ORIGINAL RESEARCH PAPER

Volume-8 | Issue-8 | August - 2019 | PRINT ISSN No. 2277 - 8179

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

DIVERSITY OF DERMATOPHYTIC FUNGI ISOLATED FROM PATIENTS

Botany

P. Abirami Department of Botany, Seethalakshmi Achi College for Women, Pallathur, Sivagangai-630 107

ABSTRACT

Dermatophytes are fungi that can cause infections of the skin, hair and nails, in part because of their ability to utilize keratin. The cutaneous infections they cause (also called tinea) are among the most common infections in humans worldwide. In the USA, 10% of the population has cutaneous fungal infections at any given time, and at least 40% will acquire this skin condition at some time in their life. The World Health Organization estimates global prevalence of dermatomycoses to be approaching 20%. The dermatophytes include three genera of molds in the class Euascomycetes: *Trichophyton*, *Microsporum*, and *Epidermophyton*. In the present investigation totally 41 fungal species belonging to 20 genera (Deuteromycetes -16 genus and 32 species, Phycomycetes - 4 genus and 9 species) were identified from the dermatophytic patients at Rajamirasudhar Government Hospital, Thanjavur, Tamil Nadu, India, during August 2006 - July 2008. In general, among the 20 genera recorded, the genus *Aspergillus* (10 species) was dominant genera followed by *Mucor* (4 species), *Penicillium*, *Fusarium, Rhizopus* and *Trichophyton* (3 species each) and *Microsporum* (2 species). *Microsporum gypseum* and *Trichophyton rubrum* were the common one, which showed 100% frequency in two years study period.

KEYWORDS

Dermatophytes; fung;infections; *Microsporum gypseum* and *Trichophyton rubrum*

INTRODUCTION

Human disease is an abnormal medical conditions caused by external factors such as infection, diseases or internal disinfections such as autoimmune diseases. There are four types of diseases, pathogeneses, deficiencies, hereditary and physiological. Over 9.5 million people die each year due to infectious diseases and nearly all these deaths are in developing countries. Tuberculosis, Gonorrhea, Malaria and Childhood ear infections are just a few of the common and widespread diseases that have become more difficult to treat due to the emergence of drug resistant pathogen.

Superficial fungal infections are common skin diseases, affecting millions of people worldwide (Pierard and Arrese, 1996). These infections occur in both healthy and immune compromised patients and etiologic agents consist of dermatophytes are responsible for most superficial fungal infections and the estimate life time risk of acquiring a dermatophyte infection is between 10-20% (Drake *et al.,* 1996).

Dermatophytes are the most common cause of fungal infections worldwide, resulting in treatment costs of close to half a billion dollars annually in the USA (Smith *et al*., 1998; Drake *et al*.,1996). The World Health Organization estimates global prevalence of dermatomycoses to be approaching 20% (Marques *et al*., 2000). Despite this, researchers lack a sophisticated understanding of dermatophyte pathogenesis (White *et al*., 2008).

MATERIALS AND METHODS

Collection of samples

Samples were collected from the patients who outpatients of dermatology sections in Raja Mirasudhar Government Hospital, Thanjavur, Tamil Nadu (Fig. - 1). Suspected lesions from infected human skins were cleaned with 70% alcohol to remove dirt and contaminants (Pl. - 1). Well sterilized cotton swabs were used to collect with sterile iso saline and these were rubbed on to the patient's skin. They were kept under sterile vessels and brought to the laboratory.

Pl. - 1: Raja Mirasudhar Government Hospital in Thanjavur

Collection of sample from Dermatophytic patient

Isolation of dermatophytic fungi

The Potato Dextrose Agar Medium was poured into two conical flasks and cotton plugged and sterilized in pressure cooker for 20 minutes. Streptomycin sulphate ($100mg^{-1}$) was added to the medium to prevent the bacterial growth. The medium was transferred to the sterile petridishes. Samples were streaked on the PDA plates for the cultivation of fungal strains. The plates were incubated at 25± 2°C for the five days and the fungi appearing on the medium were recorded. Fungi were isolated through the simple streak methods and pure cultures were maintained for further studies.

Identification of dermatophytic fungi

The fungal cultures were identified by using lactophenol cotton blue staining technique. The stain contains four constituents namely phenol, which serves as a fungicides, lactic acid, which acts as a clearing agent, cotton blue which strain the cytoplasm of the fungus and glycerin which gives a semi-permanent slide preparation. The slides were observed under microscope (400X). Identification of the fungi was carried out by referring the standard manuals of Raper and Thom (1949), Raper and Fenell (1965), Ellis (1976), Kohlmeyer and Kohlmeyer (1979) and Gillman (1957) and it photographed using Nikon Photomicroscope (Japan).

Presentation of data

Frequency occurrence was calculated as follows in order to identify their existence in the dermatophytic samples collected from different months.

$$\% \text{ frequency} = \frac{\text{Number of samples in which a particular fungus occurred}}{\text{Total number of samples examined}} \times 100$$

Based on the frequency occurrences the fungi were grouped as rare (0-25% frequency), Occasional (26-50%. frequency), Frequent (51-75% frequency) and common (76-100% frequency) species.

RESULTS AND DISCUSSION

Dermatophytes are the most common agents of fungal infections worldwide (Robert *et al.,* 2004 and Yuanwu *et al*., 2009). Dermatophytic infections have been considered to be a major public health problem in many parts of the world. The infections are common in the developing countries, and are of particular concern in the tropics, especially in infants (Guest and Sam, 1998). The infections are caused by 40 species of fungi which are grouped into three genera; *Trichophyton, Microsporum and Epidermophyton* (David *et al.,* 2010). The mode of spread is either by direct or indirect contact with an infected particle which is usually a fragment of keratin containing viable fungus. Indirect transfer may occur via the floor of swimming pools, bath rooms or on brushes, combs, towels and animal grooming implements (Nweze, 2001). Dermatophytes infections are hardly fatal but mostly debilitating and disfiguring diseases that can give rise to permanent deformations if untreated (Yuanwu *et al*., 2009).

Superficial fungal infections are common skin diseases, affecting millions of people worldwide (Pierard *et al*., 1996). These infections occur in both healthy and immune compromised patients and etiologic agents consist of dermatophytes, yeasts and nondermatophyte molds. Dermatophytes are responsible for most superficial fungal infections (Aly, 1994) and the estimated lifetime risk of acquiring a dermatophyte infection is between 10 to 20% (Drake *et al*., 1996).

The prevalence of superficial mycoses had been studied in different part of the world (Hay *et al*., 2001; Akploat *et al.,* 2005). The relative occurrence of the etiologic agents of these infections varied from country to country and from one climatic region to another (Ayadi *et al.,* 1993; Korstanje and Staats, 1995) In tropical countries, a warm and humid climate, crowded living and poor sanitary conditions all promoted the spread of these infections (Abdel Rahman and Nahata, 1997).

In the present investigation totally 41 fungal species belonging to 20 genera (Deuteromycetes -16 genus and 32 species, Phycomycetes - 4 genus and 9 species) were identified from the dermatophytic patients at Rajamirasudhar Government Hospital, Thanjavur, Tamil Nadu, India, during August 2006 - July 2008. In general, among the 20 genera recorded, the genus *Aspergillus* (10 species) was dominant genera followed by *Mucor* (4 species), *Penicillium*, *Fusarium, Rhizopus* and *Trichophyton* (3 species each) and *Microsporum* (2 species). All other genera were represented by one species each (Table-1). Similarly Bakheshwain *et al*. (2011) isolated 19 fungal species from dermatophytic samples belonging to the fungal genera *Alternaria*, *Aspergillus*, *Bipolaris*, *Cladosporium*, *Exophiala*, *Fusarium*, *Graphium*, *Malassezia*, *Prototheca*, *Rhizopus*, *Rhodotorula*, *Trichosporon* and *Ulocladium. Aspergillus* was the leading genus represented by six species. Evidently, Mbata and Nwajagu, (2007) reported *Microsporum gypseum* and *Trichophyton* species were the main etiologic agents in a total of 2,117 nursery and primary school children aged 1-13 years for hair scalp infection in Awka, Nigeria. Other non dermatophytic fungi species isolated were *Alternaria alternata* 14 (17%), *Aspergillus fumigatus* 10 (12%), *Fusarium solani* 7 (8%), *Penicillium* sp. 3 (4%) and *Candida albicans* 3 (4%).

Dion and Kapica, (1975) studied 10057 specimens of scrapings from skin, nails and scalp examined for dermatophytes, yeasts, pityriasis versicolor and systemic mycoses between 1963 and 1973, 30.4 percent were positive for fungi. Among the isolates, *Trichophyton rubrum* was the predominant species (23.6 percent); of lesser prevalence were *Microsporum canis* (9.3 percent), *T. mentagrophytes* (8.4 percent) and *Epidermophyton floccosum* (4.8 percent).

Table - 1: List of fungi isolated from Dermatophytic Patients

S.No	Name of the fungal isolates
1.	**Deuteromycetes**
2.	*Acrophialophora fusispora* (S.B.Saksena) Samson, 1970
3.	*Alternaria alternata* (Fr) Keissl, 1912
4.	*Aspergillus candidus* Link, 1809
5.	*A. clavatus* Desm, 1834
6.	*A. flavus* Johann Heinrich Friedrich Link,1809
7.	*A. fumigatus* Fresenius, 1863
8.	*A. luchuensis* Lnui,
9.	*A. niger* Van Tieghem, 1867
10.	*A. ochraceous* Wilhelm
11.	*A. oryzae* (Ahiburg) E.cohn
12.	*A. terreus* Thom
13.	*A. versicolor* Thom and Raper
14.	*Blastomyces dermatitidis* Gilchrist & Stokes, 1898
15.	*Candida albicans* (C.P.Robin) Berkhout 1923
16.	*Cladosporium carrionii,* Trejos, 1954
17.	*Curvularia lunata* (Wakker) Boedijn
18.	*Fusarium moniliforme* Seld 1904
19.	*F. oxysporum* schlecht emerded snyder and Hansen
20.	*F. solani* f.pisi (Jones) Snyder and Hansen 1941
21.	*Geotrichum* sp. Link
22.	*Helminthosporium solani* Durieu&Mont., 1849
23.	*Madurella* sp. Brumpt in 1905
24.	*Malassezia furfur* (Robin) Baill, 1889
25.	*Microsporum canis* Var. distortum
26.	*M. gypseum* Guiart and Grigorakis in 1928
27.	*Penicillium chrysogenum* Them
28.	*P. citrinum* Them
29.	*P. restrictum* J.C.Gilman & E.V.Abbott 1927
30.	*Trichophyton mentagrophytes* Var. erinacei
31.	*T. rubrum* Var.rodhaini
32.	*T. schoenleinii* (Lebert) Langeron Milochevitch
	Phycomycetes
33.	*Absidia* sp. Van Tieghem, 1878
34.	*Mucor ambiguus* Vuill. 1887
35.	*M. flavus* Bainier, 1903
36.	*M. hiemalis* wehmer 1903
37.	*M. indicus* Lendn. 1930
38.	*Rhizomucor* sp. (Lucet & cost) Wehmer, 1907.
39.	*Rhizopus nigricans* Ehrenberg.
40.	*R. oryzae* Went & prins, Geerl, 1895.
41.	*Rhizopus* sp. *Ehrenb,* 1820.

The fungal species diversity was recorded in the month of August 2006 to January 2007 was 20 species belonged to 14 genera which showed variations. Among the 14 genera, the genus *Aspergillus* was represented by the maximum number of five species followed by *Mucor* and *Rhizopus* (2 species each). All other genera were represented by one species each (Tab. - 2).

Table –2: Isolation and identification of fungi from dermatophytic patients (August 2006 - January 2007)

S. No	Name of the fungi	Fungi availability					
		Aug	Sep	Oct	Nov	Dec	Jan
1.	*Acrophialophora fusispora*	-	+	-	-	-	+
2.	*Alternaria alternata*	-	-	+	-	+	+
3.	*Aspergillus flavus*	+	+	+	-	+	+
4.	*A. fumigates*	+	+	+	+	+	+
5.	*A. niger*	+	+	+	+	-	+
6.	*A. ochraceous*	-	-	-	+	-	-
7.	*A. oryzae*	+	-	+	-	-	-
8.	*Candida albicans*	-	-	-	-	+	+
9.	*Curvularia lunata*	-	-	+	-	-	+
10.	*Fusarium solani*	+	+	-	+	-	+
11.	*Geotrichum* sp.	+	-	-	-	-	+
12.	*Helminthosporium solani*	+	-	+	-	-	-
13.	*Microsporum gypseum*	+	+	+	+	+	+
14.	*Mucor hiemalis*	-	+	-	-	-	-
15.	*Mucor indicus*	-	-	+	-	+	-
16.	*Penicillium citrinum*	+	-	+	-	-	+
17.	*Rhizopus nigricans*	+	-	+	-	+	-
18.	*R. oryzae*	-	-	+	-	-	-
19.	*Trichophyton rubrum*	+	+	+	+	+	+
20.	*Verticillium* sp.	-	+	-	-	-	-

(+) Present (-) Absent

Totally 24 fungal species belonged to 15 genera were recorded during February 2007 to July 2007. Among the 15 genera recorded the genus *Aspergillus* and *Mucor* were constituted by the maximum number of species (3 species each) followed by *Fusarium*, *Penicillium* and *Rhizopus* (2 species each) and all other genera were represented one species each (Tab. - 3).

Tab. - 3: Isolation and identification of fungi from dermatophytic patients (February 2007 - July 2007)

S.No	Name of the fungi	Fungi availability					
		Feb	Mar	April	May	Jun	Jul
1.	*Acrophialophora fusispora*	+	-	-	+	+	-
2.	*Alternaria alternate*	-	-	-	-	+	-
3.	*Aspergillus candidus*	-	-	-	-	+	-
4.	*A. fumigates*	+	+	+	-	-	+
5.	*A. luchuensis*	+	+	+	-	+	+
6.	*A niger*	+	+	-	-	-	-
7.	*A. versicolor*	-	+	+	+	-	+
8.	*Candida albicans*	-	-	+	+	-	+
9.	*Cladosporium carrionii*	+	-	+	-	-	-
10.	*Curvularia lunata*	+	+	-	+	+	-
11.	*Fusarium moniliforme*	+	+	+	+	+	+
12.	*F. oxysporum*	-	+	+	+	+	+
13.	*Geotrichum* sp.	-	+	+	+	-	-
14.	*Helminthosporium solani*	-	-	-	-	+	+
15.	*Microsporum gypsum*	+	+	+	+	+	+
16.	*Mucor flavus*	+	-	+	+	-	+
17.	*M. hiemalis*	-	+	+	+	+	-
18.	*M. indicus*	-	+	-	+	-	+
19.	*Penicillium chrysogenum*	+	+	-	-	-	-
20.	*P. citrinum*	+	+	+	+	+	+
21.	*Rhizopus nigricans*	+	-	+	+	-	+
22.	*R. oryzae*	-	+	+	+	+	-
23.	*Trichophyton rubrum*	+	+	+	+	+	+
24.	*Verticillium* sp.	+	+	+	+	+	-

(+) Present (-) Absent

In the month of August 2007 to January 2008, a total number of 27 fungal species belonged to 17 genera were recorded. Among the 17 genera, the genus *Aspergillus* by the maximum number of 5 species followed by *Trichophyton* and *Rhizopus* (3 species each), *Mucor* and *Penicillium* (2 species each) and all other genera were represented one species each (Tab. - 4).

Tab. – 4: Isolation and identification of fungi from dermatophytic patients (August 2007 - January 2008)

S.No	Name of the fungi	Fungi availability					
		Aug	Sep	Oct	Nov	Dec	Jan
1.	*Acrophialophora fusispora*	+	+	-	+	+	-
2.	*Alternaria alternate*	+	+	+	+	+	+
3.	*Aspergillus candidus*	-	+	-	+	+	+
4.	*A. flavus*	+	-	+	-	-	-
5.	*A. fumigates*	-	-	-	-	-	+
6.	*A. luchuensis*	+	+	-	+	-	-
7.	*A. niger*	-		-	-	+	+
8.	*Blastomyces dermatitidis*	-	-	+	-	+	-
9.	*Candida albicans*	-	+	-	-	-	-
10.	*Cladosporium carrionii*	-	+	-	+	-	-
11.	*Curvularia lunata*	+	-	-	+	-	+
12.	*Fusarium solani*	-	+	+	-	-	-
13.	*Geotrichum* sp.	-	-	-	-	-	+
14.	*Helminthosporium solani*	+	+	-	-	+	+
15.	*Microsporum gypseum*	+	+	+	+	+	+
16.	*Mucor hiemalis*	-	+	+	-	-	-
17.	*M. indicus*	+	+	+	+	+	+
18.	*Penicillium chrysogenum*	-	+	-	-	+	-
19.	*P. citrinum*	+	+	+	+	+	+
20.	*Rhizomucor* sp.	+	-	+	-	-	-
21.	*R. nigricans*	+	+	+	+	-	+
22.	*R. oryzae*	-	+	-	-	+	+
23.	*Rhizopus* sp.	-	+	-	+	+	+
24.	*Trichophyton mentagrophytes*	-	+	+	+	+	+
25.	*T. rubrum*	+	+	+	+	+	+
26.	*T. schoenleinii*	+	+	-	+	+	+
27.	*Verticillium* sp.	+	+	+	-	+	+

(+) Present (-) Absent

The maximum number of 33 fungal species belonged to 20 genera were recorded during the month of February 2008 to July 2008. Among the 20 genera recorded, the genus *Aspergillus* constituted by the maximum number of 6 species followed by *Mucor*, *Trichophyton* (3 species each), *Fusarium* and *Penicillium* (2 species each). All other genera were represented one species each (Tab. - 5).

Tab. – 5: Isolation and identification of fungi from dermatophytic patients (February 2008 - July 2008)

S.No	Name of the fungi	Fungi availability					
		Feb	Mar	April	May	Jun	Jul
1.	*Absidia* sp.	-	-	-	-	-	+
2.	*Acrophialophora fusispora*	-	-	-	+	+	-
3.	*Alternaria alternata*	+	+	+	+	+	+
4.	*Aspergillus clavatus*	+	-	+	+	+	-
5.	*A. flavus*	+	+	-	-	+	-
6.	*A. fumigates*	+	+	-	-	+	+
7.	*A. luchuensis*	-	-	+	-	-	-
8.	*A. niger*	-	+	-	+	+	-
9.	*A. terreus*	+	+	+	+	+	+
10.	*Blastomyces dermatitidis*	+	+	+	+	+	+
11.	*Candida albicans*	-	-	-	-	-	+
12.	*Cladosporium carrionii*	+	-	+	-	-	-
13.	*Curvularia lunata*	+	-	+	-	+	-
14.	*Fusarium oxysporum*	-	-	+	+	-	+
15.	*F. solani*	-	-	+	+	+	+
16.	*Geotrichum* sp.	-	-	-	+	-	-
17.	*Helminthosporium solani*	+	+	-	-	+	+
18.	*Madurella* sp.	+	+	-	-	-	+
19.	*Malassezia furfur*	+	+	+	+	+	+
20.	*Microsporum canis*	+	+	+	+	+	-
21.	*M. gypseum*	+	+	+	+	+	+
22.	*Mucor ambiguous*	-	-	+	-	-	-
23.	*M. hiemalis*	-	-	-	+	-	-
24.	*M. indicus*	-	+	+	-	+	-
25.	*Penicillium chrysogenum*	+	+	+	+	+	+
26.	*P. restrictum*	-	+	-	+	-	+
27.	*Rhizomucor* sp.	+	-	+	+	-	-
28.	*Rhizopus nigricans*	+	-	-	+	-	+
29.	*R. oryzae*	-	+	-	-	+	+
30.	*Trichophyton mentagrophytes*	-	+	+	+	-	+
31.	*T. rubrum*	+	+	+	+	+	+
32.	*T. schoenleinii*	+	+	-	+	-	+
33.	*Verticillium* sp.	-	+	-	-	-	-

(+) Present (-) Absent

Percentage frequency

Microsporum gypseum and *Trichophyton rubrum* were the common one, which showed 100% frequency in two years study period (Tab. - 8). *M. indicus* (68.3%), *Alternaria alternata* (66.7%), *Aspergillus fumigatus, P. citrinum*, *Rhizopus nigericans* (62.5%) were frequent. *A. niger, Curvularia lunata*, *Helminthosporium solani*, *Verticillium* sp. (50%), *Acrophialophora fusispora, R. oryzae* (45.8%), *F. solani, A. flavus, Penicillium chrysogenum* (41.7%), *A. luchuensis, Trichophyton mentagrophytes, T. schoenleinii (37.5%), Blastomyces dermatitidis, F. oxysporum, M. hiemalis* (33.3%), *Candida albicans, Geotrichum* sp. (29.2%) were occasional while rest of others were rare in occurrence (Tab.- 6).

Tab. – 6: Percentage frequency and frequency class of different species of fungi recorded at August 2006 to July 2008 (n=24)

S.No	Fungal isolates	No. of months in which the fungus occurred	Percentage frequency	Frequency class
1.	*Absidia* sp.	1	4.1	R
2.	*Acrophialophora fusispora*	11	45.8	O
3.	*Alternaria alternate*	16	66.7	F
4.	*Aspergillus candidus*	5	20.8	R
5.	*A. clavatus*	4	16.7	R
6.	*A. flavus*	10	41.7	O
7.	*A. fumigates*	15	62.5	F
8.	*A. luchuensis*	9	37.5	O
9.	*A. niger*	12	50.0	O
10.	*A. ochraceous*	1	4.2	R
11.	*A. oryzae*	2	8.3	R
12.	*A. terreus*	6	25	R
13.	*A. versicolor*	4	16.7	R
14.	*Blastomyces dermatitidis*	8	33.3	O
15.	*Candida albicans*	7	29.2	O
16.	*Cladosporium carrionii*	6	25	R
17.	*Curvularia lunata*	12	50	O
18.	*Fusarium moniliforme*	6	25	R
19.	*F. oxysporum*	8	33.3	O

20.	*F. solani*	10	41.7	O
21.	*Geotrichum* sp.	7	29.2	O
22.	*Helminthosporium solani*	12	50	O
23.	*Madurella* sp.	3	12.5	R
24.	*Malassezia furfur*	5	20.8	R
25.	*Microsporum canis*	5	20.8	R
26.	*M. gypseum*	24	100	C
27.	*Mucor ambiguous*	1	4.2	R
28.	*M. flavus*	4	16.7	R
29.	*M. hiemalis*	8	33.3	O
30.	*M. indicus*	14	68.3	F
31.	*Penicillium chrysogenum*	10	41.7	O
32.	*P. citrinum*	15	62.5	F
33.	*P. restrictum*	3	12.5	R
34.	*Rhizomucor* sp.	5	20.8	R
35.	*Rhizopus nigricans*	15	62.5	F
36.	*R. oryzae*	11	45.8	O
37.	*Rhizopus* sp.	4	16.7	R
38.	*Trichophyton mentagrophytes*	9	37.5	O
39.	*T. rubrum*	24	100	C
40.	*T. schoenleinii*	9	37.5	O
41.	*Verticillium* sp.	12	50	O

R – Rare (0-25%); O – Occasional (26-50%); F – Frequent (51-75%); C – Common (76-100%)

CONCLUSION

The human body is covered with a vast amount and diverse range of germs. These germs live harmlessly within the body and on the skin. However, certain types of fungus can build up on the skin and cause infections. A fungal infection usually appears on the skin, as the organisms live on a protein called keratin. This protein makes up the nails, skin and hair. The various symptoms of a fungal infection depend on the type of the fungus that has caused the infection. Emergence of new diseases, re-emergence of old, development of resistant strains, side effects of some currently available drugs including toxicity and other undesirable effects in allergic patients are a few major problems which require immediate attention to combat these diseases with effective drugs of high therapeutic index. Furthermore, effective drugs are also needed for immune compromised patients who are at great risk by opportunistic pathogens that normally do not pose any major threat in the normal population. Therefore, there is an immense need for the development; and discovery of new and safer bioactive compounds.

ACKNOWLEDGEMENT

Special thanks and appreciation goes to God Almighty who gave us the opportunity to see to the completion of this work. I would also like to acknowledge Principal of Seethalakshmi Achi College for Women, Pallathur, Sivagangai district.

REFERENCES

1. Abdel-Rahman, S.M. and Nahata, M.C., 1997. Treatment of Tinea capits. Ann. Pharma cother., 31: 338-48.
2. Akploat, N.O., Akdeniz, S., Elci, S., Atmaca, S. and Ozekinci, T., 2005. Tinea capitis in Diyarbakir, Turkey. Mycos., 48: 8-10.
3. Aly, R., 1994 Ecology and epidemiology of dermatophyte infections. J. Am. Acad. Dermatol., 31:21-25.
4. Ayadi, A., Borgi, N. and Makni, F., 1993. Prevalance supersterm mycoses in an urban ecosystem in s fax (Tunisa). Bull. Soc. Path. Exot., 86(3): 188-9.
5. David, E., Elumalai, E.K., Sivakumar, C., Viviyan Therasa, S. and Thirumalai, T., 2010 Evaluation of antifungal activity and phytochemical screening of Solanum surattense Seeds. J. Pharmacy Res., 3(4): 684-687.
6. Dion, W. M. and Kapica, L., 1975. Isolation of dermatophytes, Candida species and systemic fungi from dermatologic specimens in Montréal, 1963 to 1973. Can. Med. Assoc. J., 112(6):712 -716.
7. Drake, L. A., Dinehart, S. M. and Farmer, E. R., 1996. "Guidelines of care for superficial mycotic infections of the skin: tinea corporis, tinea cruris, tinea faciei, tinea manuum, and tinea pedis," J. Amer. Acad. Dermatol., 34(2) 282–286.
8. Guest, P.J. and Sam, W.M. Jr., 1998. Dermatophyte and superficial fungi In: Sam wwwjr lynch P. J. Principle and practice Dermatology. New York, pp. 3-4.
9. Hay, R. J., Robles, W., Midgley, G. and Moore, M. K., 2001. Tinea capitis in Europe: New perspective on an old problem. J.Euro Acad.Dermatol. Venereol., 15:229-33.
10. Korstanje, M.J. and Staats, C.C., 1995. Fungi infection in the Nether lands: preventing fungi and pattern of infection. Dermatol., 1: 39-42.
11. Marques, S. A., Robles, A. M., Tortorano, A.M., Tuculet, M. A., Negroni, R. and Mendes, R. P., 2000. Mycoses associated with AIDS in the third world. Medical Mycol., 38(1): 269–279.
12. Mbata, T.I. and Nwajagu, C.C., 2007. Dermatophytes and other fungi associated with hair-scalp of nursery and primary school children in Awka, Nigeria. I. J. of Der., 5 (3):1.
13. Nweze, E.L.O., Okafor, J.I. and Njoku, O., 2004. Antimicrobial activities of methanolic extracts of Trema guineensis (Schumm and thorn) and Morinda lucida bench used in Nigeria. Bioresearch., 2: 39.
14. Pierard, G.E., Arrese, J. E.and Pierard-Franchimontc, 1996. Treatment and prophylaxis of tinea infections, Drugs, 52:209-224.
15. Robert, J., Maniero, G., Cohen, N. And Gantress, J., 2004. Xenopus as a model system to study evolution of HSP-immune system responses. In: Methods: A companion to methods in enzymologist (HSP-immune system interactions), P. Srivastava (ed.). Academic Press, Philadelphia Pennsylvania, 32: 42–53.
16. Smith, R.C., Baker, K.S., Byers, M.L. and Stammerjohn, S.E. 1998. Primary productivity of the Palmer Long Term Ecological Research Area and the Southern Ocean. J. Marine Sys., 17: 245-259.
17. White, T. C., Oliver, B. G., Graser, Y. and Henn, M. R., 2008. Generating and testing molecular hypotheses in the dermatophytes. Eukaryotic Cell., 7(8): 1238–1245.
18. Yuanwu, J.Y., Fanyang, T., Wenchuan, L., Yonglie, C. and Qijin, 2009. Recent dermatophyte divergence revealed by comparative and phylogenic analysis of mitochondrial genomes. BMC genomics., 10:1471-2164.