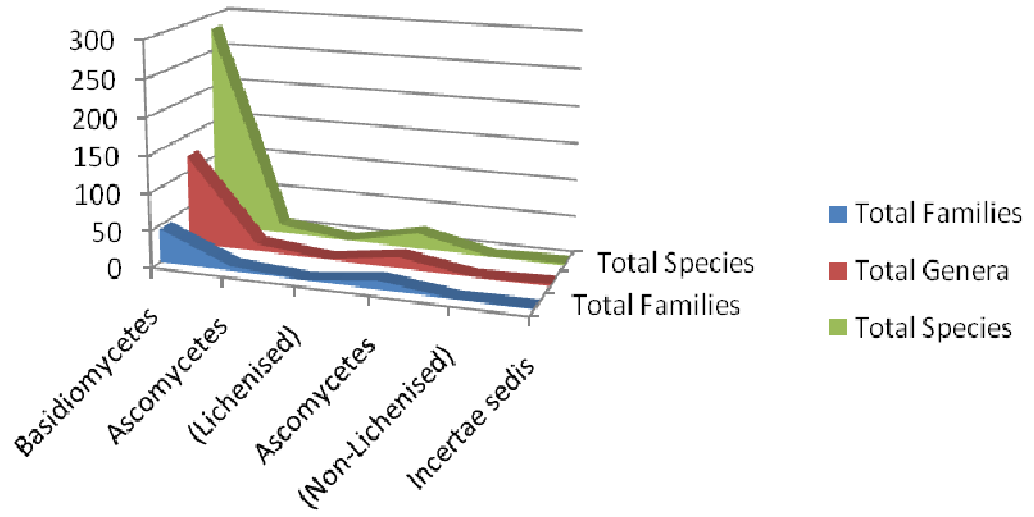

Fig 1. Graphical representation of total count of Families, Genera and Species showing Antimicrobial Properties

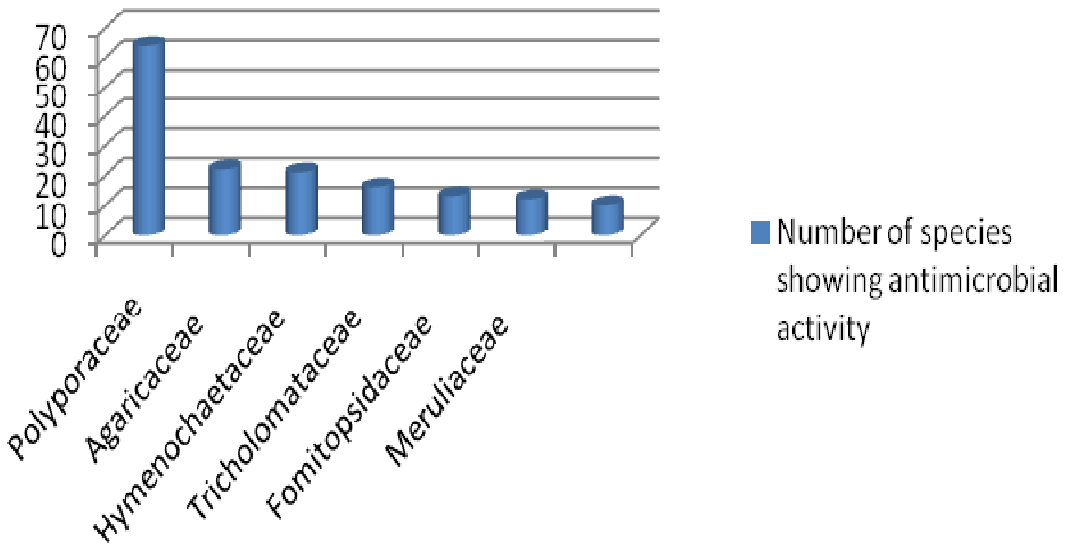

Fig 2. Number of Species from different families showing antimicrobial activity

Table 3. Species wise dominant families showing antimicrobial properties

Family	Number of species showing antimicrobial activity
Polyporaceae	64
Agaricaceae	22
Hymenochaetaceae	21
Tricholomataceae	16
Fomitopsidaceae	13
Meruliaceae	12
Physalacriaceae, Pleurotaceae and Marasmiaceae	10
Stereaceae and Mycenaceae	08
Amanitaceae, Auriculariaceae, **Incertae sedis**, Pezizaceae, Pluteaceae, Suillaceae and Umbilicariaceae	03
Bankeraceae, Gloeophyllaceae, Inocybaceae, Meripilaceae, Nectriaceae, Paxillaceae and Rhizopogonaceae	02
Amphishaeriaceae, Arthoniaceae, Auriscalpiaceae, Botryosphaeriaceae, Clavaridelphaceae, Coniophoraceae, Cordycipitaceae, Cyphellaceae, Dacrymycetaceae, Diaporthaceae, Entolomataceae, Fistulinaceae, Glomerellaceae, Gomphaceae, Gomphidiaceae , Hydnaceae, Hygrophoraceae, Lecanoraceae, Lyophyllaceae , Morchellaceae, Niaceae, Phallaceae, Phanerochaetaceae, Physciaceae, Pleosporaceae, Ramalinaceae, Schizophyllaceae, Schizoporaceae, Sparassidaceae and Xylariaceae	01
Total: 64 Families	**316**

*Total **03** Unknown families quoted under **Incertae sedis**

Table 4. List of families of bacteria used to check the antimicrobial activity

Name of the Family	Species	Name of the Family	Total Species of the Families
Aeromonadaceae	*Aeromonas hydrophelia*	Aeromonadaceae	01
Bacillaceae	*Bacillus cereus, B.megaterium,B. mycoides, B. pumilllus,B. subtilis,*	Bacillaceae	05
Brucellaceae	*Brucella abortus*	Brucellaceae	01
Corynebacteriaceae	*Cornyebacterium xerosis*	Corynebacteriaceae	01

Table 4 contd.....

Enterobacteriaceae	*E. coli, Enterobacter aerogenes, E. cloacae, Enterococcus faecalis, Klebsiella pneumonia, Salmonella enteric, S. typhi, S. typhimurium, S. typhisuis, Shigella flexneri, Yersinia enterocolis,*	Enterobacteriaceae	12
Flavobacteriaceae	*Flavobacterium sp.*	Flavobacteriaceae	01
Helicobacteraceae	*Helicobacter pylori*	Helicobacteraceae	01
Listeriaceae	*Listeria monocytogenes*	Listeriaceae	01
Micrococcaceae	*Micrococcus luteus*	Micrococcaceae	01
Pseudomonadaceae	*Pseudomonas aeruginosa, Pseudomonas syringa*	Pseudomonadaceae	02
Staphylococcaceae	*Staphyllcoccus aureus, S. epidermis, S. faecalis, S. sp.*	Staphylococcaceae	04
Streptococcaceae	*Streptococcus mutans*	Streptococcaceae	01
Streptomycetaceae	*Streptomyces pyrogens*	Streptomycetaceae	01

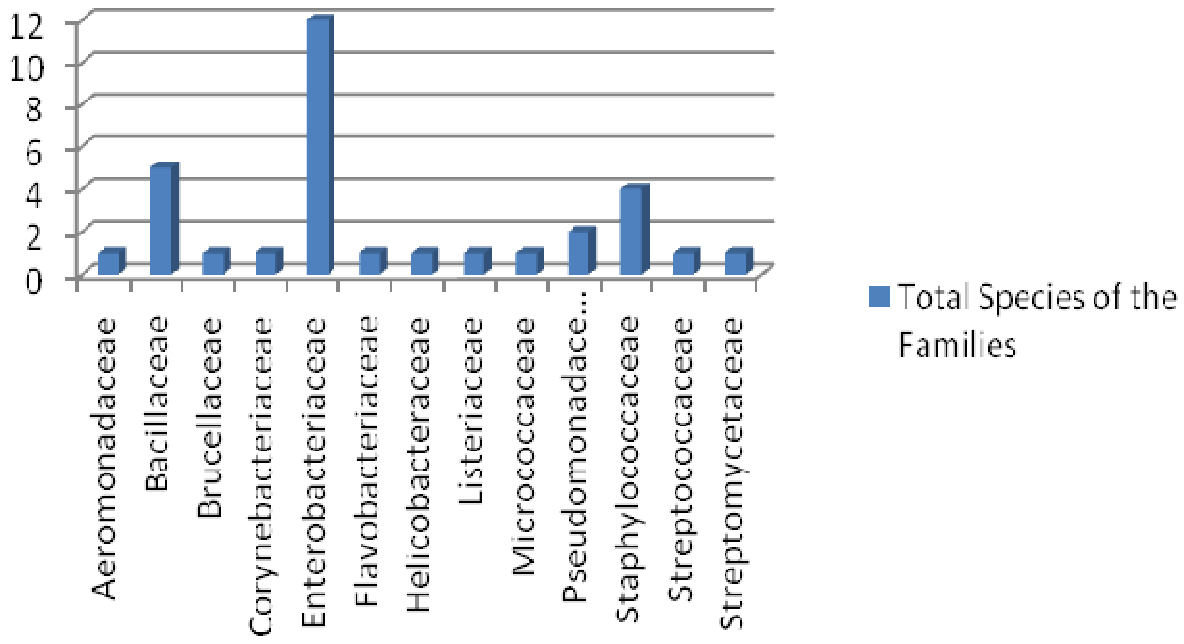

Fig 3. Generic dominance of the Bacterial Families

Table 5. List of fungi used for checking antimicrobial activity

Family	Genus	Species	Reference
Ceratobasidiaceae	*Rhizoctonia*	*Rhizoctonia solani*	Ding et al. 2010
Trichocomaceae	*Aspergillus*	*Aspergillus flavus*	Balakumar et al. 2011
		Aspergillus fumigates	Balakumar et al. 2011
		Aspergillus niger	Nyyetabura et al. 2010
	Paecilomyces	*Paecilomyces variotii*	Rankovic et al. 2010
	Penicillium	*Penicillium notatum*	Turgay T.et al. 2004
		Penicillium purpurescens	Rankovic et al. 2010
		Penicillium sp.	Balakumar et al. 2011
		Penicillium verrucosum	Rankovic et al. 2010
Sclerotiniaceae	*Botrytis*	*Botrytis cinerea,*	Imtiaj and Lee 2007, Rankovic et al. 2010
Davidiellaceae	*Cladosporium*	*Cladosporium herbarium*	Ofodile et al. 2010
Arthrodermataceae	*Epidermophyton*	*Epidermophyton spp.*	Akyuz et al. 2010
Nectriaceae	*Fusarium*	*Fusarium oxysporum*	Ding et al. 2010
		Fusarium oxysporum f. sp. *vasinfectum*	Ding et al. 2010
Mucoraceae	*Mucor*	*Mucor indicus*	Balakumar et al. 2011
		Mucor mucedo	Rankovic et al. 2010
Saccharomycetaceae	*Scaccharomyces*	*Scaccharomyces cerevisiae*	Yamac & Bilgili 2006
Hypocreaceae	*Trichoderma*	*Trichoderma harsianum*	Rankovic et al. 2010
Arthrodermataceae	*Trichophyton*	*Trichophyton sp.*	Akyuz et al. 2010
Pleosporaceae	*Curvularia*	*Curvularia sp.*	Pushpa & Purushottama 2010
	Alternaria	*Alternaria sp.*	Pushpa & Purushottama 2010
Incertae sedis	*Candida*	*Candida albicans*	Fagade and Oyelade, 2009, Nyyetabura et al. 2010, Srimathi et al. 2011, Akyuz et al. 2010, Bhosale et al. 2010, Rankovic et al. 2010, Pushpa & Purushottama 2010, Yamac & Bilgili 2006
		Candida glabrata	Akyuz et al. 2010
		Candida tropicalis	Naranmandakh et al. 2010

ACKNOWLEDGMENTS

We thank all of the authors from world for working on the antimicrobial potentials of fungi and because of them only I could gather such type of information which is very much useful for the further research on medicinal fungi. We are really thankful to Prof. M.R. Walher, Principal, Waghire College, Saswad for constant encouragement. We are especially grateful to Mr. Janrao sir and Mr. Rahul Kale, ARI, Library for their continuous literature help.

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