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MONITORING OF FUNGI GENERA IN THE FLOOR DUST AND THE INDOOR AIR OF ELEMENTARY AND PREPARATORY SCHOOLS IN THE CITY OF ZAWIA, LIBYA

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ABSTRACT

Background: Spores of fungi, bacteria and actinomycetes are always present in large number in dusts and indoor air of schools. Some of these fungi are recognized to play a role in causing human and animal diseases. Studying the different groups of fungi such as spores and mycelium fragments of mesophilic (glucophilic, pathogenic and keratinophilic) fungi is of considerable important. **Objectives:** The present investigation is aimed to study the occurrence, the distribution, the seasonal variations, and the fluctuations of the fungi inhabiting dusts and indoor air of elementary and preparatory schools at Zawia governorate. **Methods:** Fifty floor dust samples were collected during January to April 2006 from different Elementary and Preparatory schools at Zawia city. Also, twenty-four floor dust samples were collected fortnightly during January-December 2006 from classrooms of Al-Shabbani Bin Nasart School at Zawia city. All samples were stored at a refrigerator (2-5 °C) till use. Modified-Czapek's agar medium used for isolation ofglucophilic fungi and Sabourauddextrose agar medium was used for isolation of pathogenic fungi. Theisolation of keratinophilic fungi was achieved by hair baiting technique. The developing colonies were counted, examined, identified and the total number of eachgenuswas calculated. **Results:** 18 genera of Glucophilic fungi, 11 Pathogenic fungi genera, and 13 Keratinophilic fungi genera were isolated from 50 floor dust samples. The most common Glucophilic fungi genera were: *Alternaria, Aspergillus, Cladosporium, Emericella, Fusarium, Mucor, Penicillium,* and *Ulocladium* were isolated in high frequencies of occurrence. Pathogenic fungal genera; *Alternaria, Aphanoascus, Aspergillus, Mucor* and *Penicillium* were recovered in high frequencies of occurrence as well on Sabouraud dextrose agar. The most common Keratinophilic fungi genera were: *Alternaria, Aphanoascus, Aspergillus* and *Trichophyton*. The average maximum and minimum temperature of the air of Al-Sabbani Bin Nazart elementary school during the experimental period ranged between 20° - 36°C and l0°C-26 °C, respectively. The average maximum and minimum relative humidity fluctuated between 60 -95 % and 8-24%, respectively. The monthly counts of Glucophilic fungi genera irregularly fluctuated and the highest count was estimated during spring and the lowest in summer. The monthly counts of pathogenic and keratinophilic fungi were irregularly fluctuated and varied giving peaks in January and December and minima during August and June, respectively. The monthly counts of airborne fungi fluctuated irregularly and the peak was found in winter. The monthly counts of Pathogenic and keratinophilic fungal genera irregularly fluctuated giving peaks during December and April, respectively. **Conclusion:** It can be concluded that a various fungal genera were isolated from floor dust, and indoor air samples. The most prevailed fungal genera isolated were *Alternaria, Aspergillus, Penicillium, Mucor, Ulocladium, Emericella* and *Rhizopus*. Overall, the highest number of fungal genera was obtained from floor dust samples. Our results obtained of pathogenic and non-pathogenic fungi in the floor dust and indoor air of Elementary and Preparatory schools were almost basically similar to those fungi in many parts of the world but with different numbers, frequencies and months of fungi. Further studies on mycoflora taxa frequently isolated from floor dust and indoor air environment of schools in different governorates of Libya would be interesting. A large number of fungal species still waiting proper identification. Different modern sampling techniques can be used to investigate culture ability and total fungal spores and to estimate Colony Forming Units (CFU).

KEYWORDS: Fungi genera, Floor dust, Indoor air, Elementary schools, Preparatory schools, Zawia governorate.

INTRODUCTION

Spores of fungi, bacteria and actinomycetes are always present in large number in dusts and indoor air of schools. These spores are proved to be associated with human diseases such as chronic bronchitis, emphysema, asthma, allergies, poisoning, and infection, thus hygienic and ecologic interests have led us to study the mycoflora of school environment.

Fungi that could degrade hairs are generally termed as keratinophilic fungi. These fungi have the biological ability to metabolize keratinaceous substance from animals such as hairs that constitute the external surfaces of the animal body. Although some of these fungi metabolize the keratin in a saprobiontic activity therefore only utilize the inert keratinic fragments while, in contrast, others have developed a biochemical activity and become parasites. The later types of fungi are known as dermatophytes. Recent research tend to give more concentration on the keratinolytic capacity of other fungi, although with less frequency, and to recognize their role in causing human and animal diseases. Epidemiological studies that carried out earlier were aimed to define the relationships between the above mentioned fungi and the environment like from soil, air dust, schools, public parks and also from household environments.

Few studies were focused on the mycoflora of sedimented dust particles whereas the components of dust particles are sources of most potent allergens. It is well know that microfungi can provoke allergy (Maunsell 1971, Gravesen 1979 and Salvaggio&Aukrust 1981). Allergic reactions may be immediate or delayed for several hours after exposure to the allergen (Pepys 1969). The type of allergy caused by inhalation of spores depends on the constitution of the subject, the nature of the inhaled particle (Woodfolk JA et al 2015), and the degree of exposure (Lacey 1975). In infection (mycosis), living tissue is invaded by fungal mycelium (kovats&Bugyi 1968, Austwick 1977). Since studying the different groups of fungi such as spores and mycelium fragments of mesophilic (glucophilic, pathogenic and keratinophilic) fungi is of considerable importance.

Numerous investigations have been made on the distribution of fungi in different types of soils. Studies on Keratinophilic fungi are of considerable significance and have been reported from soil in many countries all over the world (Verhoeff et al.1994; Ulfig et al. 1995, 1996, 997 a, b, 1998 a, b, 1999; Leese et al 1997; Deshmukh 1999; Deshmukh 2000 et al.; Allerman et al. 2003, 2006; Mayer et al 2004; Rao et al.2005; Wurtz et al.2005; Quesada et al 2007; Bing &Ying 2008, and John et al 2008).

Due to the spread of the fungi in the floor dust and air of Elementary and Preparatory schools at Zawia Governorate, which may cause different diseases to students, our research team intend to study this problem, with a view to identify the types of these fungi. This study play an important role in characterizing the different types of pathogenic and non-pathogenic fungi existing in floor dust and air of Elementary and Preparatory schools at ZawiaGovernorate , Libya. Since these fungi cause various diseases, so this study drives at fighting the fungi for protecting the students from infection.

Objectives

The present investigation is aimed to study the occurrence, the distribution, the seasonal variations, and the fluctuations of the fungi inhabiting dusts and indoor air of elementary and preparatory schools at Zawia governorate.

MATERIALS AND METHODS

Fifty floor dust samples were collected from different Elementary and Preparatory schools at Zawia city. The number of samples was as follows: 32 and 18 samples of Elementary (E) and Preparatory (P) schools, respectively (Table A). The floor dust samples were collected during January to April 2006. Each sample was put in a polyethylene bag, sealed and put in other bags, which also sealed to minimize the loss of water content and give sufficient aeration. Samples were transferred immediately to the at EL-Igd EL-Fareed Private Medical laboratory and sifted through a mesh screen which has opening measuring 120 µm to remove large dust particles. All samples were stored at a refrigerator (2-5 °C) till use.

Table A: Different Elementary (E) and Preparatory (P) schools at Zawia city from which dust samples were collected.

Sample No	School Name	Sample No	School Name
1-3	Gamal Abdl El-Nasser (E)	28-30	Fattima Al-Zahraa (P)
4-9	Al-Shaheed Helmy Saqleila (P)	31-33	Al-Fassy (P)
10-12	Al-Deyaa (E)	34-36	Omer Bin Eigee (P)
13-15	Khalid Bin Al-Waleed (P)	37-39	Mohammad Al-Zeheiwi (P)
16-18	Al-Ketaab Al-Akhdar (P)	40-42	Asmaa Bent Abi-Bakr (P)
19-21	7th of October (E)	43-45	Haie El-Wehda (P)
22-24	Daiee El-Helal (E)	46-48	Al-Sabbani Bin Nazart (E)
25-27	Seidy Abd El-Wahed (P)	49-50	Emhammad Al-Ujeili (P)

During January to December 2006

Twenty-four floor dust samples were collected fort-nightly during January-December 2006 from classrooms of Al-Shabbani Bin Nasart School at **Zawia** city. Ten plates of agar medium were used for each sample (5 plates for glucophilic and the other 5 plates for pathogenic fungi). The hair baiting technique was employed. Five plates were used for each dust sample.

Airborne Fungi samples

Glucophilic and pathogenic fungi

Ten plates (5 plates for each type of medium) of 9 cm diameter were used for each sample. Glucose-Czapek's agar and Sabouraud dextrose agar media were used for isolation of saprophytic and pathogenic fungi, respective-ly. The plates (bottom-side) were exposed at 11 a.m. fortnightly, about 1 m above floor level, for 15 min (saprophytic fungi) or 60 min (pathogenic fungi) in the classrooms.

Keratinophilic fungi

Plates of 9 cm diameter containing each 40 g dust were moistened with sterilized water to about 25-30 %. Goat hair fragments were scattered on the dust surface. The plates were autoclaved (three times) at 121°C for 30 min. Five plates were exposed fortnightly to the indoor air of the classrooms, about 1 m above floor level, at 11 a.m. for 1 h. Plates were incubated at 25°C for 10-12 weeks and remoistened whenever necessary. Twenty-five hair fragments (5 fragments/dish) for each exposure were transferred to the surface of Sabouraud dextrose agar medium which was supplemented with chloramphenicol (0.5 mg/ml medium) and cycloheximide (0.5 mg/ml medium) to supress bacterial growth.

Laboratory studies

Modified-Czapek's agar medium:(g/L; sodium nitrate, 3.0; potassium dihydrogen phosphate, 1.0; magnesium sulphate, 0.5; potassium chloride, 0.5; ferrous sulphate, 0.01; glucose, 10; agar, 15) were used for isolation of glucophilic fungi. Rose Bengal (1/30000) and chloramphenicol (0.5 mg/ml medium) were used as bacteriostatic agents (Smith and Dawson 1944; Al-Doory 1980).

Sabouraud dextrose agar medium for isolation of pathogenic fungi

Sabouraud dextrose agar medium (Moss and McQuown 1969; El-Said, A. H et al, 2009): (g/L; Peptone from meat, 10; glucose, 40; agar, 15) was used for isolation of pathogenic fungi. Two antibiotics were added to this medium to inhibit the growth of bacteria: chloramphenicol (0.5 mg/ml medium) and cycloheximide (actidione) (0.5 mg/ml medium). Before adding to the agar medium, the first antibiotic was dissolved separately in sterile distilled water while the second was dissolved in methanol.

Isolation of keratinophilic fungi by hair baiting technique

Isolation of keratinophilic fungi was carried out by hair baiting technique (Vanbreuseghem, 1952; Larone DH 1987; Altayyar et al, 2016). One hundred grams from each of dust sample (based on dry weight) were put in a sterile plate containing a sufficient quantity of sterile distilled water (about 25-30% moisture content) was added and mixed thoroughly. Pieces of sterile goat hair fragments were sprinkled on the surface of the moistened dust. Two plates were used for each sample. The plates were incubated at 25°C for 10-12 weeks, and the dust in the plates was remoistened with sterile distilled water whenever necessary. Pure cultures of fungi were noticed on Sabouraud dextrose agar media containing chloramphenicol (0.5 mg/ml) and cycloheximide (0.5 mg/ml). The plates were incubated at 25°C for 2-3 weeks, and the developing fungi were identified based on macro-and microscopical characteristics and the total numbers were calculated per 10 hair fragments for each sample.

Mycoflora Analysis

Methods used for isolation of fungal genera

Fungi were isolated using dilution and settle Plate methods described by Johnson and Curl, 1972; R. Rathish et al, 2017).

Fungal genera frequency during the year 2006

Floor dust fungi: Twenty-four floor dust samples were collected fortnightly during January-December 2006 from classrooms of Al-Shabbani Bin NasartSchool at Zawia city.

The fungal analysis was studied by using the dilution plate method as described previously. Ten plates of agar medium were used for each sample (5 plates for glucophilic and the other 5 plates for pathogenic fungi). Plates were incubated at 25°C for 1-2 (saprophytic fungi) or 2-3 weeks (pathogenic fungi). The developing colonies were counted, examined, identified and the numbers were calculated. The hair baiting technique was employed for estimation of keratinophilic fungi as previously mentioned. Five plates were used for each dust sample. The developing fungi on hair fragments were identified and the numbers were calculated per 50 goat-hair fragments for each sample.

Indoor air fungi: Treated Plates as mentioned above were incubated at 25°C for 2-3 weeks and the developing colonies were encountered, examined, identified and the numbers were calculated per 50 goat-hair fragments in 2 exposures of 1 h each. (Ali-Shtayeh&Asa'd Al-sheikh 1988; Hiromi OHARA et al 2014).

Identification of Fungal genera

The identification of fungal genera was used based on macro and microscopical characteristics according to the following references (Table B).

Table B: The identification of fungal genera based on macro and microscopical characteristics according to references.

No.	Fungal Taxonomy	References	No.	Fungal Taxonomy	References
1	Dermatophytes and their imperfect and perfect states	Ajello (1977)	**17**	Imperfect fungi	Kendrick (1971)
2	*Chaetomium* species	Ames (1969)	**18**	*Scopulariopsis* species	Morton and Smith (1963)
3	The genera imperfect fungi	Barnett (1972)	**19**	Medical mycology	Moss and Mc Quown (1969)
4	The genera of hyphomycetes	Barron (1977)	**20**	Industrial mycology	Onions *et al*. (1981)
5	Medical mycology in general	Beneke (1957)	**21**	*Penicillium* and its teleomorphic state Talaromyces	Pitt (1979)
6	*Fusarium* species	Booth (1977)	**22**	Common *Penicillium* species	Pitt (1985)
7	*Paecilomyces*	Brown and Smith (1957)	**23**	manual and atlas of *Penicillium*	Ramirez (1982)
8	*Chrysosporium*and some other aleuriosporic Hyphomycetes	Carmichael (1962)	**24**	*Aspergillus* species	Raperand Fennell (1965).
9	Synoptic key to *Aspergillus nidulans* group species and related *Emericella* species	Christensen and Raper (1978)	**25**	*Penicillium* species and related genera	Raperand Thom (1949)
10	*Cladosporium* species	De Vries (1952)	**26**	*Trichoderma* species	Rifai (1969)
11	Fungi in general	DomschandGams (1972)	**27**	*Aspergillus* described since 1965	Samson (1979)
12	Soil fungi	Domsch*et al* . (1980)	**28**	*Alternaria* and *Ulocladium*	Simmons (1967)
13	Dematiaceous Hyphomycetes	Ellis (1971)	**29**	The bitunicate Ascomycetes and their anamorphs	Sivanesan (1984)
14	More Dematiaceous Hyphomycetes	Ells (1976)	**30**	*Chaetomium* species	Skolko and Groves (1953)
15	Identification of pathogenic fungi	Frey *et al* . (1979)	**31**	*Chrysosporium* and allied genera	Van Oorshot (1980)
16	Genera of Ascomycetes	Hanlin (1990)	**32**	Mucorales species	Zycha (1963)

RESULTS AND DISCUSSION

The total number of fungal colonies in dust collected from schools at different sites ofZawia area is presented in Table 1. Glucophilic fungi were represented by 18 genera, isolated from 50 floor dust samples tested on glucose - Czapek's agar at 25°C (Table 1). The most common genera were: *Alternaria*, *Aspergillus*, *Cladosporium*, *Emericella*, *Fusarium*, *Mucor*, *Penicillium*, and *Ulocladium*, which were isolated in highfrequencies of occurrence. Similar results were found, but with different numbers and frequencies, from sediment dust in some Egyptian governorates on plates of glucose – Czapek's – Dextrose agar at 28°C (Abdel-Hafez *et al*. 1990, 1993 and Abdel-Raouf 2000).

Table 1: The total number of fungal colonies in Floor dust on Glucose Czapek's agar.

Fungal genera	Average Total Number
Alternaria	438.36
Aspergillus	683.26
Chladosporium	300
Cunninghamella	67.5
Drechslera	128
Emericella	452
Fusarium	423
Mucor	364.5
Mycosaharella	290
Penicillum	544
Phoma	87.05
Rhizopus	144
Stachybotrys	141.14
Sterile mycelia	69.09
Torula	146.08
Trichoderma	110.90

Ulocladium	471.06
Chaetomium	108.33

Pathogenic fungi belonging to 11 genera were isolated from 50 floor dust samples on Sabouraud dextrose agar (Table 2). *Alternaria, Aphanoascus, Aspergillus, Mucor and Penicillium* genera were recovered in high frequency of occurrence on Sabouraud dextrose agar. Abdel-Raouf (2000) was isolated different species of these genera in high frequency of occurrence on Sabouraud dextrose agar from schools at Qena and Red Sea region and Sohage region, Egypt.

Keratinophilic fungi belonging to 13 genera were isolated from 50 dust samples using Goat Hair Fragments as bait at 25 C (Table 3). Few numbers of keratinophilic fungi had been encountered. The most common genera were: *Alternaria, Aphanoascus, Aspergillus* and *Trichophyton*.These fungal genera were also prevalent in sedimented dust from Egypt (Abdel-Raouf 2000), and in Palestine (Ali-Shtayeh*et al* 1998). Members of *Aspergillus* and *Penicillium* were isolated previously, but with different frequencies, from various types of soils in many parts of the world (El-Said 1995; Anbu*et al* 2004; Ali-Shtayeh*et al.* 2000; Hedayati*et al* 2004; Vidyasagar *et al*.2005). Most of the above genera were previously encountered in different types of soil around the world (El-Said 1995; Abdel-Raouf 2000).

Seasonal variations in the mycoflora of indoor air of classrooms of Al-Shabbani Bin Nasart school at Zawia city were studied over a period of one year (January-December 2006) The average maximum and minimum temperature of the air of Al-Sabbani Bin Nazart elementary school during the experimental period ranged between 20°-36°C and l0°C-26 °C, respectively. The maximum temperature was recorded in summer (June-August) and the minimum in winter (January and December). The average maximum and minimum relative humidity fluctuated between 60 -95 % and 8-24%, respectively. The maximum relative humidity was obtained during October and the minimum during June (Meteorological Station ,Zawia, Libya). The airborne fungi in Al-Sabbani Bin Nasart school at Zawia city was studied over a year (January - December 2006).

Glucophilic fungi genera were isolated from 24 floor dust samples gathered fortnightly during January-December 2006 from classrooms of Al-Sabbani Bin NasartSchool at Zawia city on glucose - Czapek's agar at 25°C. The monthly counts of these fungi irregularly fluctuated (Figure 1) and the highest count was estimated during Spring season, while the lowest count was in Summer season. The most common glucophilic fungal genera in sediment dust were: *Alternaria*, *Aspergillus*, *Cladosporium*, *Cochliobolus*, *Fusarium*, *Mucor*, *Penicillium*, *Rhizopus* and sterile mycelia. The monthly counts of these genera irregularly fluctuated and their peaks were estimated during various months.

Pathogenic and keratinophilic fungi represented by 16 genera were characterized from 24 floor dust samples on Sabouraud dextrose agar and using goat hair fragments as bait at 25°C. The monthly counts of these fungi were irregularly fluctuated and varied giving peaks in January and December and minima during August and June, respectively. The most common pathogenic genera in floor dust (Figure 2) were: *Alternaria, Arthroderma, Aspergillus, Aphanoascus, Candida, Scopulariopsis, Penicillium, Sterile mycelia* and *Syncephalastrum.* Keratinophilic fungi belonging to six genera were characterized from floor dust (Figure 3). These fungi were: *Emericella, Aphanoascus, Mucor, Penicillium, Aspergillus and Cunninghamella*.

Table 2: The total number of fungal colonies in Floor dust on Sabouraud dextrose agar.

Fungal Genera	Average Total Number (n = 50)
Acremonium	74.28
Alternaria	373.33
Aphanoascus	169.78
Aspergillus	412.24
Cladosporium	48
Cochliobolus	69
Drechslera	42
Mucor	158.75
Penicillium	220.48
Rhizopus	80.71
Sterile mycelia	70

Table 3: The total number of fungal colonies in Floor dust using Goat Baiting Technique.

Fungal Genera	Average Total Number(n = 50)
Alternaria	4.33
Aphanoascus	4.70
Aspergillus	4.06
Chaetomium	3.25
Cunninhamalla	1.5
Emericella	2
Fusarium	2
Mucor	2
Mycospharella	2.5
Penicillium	2.37
Rhizopus	3.33
Trichophyton	3.4
Ulocladium	2.5

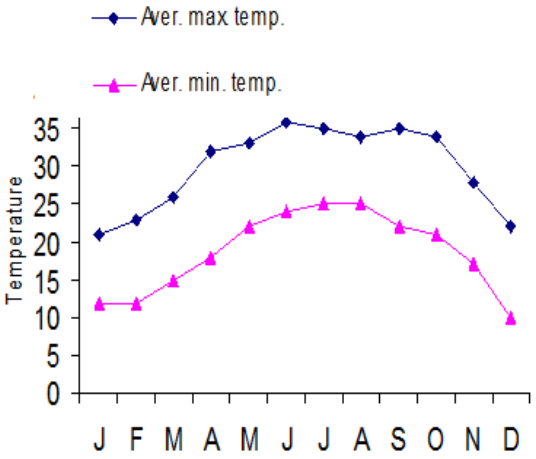
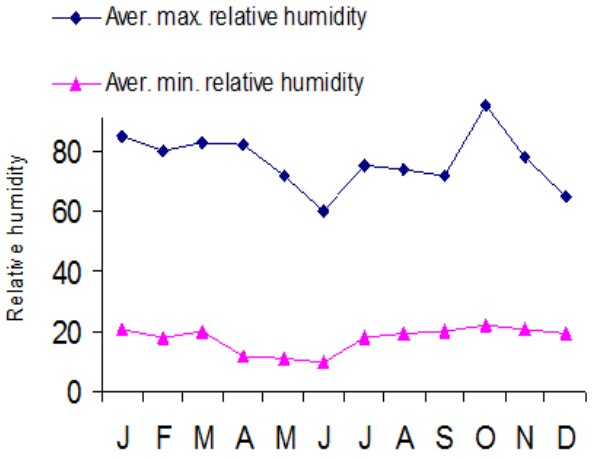


Figure:(A).



Figure(B).

Other opportunistic pathogens were characterized from floor dust such as members of *Aspergillus, Candida, Emericella, Nectria, Penicillium, Scopulariopsis*and others. Their monthly counts were irregularly fluctuated giving peaks during various months. This is almost in accordance with the results obtained previously from sedimented dusts of Egypt by Abdel-Raouf (2000).Also, the above keratinophilic fungi were recovered previously, but with different frequencies, from various types of soils in many parts of the world using animal or human hair fragments as baits (Anbu*et al.*2004;Hedayati *et al.*2004; Kellogg *et al.* 2004; Wu *et al.* 2004; Ho *et al.*2005; Prospero *et al.*2005; Vidyasagar *et al.* 2005; Griffin *et al.*,2006 ; Dale *et al.*2007; Quesada *et al.*2007; John *et al.* 2008).

The airborne fungi in Al-Shabbani Bin Nasart school at Zawia city studied over a year (January–December, 2006) (Figure 3).Glucophilic fungi belonging to 12 genera were isolated on glucose - Czapek's agar at 25°C. The monthly counts of airborne fungi fluctuated irregularly and the peak was found in winter. Previously in Egypt, Moubasher*etal.* (1981) had found maximum numbers of fungal spores present in air at Qena city in autumn, while Moubasher and Moustafa (1974) recorded peaks of Assiut in Spring and Autumn. Recently, Ismail (1990) found that the monthly counts of glucophilic fungi in the atmosphere of Hibis temple (El-Kharga Oasis) were irregularly fluctuated giving peak during October 1988. On the other hand, Abdel-Hafez *etal.* (l993) observed peaks of outdoor airborne fungi at Assiut in April and December 1985. In other areas of the world, peak numbers of airborne fungi have been recorded at different times of the years. For instance, in India, Srivastava *et al.* (1990) found peaks in Winter or Autumn. The most frequently encountered genera were: *Aspergillus, Cochliobolus, Mucor, Mycosphaerella, Penicillium, Phoma, Rhizopus, Stachybotrys* and sterile mycelia. Their counts irregularly fluctuated giving peaks at various months.

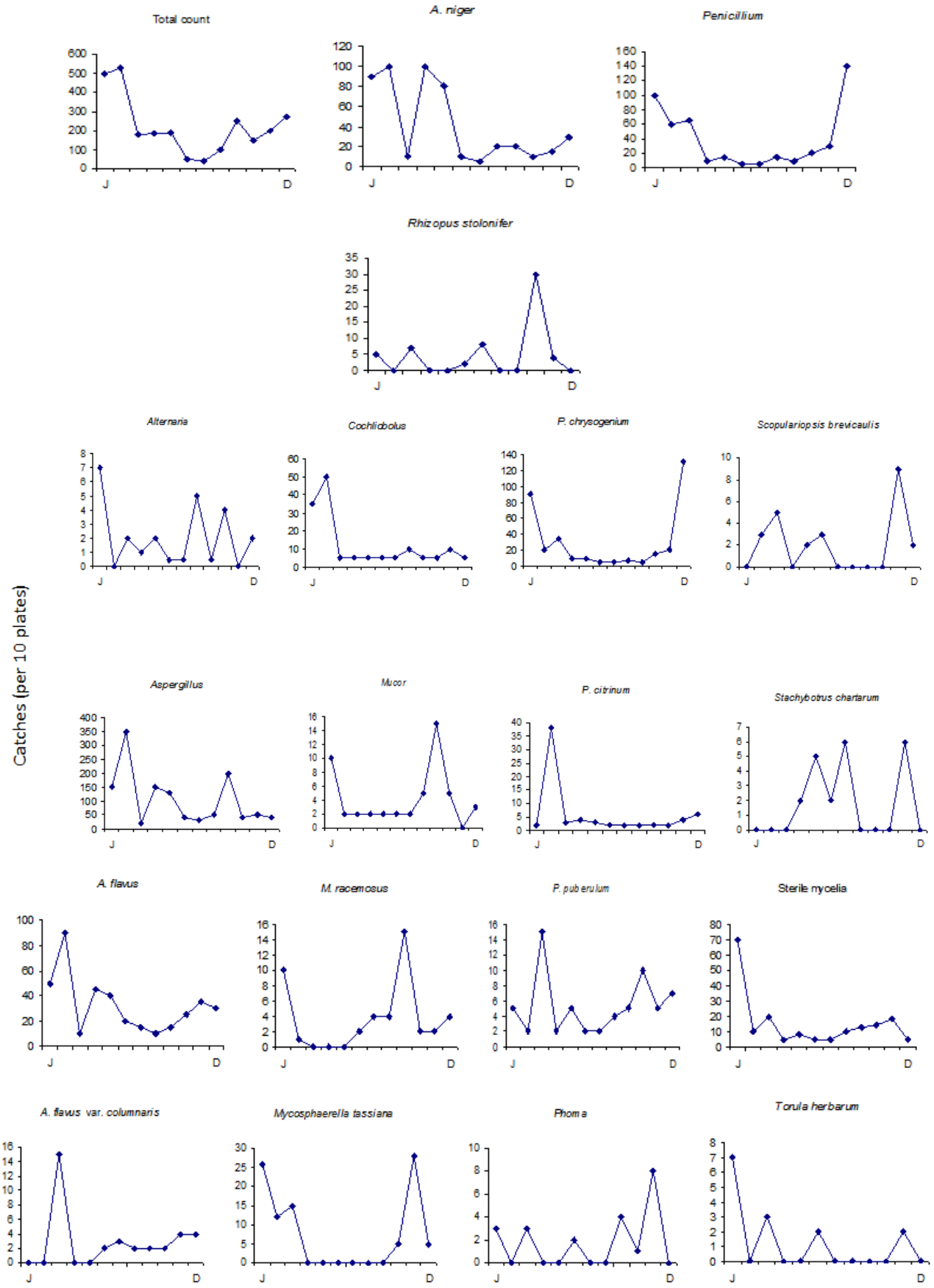


Fig 3: Monthly catches (per 10 plates) of common airborne glucophilicfungi during the period from January December 2006.

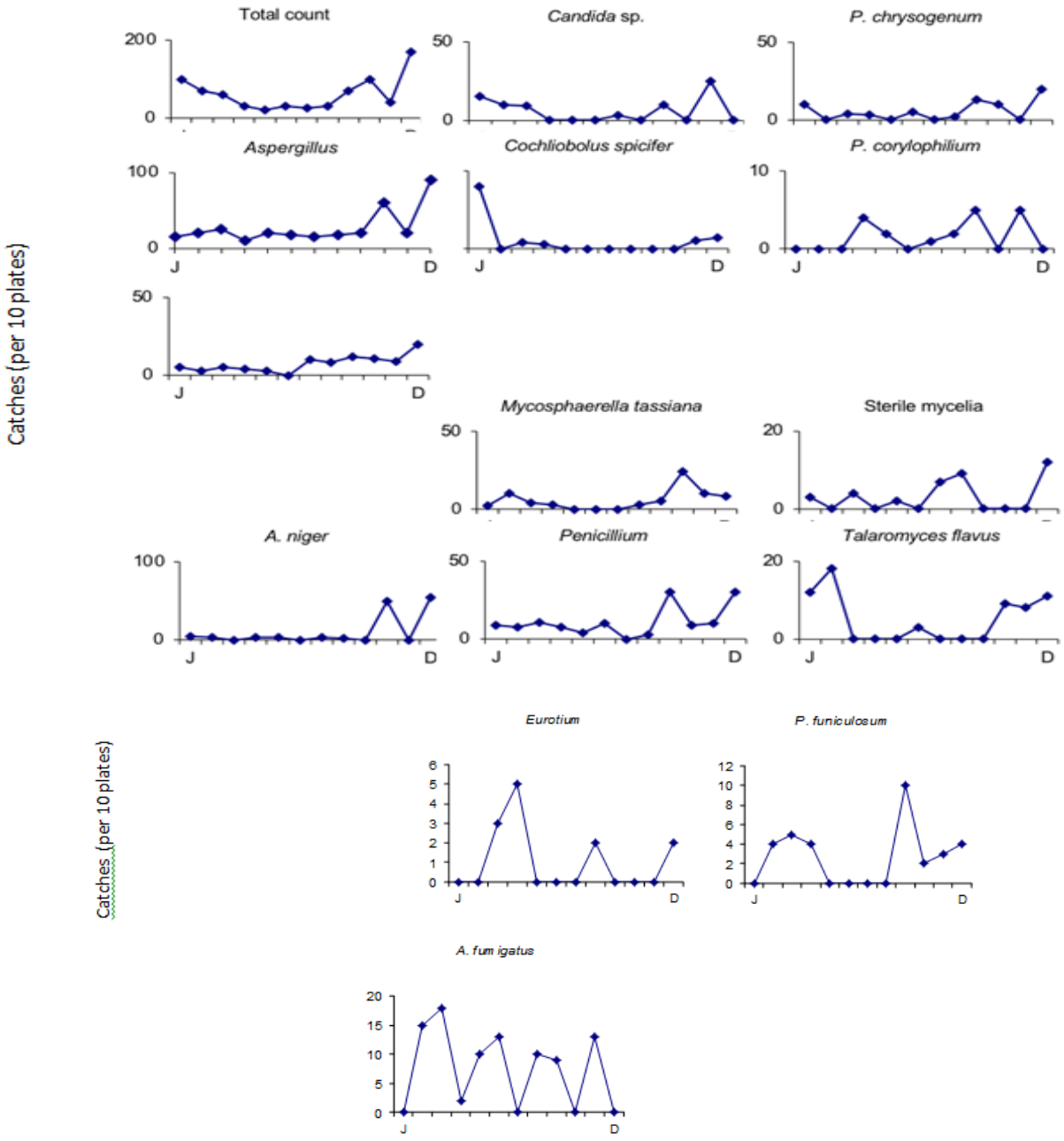


Fig 4: Monthly catches (per 10 plates) of common airborne pathogenic fungi during the periodfrom January-December 2006.

Pathogenic and keratinophilic fungal genera were characterized from the atmosphere of Al-Shabbani Bin Nasart school at Zawia city on plates ofSabouraud dextrose agar (Figure 5) and using goat hair fragments as bait at 25°C (Figure 6).

The monthly counts of these fungi irregularly fluctuated giving peaks during December and April, respectively. Few numbers of keratinophilic fungi had been encountered previously from the air in some parts of the world (Gupta and Cheong 2005; Ho *et al*.2005; Griffin *et al* 2006; Pounder *et al*.2007; Wu *et al*.2007; Celine and Hubert 2008, and Zuraimi and Tham 2008).

Other moulds were also isolated from the air on plates of Sabouraud dextrose agar or using goat hair fragments as bait and these included some members of *Alternaria*, *Aspergillus*, *Candida* sp., *Cladosporium*, *Cunninghamella*, *Cochliobolus*, *Eurotium*, *Mycosphaerella*, sterile mycelia, *Syncephalastrum*, *Talaromyces*, and *Torula*. Several of these fungi have been known to be allerginic (Plutarco 1958; Masatomo*et al*. 1991; De-Wei Li and Chin S. Yang 2004), causing asthma (Beaumont *et al.* 1985), ocular infection (Sehgal *et al*. 1981), hypersensitivity pnenmonitis (Riario Sforza and Androula Marinou, 2017) and pulmonary infection (Treger *et al*. 1985 and Arianayagam *et al*. 1986).

Dermatophytes and closely related fungi were represented by *Alternaria*, *Aphanoascus*, *Aspergillus*, *Chaetomium*, *Cunninhamalla*, *Emericella*, *Fusarium*, *Mucor*, *Mycospharella*, *Penicillium*, *Rhizopus*, *Trichophyton Ulocladium*genera of which *Aphanoascus* was the most reported common genus. The monthly counts of *Aphanoascus* irregularly fluctuated giving peaks during April or December.

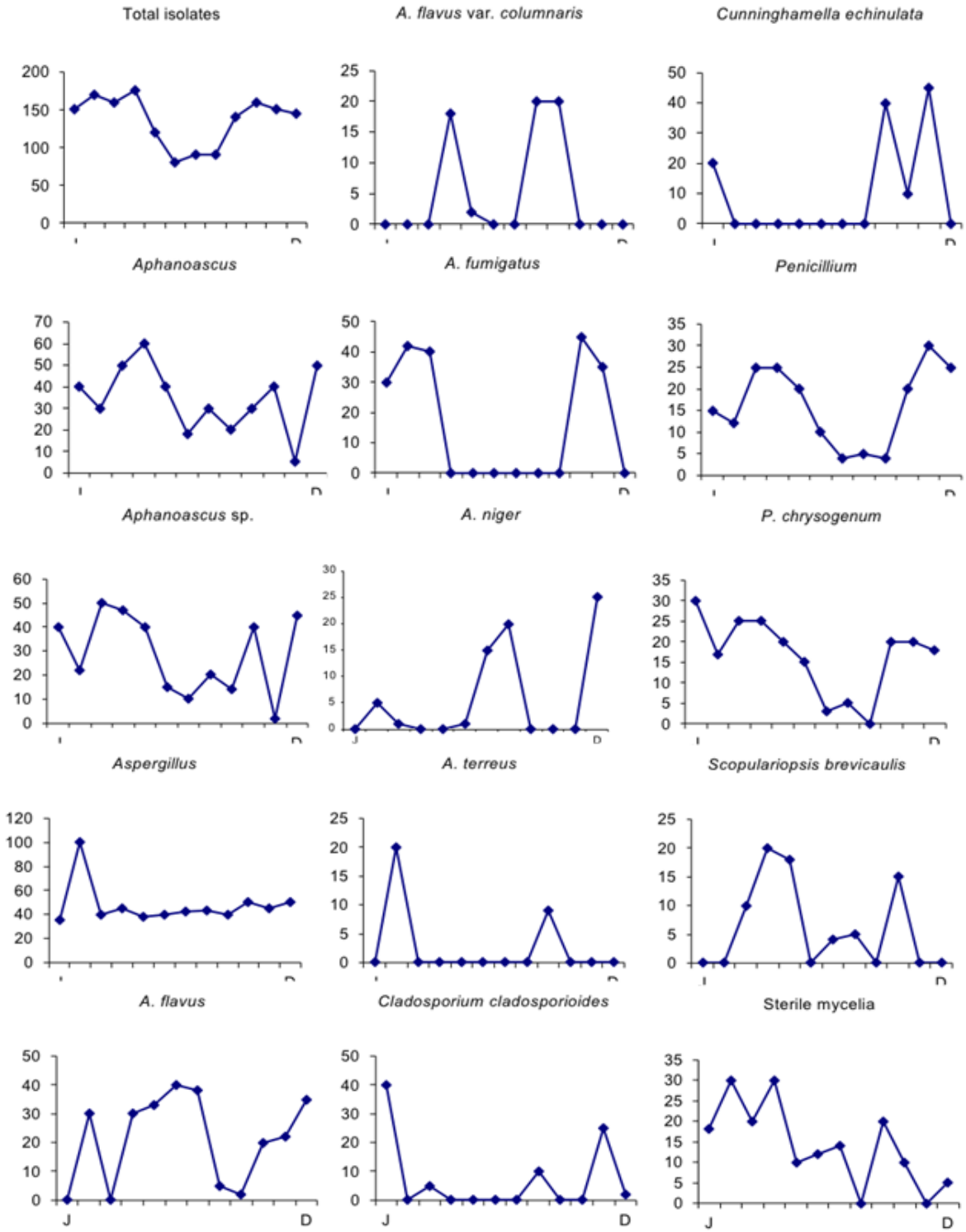
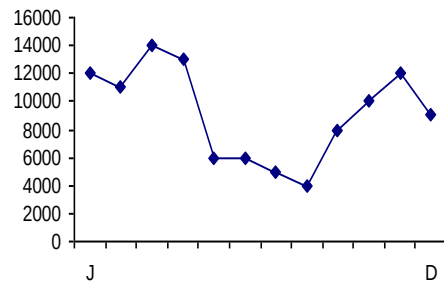
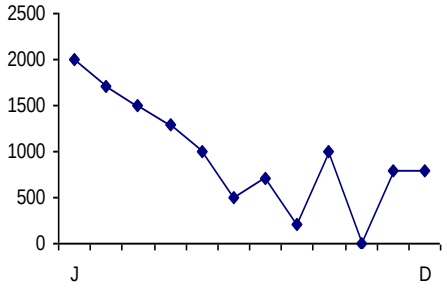


Fig. 5: Monthly catches (per 50 goat hair fragments) of common airborne keratinophilic fungi during the period from January-December 2006.

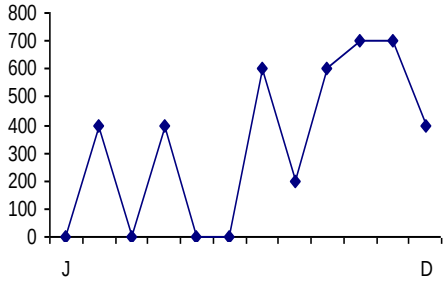
Average total count



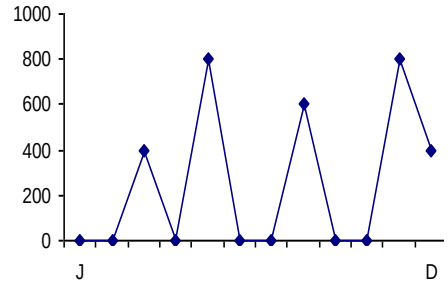
A. flavus



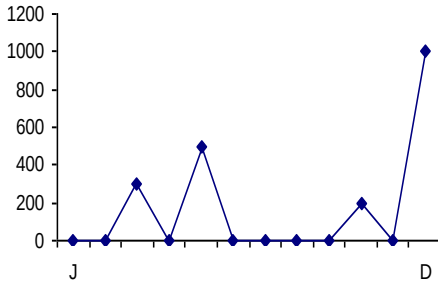
Cladosporium



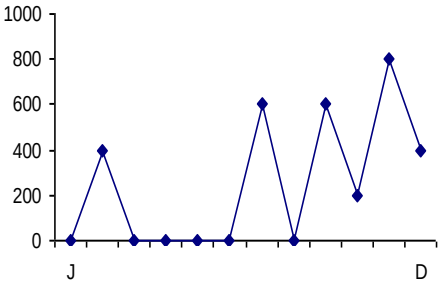
Alternaria



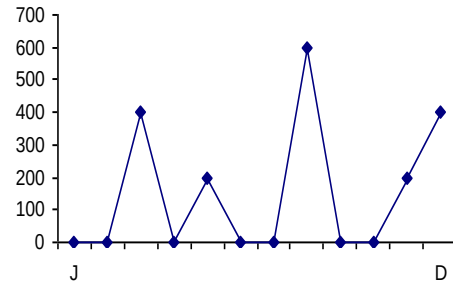
A. flavus var. *columnaris*



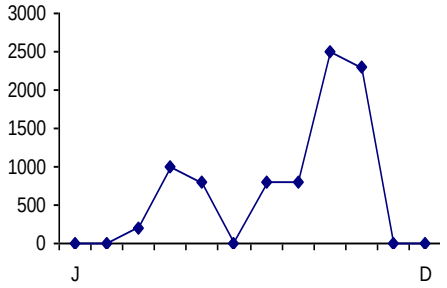
Cladosporium cladosporioides



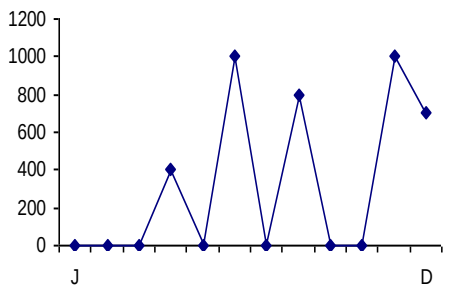
A. alternata



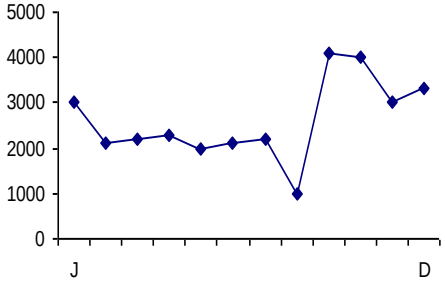
A. fumigatus



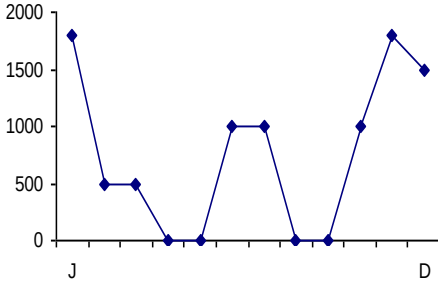
Cochliobolus



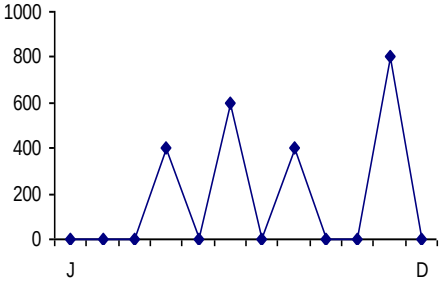
Aspergillus



A. niger



C. spicifer



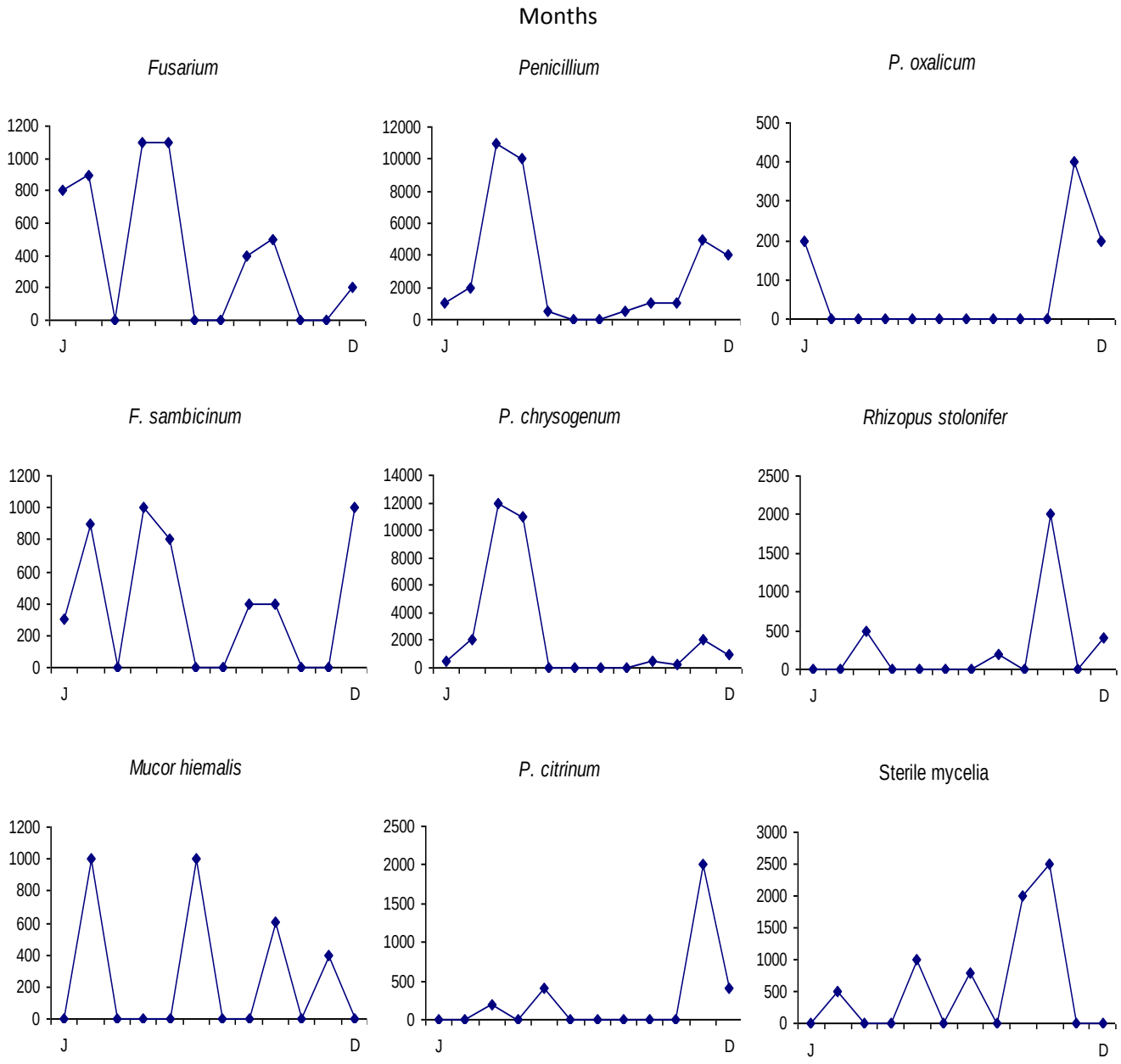


Fig. 6: Monthly total counts 9calculated per g dry dust) of common glucophilic fungi in sedimented dust during the period from January - December 2006.

CONCLUSION

It can be concluded that a various fungal genera were isolated from floor dust, and indoor air samples. The most prevailed fungal genera isolated were *Alternaria, Aspergillus, Penicillium, Mucor, Ulocladium, Emericella*and *Rhizopus*. Overall, the highest number of fungal genera was obtained from floor dust samples. Our results obtained of pathogenic and non-pathogenic fungi in the floor dust and indoor air of Elementary and Preparatory schools were almost basically similar to those fungi reported in many parts of the world but with different numbers, frequencies and months of fungi. Further studies on mycoflora taxa frequently isolated from floor dust and indoor air environment of schools in different governorates of Libya would be interesting. A large number of fungal species still wait proper identification. Different modern sampling techniques can be used to investigate culture ability and total fungal spores and to estimate Colony Forming Units (CFU).

REFERENCES

1. Abdel-Hafez A.I.I., Mazen M.B. and Gala] A.A. Glycophi1ic and cellulose decomposing fungi from soils of Sinai Peninsula, Egypt. Arab Gulf J. Scient. Res, 1999; 8(1): 153-168.
2. Abdel-Hafez S.I.I. and Shoreit A.A.M. Mycotoxins producing fungi and mycoflora of air-dust from Taif, Saudi Arabia. Mycopathologia, 1985; 92: 65-71.
3. Abdel-Hafez S. I.I., Moharram A. M. and Abdel-Sater M. A. Soil fungi of the new valley area, Western desert,

Egypt. Bull. Fac. Sci., Assiut Univ, 2000; 29(2): 255-271.
4. Abdel-Hafez S.I.I., Moubasher A.H. and Barakat A. Keratinophilicfungi and other moulds associated with air-dust particles from Egypt. Folia Microbiol, 1990; 35: 311-325.
5. Abdel-Hafez S.I.I., Maharram A.M. and Ismail M.A. Mycoflora of sedimented dust in the Oases of western desert, Egypt. Abhath Al Yarmouk (in press), 1993.
6. Abdel-Hafez S.I.I., Moubasher A.A.H. and Barakat A. Seasonal variations of fungi of outdoor air and sedimented dust at Assiut region, Upper Egypt. Grana, 1993; 32: 115-121.
7. Abdel-Mallek A.Y., Bagy M.M.K. and Moharram A.M. Fungiof the floor dust in students residential halls of Assiut University, Egypt. J. Bot, 1988; 31(1-3): 69-80.
8. Abdel-Raouf N. M. Studies on keratinophilic fungi of schools in Sohage region. M. Sc., Thesis, Bot. Dept., Fac. Sci., Qena. South Valley Univ., Egypt, 2000.
9. Abu El-Souod S.M. and MoubasherA.H. Mycological comparative study of English and Egyptian soils using different substrates. J. of Ac.Sc, 1981; 1(1):87-108.
10. Acosta F. J. and Roberstad G.W. *Chrysosporium*species as fungal air pollutants. Ann, Allergy, 1979; 42: 11-13.
11. Ajello L. Milestones in the history of medical mycology. The dermatophytes, 1977; 3-11. In Recent Advances, in Medical and Veterinary Mycology, by Kazuo Iwata. Univ. Tokyo Pess.
12. Al-Doory Y. Laboratory medical mycology (P. 410), Lea and FebigerPhiladephiaKimpton Publisher, London, 1980.
13. Ali-Shtayeh M.S. Keratinophilic fungi isolated from children's sandpits in the Nablus area, West Bank of Jordan. Mycopathologia, 1988; 103: 141-146.
14. Ali-Shtayeh M.S. Keratinophilic fungi of school playgrounds in the Nablus area, West Bank of Jordan. Mycopathologia, 1989; 106: 103-108.
15. Ali-Shtayeh M.S. and Asa'd Al-Sheikh B.S. Keratinophilic fungi in floor dust of Arab kindergarten schools in the West Bank of Jordan. Mycopathologia, 1988; 103: 69-73.
16. Ali-Shtayeh M.S. and Arda H.M. Isolation of keratinophilic fungi from floor dust in Arab elementary and preparatory schools in the West Bank of Jordan, Mycopathologia, 1989; 106: 5-11.
17. Ali-Shtayeh M. S., Salameh A.A. M., Abu-Ghdeib and Jamous Rana M. Hair and scalp mycobiota in school children in Nablus area. Mycopathologia, 2000; 150: 127-135.
18. Allermann L., Meyer H.W., Poulsen O.M., Nielsen J.B. and Gyntelberg F. Inflammatory potential of dust from schools and building related symptoms. Occupational and Environmental Medicine, 2003; 60: 5. (about5p).
19. Alteras I. and Lehrer N. Fungal flora in the air of a large hospital. Catellania, 1977; 5(11): 217-219.
20. Altayyar et al, Isolation and Identification of Soil Keratinophilic Fungi from Different Area in South of LibyaI. J. of Appl. Med. And Bio. Res, 2016; 1(1): p 27-32.
21. Ames L.M. A monograph of the chaetomiaceae. Whelon. and Wesley. L.T.D. New York, 1969; PP. 565
22. Anbu P., Hilda A. and Gopinath S. C. B. Keratinophilic fungi of poultry farm and feather dumping soil in Tamil Nadu, India, 2004; 158: 303-309.
23. Andersen A. .Microfungi in beds and their relation to house dust mites. Grana, 1985; 24: 55-59.
24. Arianayagam S., Jayalakshmi P. and Soo-Hoo T. S. Pulmonary aspergilloma. Case reports fromMalaysis.Mycopathologia, 1986 ; 93: 151-153.
25. Asan A., Sen B. and Sarica S. Airborne fungi in urban air of Edirne city (Turkey). Biologia, 2002 ; 7(1): 59 - 68.
26. Asan A., kirgiz T., Sen B., Camur- Elipek B., Guner U. and Guher H. Isolation, identification and seasonal distribution of airborne and waterborne fungi in Terk Lake (Istanbul - Turkey). Journal of Basic Microbiology, 2003 ; 43(2): 83 - 95.
27. Bagy M.M.K. Fungi on the hair of large mammals in Egypt. Mycopathologia, 1986 ; 93: 73-75.
28. Barnett H.L. Illustrated genera of Imperfect fungi, 1972; (PP. 241). Minneapolis: Burgess Publishing.
29. Barron G.L. The genera of Hyphomycetes from soil. Krieger R.E. Publishing company Huntington, New York, 1977; (PP. 364).
30. Beaumont F., Kauffman H.F., Sluiter H.J. and DE Vries K. Sequential sampling of fungal air spores inside and outside the homes of mould-sensitive, asthmatic patients: A search for a relationship to obstructive reactions. Annals of Allergy, 1985; 55(5): 740-746.
31. Beneke E.S. Medical mycology. Burgess pub. Co. Bhatt G.C: The soil microfungi white cedar forests in Ontairo. Can. J. Hot, 1957 ; 38: 333-339.
32. Booth C..*Fusarium* laboratory guide to the identi-fication of the major species, 1977 ; (p. 58). Commonwealth Mycological Institute, Kew, Surrey, England.
33. Brown A.H.S. and Smith G. The genus *Paecilomyces* Bainierand its perfect stage *Byssocheamys* Westting. Trans. Br. Mycol. Sco, 1957 ; 40: 17-89.
34. Boreson J., Dillner A.M. and Peccia J. Correlation bioaerosol Load with pM 2.5 and PMlocfconcentrations : a compaison between natural desrt and urban – fringe aerosols. Atmospheric Environment, 2004 ; 38: 6029 – 6041.
35. Cano J., Guarro J. and Figueras H.J. Some keratinophi1ic fungi from Spain. Mycopathologia, 1987; 100: 163-167.
36. Carmichael J.W. *Chrysosporium* and some others AleruiosporicHypomycetes. Canad. J. Hot, 1962; 40: 1137-1172.
37. Celine M.O. and Hudert T.F. Prevalence of culturable airborne spores of selected allergenic and pathogenic fungi outdoor air Atmospheric Environment, 2008; 42: 4355-4368.

38. Christensen M. and Raper K.B. Synoptic key to *Aspergillusnidulans* group species and related *Emericella*species. Trans. Br. Mycol. Soc, 1978; 71: 177-191.
39. Curtis L., Rea W., Smith W.P., Fenyves E. and Pan Y. Adverse health effects of outdoor air pollutants .Evironment International, 2006; 32: 815 –830.
40. Czarnecki B. &Bialasiewicz D. Fungi as a component of the aerosphere in the H. Arctowski Polar Station and its vicinity (King George Island, South Shetland, Islands). Polish Polar Research, 1987; 8(2): 153-158.
41. Dale W.G., NilgunK.,MustafaK.,MikeA.G.,Timothy C.B. and Eugene A.S. Airborne desert dust and aeromicrobiology over the Turkish Mediterranean coastline. Atmospheric Environment, 2007; 41: 4050-4062.
42. Della Franca P. and Caretta G. Keratinophilic fungi isolated from the air at Pavia. Mycopathologia, 1984; 85: 65-68.
43. Deshmukh S. K. .Keratinophilic fungi isolated from soils of Mumbai, India. Mycopathologia, 1999; 146: 115-116.
44. Deshmukh S. K. , Agrawal S.C. and Jain P.C. Isolation of dermatophytes and other keratinophilic fungi from soils of Mysore (India). Mycoses, 2000; 43(1-2): 55-57.
45. De-Vries G.A. Contribution to the knowledge of the genus *Cladosporium* Link ex. Fr. Vitgeveriy and Druk- kerij, Hollandia Press: Baarn, 1952.
46. De-Wei Li and Chin S. Yang Fungal Contamination as a Major Contributor to Sick Building Syndrome, Advances In Applied Microbiology, 2004. DOI: 10.1016/S0065-2164(04)55002-5
47. Domsch K.H. and Gams W. Fungi in agricultural soils, 1972 ; (p. 290). Puplished by Longman.
48. Domsch K.H., Gams W. and Anderson T. Compendium of soil fungi, 1980 ; (PP. 859). Acad. Press, London.
49. Douwes J., Van S.B., Doekes G., Van L. F ., Wijnands L. , Van S.R., Verhoeff A. and Brunekreef B. Fungal extracellular polysaccharides in house dust as a marker for exposure to fungi: relations with culturable fungi, reported home dampness, and respiratory symptoms. J.Allergy Chin. Immun, 1999; 103: 494-500.
50. Ellis M.B. Dematiaceous Hyphomycetes, 1971; (PP. 608). Commonwealth Mycological Institute, Kew, Surrey, England.
51. Ellis M.B. More Dematiaceous Hyphomycetes, 1976; (pp.507). Commonwealth mycological Institute, Kew, Surrey-England.
52. EL – Said A.H.M. Studies on soil mycoflora of Bahreen. Microbiol, 1994; 149: 263 – 269.
53. El-Said A. H. M. Keratinophilic fungi in soils of Yemen Arab Republic. J. Islam. Acad. Sci, 1995; 8(4): 151-154.
54. El-Said, A. H., Sohair, T. H., & El-Hadi, A. G. Fungi associated with the hairs of goat and sheep in libya. *Mycobiology*, 2009; *37*(2): 82–88. https://doi.org/10.4489/MYCO.2009.37.2.082
55. Euan P.B., Martin K. and Geoffrey M.G. Geomycology: Fungi in mineral substrata. Mycologist, 2003; 17: 98-107.
56. Frey D., Oldfield R.J. and Bridger R.C. A colour atlas of pathogenic fungi. Wolfe Medical Publications LTd.Smeets-Weert, Holland, 1979; (pp. 168).
57. Gherbawy Y. A. M. H. Keratinolytic and keratinophilic fungi of graveyard's soil and air in the city of Qena and their response to garlic extract and onion oil treatments. Egypt. J. Microbiol, 1999 ; 34(1): 1-21.
58. Gravesen S. Identification and prevalence of culturable mesophilic microfungi in house dust from 100 Danish homes: Comparison between airborne and dust-bound fungi. Allergy, 1978 ; 33: 268-272.
59. Griffin D.W., Garrison V.H., Herman J.R. and Shinn E.A. African desert dust in the Caribbean atomosphere microbiology and pudlichealth .Aerobiologia, 2001; 14(3): 203-213.
60. Griffin D.W., kellogg C.A., Garrison V.H., Lisle J.T., Borden T.C and Shinn E.A. African dust in the Caribbean atmosphere .Aerobiologia, 2003 ; 19 (3-4): 143-157.
61. Griffin D.W., Westphal D.L. and Gray M.A. Airborne microorganisms in the African desert dust corridor over the mid-Atlantic ridge, Ocean Drilling Program.Leg 209. Aerobiologia, 2006; 22(3): 211-226.
62. Grozier W. J. The prevalence of geophilic dermato-phytes in soils of the Illawarra area of South Wales. Australian Journal of Dermatology, 1980.
63. Guinea J.,PelaezT.,Alcala L. and Bouza E. Outdoor environmental level of *Aspergillus* spp. Conidia over a wide geographical area.Medical Mycology, 2006 ; 44: 349-356.
64. Gupta A. and Cheong K.W.D. Airborne particulate matter concentrations at different heights in a residential building in Singapore In: Proceedings of Indoor Air Beijing, China, 2005; .5: 1748 –1753.
65. HanlinR.T. Illustrated Genera of Ascomycetes. The American Phytopathological Society (APS) press, 1990; (PP. 263).
66. Hedayati M.T., Mohseni-Bandpi A. and Moradi S. A survey on the pathogenic fungi in soil samples of potted plants fron Sari hospitals, Iran. Journal of Hospital In fection, 2004; 58: 59-62.
67. Hemida S. K. Thermophilic and thermotolerant fungi isolated from cultivated and desert soils, exposed continuously to cement dust particles in Egypt. Zentralbl. Mikrobiol, 1992; 147: 277-281.
68. Hollins P.D., kettewell P.S., Atkinson M.D., Stephenson D.B., Corden J.M., Millington W.M. and Mullins J. Relationships between airborne fungal spore concentrations of *Cladosporium* and the summer climate at two sites in Britain. International Journal of Biometeorology, 2004; 48: 137-141.
69. Hiromi OHARA et al. Effects of Exposure to Male Goat Hair Extracts on Luteinizing Hormone Secretion and Neuronal Activation in Seasonally

Anestrous Ewes. J. Vet. Med. Sci, 2014; 76(10): 1329-1337.
70. Ismail M.A. Studies on the mycoflora of air, air-dust and pollen grains in the Oases of western desert, Egypt. Ph. D. Thesis, Bot. Dept., Fac. Sci., Assiut Univ.Egypt, 1990; (PP. 351).
71. Jayne L.J., Gailw T.W., Paul M. W. and Anthony J. Consumption of mycorhizal and saprophytic fungi by Collembola in grassland soils. Soil Biology &Biochemistry, 2007; 39: 2594 -2602.
72. Jackson M. L. Soil chemical analysis constable and Co. London, 1958.
73. John L., Anders J., Soren E.L., Lars H.H., Iver J. and Paul H.k. Population performance of collembolans feeding on soil fungi from different ecological niches :Soil Biology & Biochemistry, 2008 ; 40: 360-369 .
74. Javier J.R., Isabel I. and Victoria J. Variation assessment of airborne *Alternaria* and *Cladolisporium*spores at different bioclimatical conditions. Mycol. Res, 2005 ; 109(4): 497 – 207.
75. Johnson L.F. and Curl E.A. Method for research on ecology of soil-borne pathogens, Burgress publ. Co. Minneapolis, 1972; 247.
76. Jussila J., komulainen H., kosma V.M., Nevalainen A., Pelkonen J. and Hirvonen M.R. Spores of *Aspergillus versicolor* isolated from indoor lungs Inhal .Toxicol, 2002 ; 14: 1216 – 1277.
77. Karl R. and Iain M.Y. Interactions between soil structure and fungi. Mycologist, 2004; 18: 52-59.
78. Kendrick B. Taxonomy of fungi imperfecti University of Toronto, 1971.
79. Kellogg C.A., Griffin D.W., Garrison V.H., Peak K.K., Royall N., Smith R.R. and Shinn E.A. Characterization of aerosolized bacteria and fungi from desert dust events in Mali, West Africa. Aerobiologia, 2004; 20(2): 99-110.
80. Kuhn D.M. and Ghannoum M.A. Indoor mold, toxigenic fungi and *Stachybotryschartarum* : infections disease per spective. Clinical Microbiology Reviews, 2003; 16: 144-172.
81. Kushwala R. K.S. The genus *Chrysosporium*, its physiology and biotechnological potential in Biology of dermatophytes and other keratinophilic fungi. RevistaIberoamericana de Micologia, Bilbao, 2000; (pp. 66-76).
82. Lalley J.S. and Viles H.A. *Terricolous lichens* in the northern Namib desert of Namibia: distribution and community composition. The Lichenologist, 2005; 37(1): 77-91.
83. Larone DH Medically Important Fungi (A Guide to Identification). Am. Soc. of Mic. Washington, D.C, 1987.
84. Leese K.E., Cole E.C., Mall R.M. and Berry M.A. Measurement of airborne and floor dusts in a non problem building. Am. Ind. Hyg. Assoc, 1997; 58: 432-438.
85. Lentner C. Geigy Scientific Tables. Vol. 6. CIBA-GEIGY Limited, Basel, Medical and Pharmaceutical Information. New Jersey. USA, 1991.
86. Liao C.M., Luow C., Chen S.C., Chen J.W. and Liang H.M., Temporal / seasonal variations of size. dependent airhorne fungi indooor / outdoor relatinships for a wind on induced naturally ventilated airspace. Atmos Environ, 2004; 38 (26): 4415 – 4419.
87. Maria C.,Capetti E. and Bonescu O. The relationship between air-borne fungal spores and Dermatophagoidespeteronyssinum in house dust. Rev Roum Med. Interne, 1981; 19(1): 73-78.
88. Masatomo M., Murakami G., Adachi Y., Kayahara M., Okada T.,Arakawa R., Kaawai K. and Igaroshi T. Immunochemical quantification of the air borne chironomid allergens.JPNJ.Allergol, 1991; 40(1): 51-59.
89. Mercantini R., Marsella R., Lambiase L. and Fulvi F. Isolation of keratinophilic fungi from floors in Roman primary schools. Mycopathologia, 1983; 82: 115-120.
90. MercantiniR. ,Marsella R. , Lambiase L. and Belardi M. Isolation ofkeratinophilic fungi from floors in Roman kindergarten and secondary schools. Mycopathologia, 1986; 94: 109-115.
91. Mercantini R., Marsella R. and Cervellati M.C. .Keratinophilic fungi isolated from antarctic soil. Mycopathologia, 1989; 106: 47-52.
92. Meyling N. and Eilenberg J. Occurrence and distribution of soil borne entomopathogenic fungi within a single organic agroecosystem .Agric .Ecosyst .Environ, 2006; 113: 336-341.
93. Morton F.J. and Smith G. The genera *Scopulariopsis*Bainier, *Microascus*zukal and *Doratomyces* Corda. Mycological papers, 1963; 8: 1-96. Commonwealth Mycological Institute, Kew, Surrey, England.
94. Moss E.S. and McquownA.L. Atlas of medical mycology.3 rd edition. The Williams and Wikins Company. Baltimore, 1969; (pp.366).
95. Moubasher A.H. and Moustafa A.F. Air-borne fungi at Assiut, Egypt. J. Bot, 1974; 17: 135-149.
96. Moubasher A.H., Abdel-Fattah H.A. and Swelim M.A. Studies on air-borne fungi at Qena. I-Seasonal fluc-tuations. Z. Allg. Mikrobiol, 1981; 21(3): 247-253.
97. MoubasherA.M., Abdel-Hafez S.I.I. and El-Maghraby O.M.O. Studies on soil mycoflora of Wadi Birn El-Ain, Eastern Desert, Egypt. Cryptogamie, Mycologie, 1985; 6: 129-143.
98. Moubasher A.H., Abdel-Hafez S.I.I., Shoreit A.A.M. and Ismael M.A. Keratinophilic and other fungi isolated from combine harvester wheat and sorghum dusts and from the atmosphere of winnow sites in Egypt. Folia Microbiol, 1990; 35: 298-310.
99. Murray P.R., Rosenthal K.S. and Pfaller M.A. Medical Microbiology. Elsevier Mosby, 2005.
100. Onions A.H.S., Allsop D. and EgginsH.O.W.(1981). Smith's introduction to industrial mycology.Edward Arnold (Publisher) Ltd., London (pp.398). Papavassilion J.T. and Bartzokas C.A. The atmospheric fungal flora of the Athens metropolitan area. Mycopathologia, 1975; 57: 31-34.

101. Piper C.S.: Soil and plant analysis. A laboratory manual of method for the examination of soil and determination of the inorganic substituents of plants. Inter. Pub. Inc. New York, 1955.
102. Picco A.M. and Rodolfi M. Airborne fungi as biocontaminants at wo Milan underground stations. International Biodeterioration and Biodegradation, 2000; 45: 43-47.
103. Pitt J.I. The genus *Penicillium* and its teleomorphicstates *Eupenicillium* and *Talaromyces*, 1979; (PP. 634). Acad. Press.
104. Pitt J.I. A laboratory guide to common *Penicillium* species, 1985; (PP. 184). Commonwealth Scientific And Industrial Research Organization Division of Food Research.
105. Plutarco N. Etiological agents of respiratory allergy in tropical countries of Central and South America. J. Allergy, 1958 ; 29: 362-374.
106. Pounder J.I., Simmon K. E., Barton C.A., Hohmann S.L., Brandt M .E. and petti C.A. Discovering potentoal pathogens among fungi identified as nonsporulating molds. Journal of Clinical Microbiology, 2007; 45: 568 –571 .
107. Prospero J.M., Blades E., Mathison G. and Naidu R. Interhemisheric transport of viable fungi and bacteria from Africa to the caribbean with soil dust .Aerobiologia, 2005; 21: 1-19 .
108. Quesada M., Navas C.J.A., Maranhao E.A.A., Ortiz U.A. and Santiago A. C. Factors affecting the occurrence and distribution of entomopathogenic fungi in natural and cultivated soils.Mycol.Res, 2007; 111: 947-966.
109. Ramirez C. Manual and Atlas Penicillia. Elsevier Biomedical Press, Amsterdam, The Netherlands, 1982 ; (pps. 874).
110. Raper K.B. and Fennell D.J. The genus *Aspergillus*, 1965; (p.686). Williams and Wilkins Baltimore, U.S.A.
111. R. Rathish, P. Madhanraj and G.S.Senthilkumar. DETERMINATION OF PHYSICOCHEMIAL PARAMETERS AND DIVERSITY PATTERN OF THREE DIFFERENT PLACES OF KANYAKUMARI DISTRICT. Int.J.Adv. Res, 2017; 5(1): 1036-1039.
112. Raper K.B. and Thom C. A manual of the Penicillia, 1949; (p.875). Wilkins, Baltmore, U.S.A.
113. Rao C.K., Cox-Ganser J.M., Chew G.L., Doekes G. and White S. Use of surrogate markers of biological agents in air and settled dust samples to evaluate a water – damaged hospital indoor Air, 2005; 15 Suppl9: 89-97.
114. Rifai M.A. A revision of the genus *Trichoderma*. Mycological papers, 1969; 116: 1-55.
115. Rijckaert G.F., Van Bronswijk J.E.M.H. and Linskens H.F. House-dust community (fungi-mites) in different climatic regions. Oecologia, 1981; 84(2): 183-185.
116. Riario Sforza and AndroulaMarinou Hypersensitivity Pneumonitis: a complex lung disease. Clin Mol Allergy, 2017; 15: 6. DOI 10.1186/s12948-017-0062-7.
117. Samson R.A. A compilation of the Aspergilli described since, 1965. Studies in Mycology 18 (PP. 40).
118. Sehgal S.C., Dhawan S., Chhiber S., Sharma M. and Talwar P. Frequency and significance of fungal isolations from conjunctival sac and their role in oculor infections. Mycopathologia, 1981; 73: 17-19.
119. Shukia P., Shukla C. B., Kango N. and Shukla A. Isolation and characterization of a dermatophyte, *Microsporiumgypseum* from poultry farm soils of Rewa (Madhya Pradesh), India .J. Bio. Sci, 2003; 6(6): 622-625.
120. Shelton B.G., Kirkand K.H. , Flanders W.D. and Morris G.K. Profiles of airborne fungi in buildings and outdoor environments in the United States . Applied and Environmental Microbiology, 2002; 68: 1743-1753.
121. Simmons E.G. Typification of *Alternaria*,*Stemphlium*and *Ulocladium*. Mycologia, 1967; 59: 67-92.
122. Sivanesan A. The bitunicate Ascomycetes and their anamorphs, 1984 ; (PP 701). Strauss and Cramer GmbH, Geymany.
123. Skolko A.J. and Groves J.W. VII-*Chaetomium*. Canad.J. Bot, 1953; 31: 779-322.
124. Smith N.R. and Dawson V.I. The bacteriostatic action of rose-bengal in media used for the plate count of soil fungi.Soil Sci, 1944; 58: 467-471.
125. Srivastava L., Srivastava J. and Srivastava N. Studies on fungal air-spora at Gorakhpur (Uttar Pradesh, India):I .District hospital compus. Vegetos, 1990; 3(2): 202-211.
126. Snezana J., Andrea F.K., Thomas G., Bijan K., Bernhardt L., Valentina M., Isolde P., Karl H.S., Monika S., Ursla W., Lris Z. and Michael S. Indoor fungi levels in homes of children with and without allergy history .Int .J.hgy .Environment Health, 2004; 207: 369- 378.
127. Treger T.R., Visscher D.W., Bartlett M.S. and Smith J.W. Diagnosis of pulmonary infection caused by *Aspergillus:*Jsefulness of respiratory cultures. J. Inf, 1985; 152: 572-576.
128. Ulfig K., Gene J. and GuarroJ. Studies on keratinophilicfungi. VI. A new *Arthropsis*(fungiimperfecti) from marine sediments. Volume LIV, 1995; pp.281-286.
129. UlfigK.,Terakowski M., Plaza G.G. and Kosarewicz O. Keratinolytic fungi in sewage sludge. Mycopathologia, 1996; 136: 41-46.
130. Ulfig K., Guarro J., Gano J., Gene J, Vidal P. and Figueras MJ: General assessment of the occurrence of keratinolytic fungi in river and marine beach sediments of Catalonian water (Spain). Water Air, & Soil Pollution, 1997; 99(3-4): 275-287.
131. Ulfig K., Plaza G., Terakowski M. and Staszewski T. A study of keratinolytic in mountain sediments. I. Hair-baiting data. Roczn. PZH, 1998 ; 49: 469-479.
132. Ulfig K., Guarro J., Cano J., Vidal P., Figueras M. J. and Lukasik W. The occurrence of keratinolytic fungi is sediments of the river. Tordera (Spain). FEMS Microbiology Ecology, 1999; 22: 111-117.

133. Vanbreuseghem R. Biological technique for the isolation of dermatophytes from soil. Ann. Soc. Bellge. Med. Trop, 1952; 32: 173.
134. Van Oorschot C.A.N. A revision of *Chrysosporium* and allied genera. Studies in Mycology, 1980; 20: 1-87.
135. Verhoeff A.P., Van W.J.H., Reenen H.E.S., Samson R.A., Van S.R.T. and BrunekreefB. (Fungel propagules in house dust. II. Relation with residential characteristics and respiratory symptoms. Allergy, 1994; 49: 540-547.
136. Veronika A., Joachim S., Renate R. and Christian S. In vitro degradation of equine keratin by dermatophytes and other kerainophilicfungi. Veterinary Microbiology, 2006 ; 114: 352-358.
137. Vidyasagar G. M., Narayan H. and Shivkumar D. .Keratinophilic fungi isolated from hospital dust and soils of Puplic places at Gulbarga, India. Mycopathologia, 2005; 159: 13-21.
138. WongN.H. and Huang B. Comparative study of the indoor air quality of naturally ventilated and air-conditioned bed-rooms of residential building in Singapore. Building and Environment, 2004; 39: 1115-1123.
139. Woodfolk JA, Commins SP, Schuyler AJ, Erwin EA, Platts-Mills TA. Allergens, sources, particles, and molecules: Why do we make IgE responses? Allergol Int, 2015; 64(4): 295-303. doi: 10.1016/j.alit.2015.06.001. Epub 2015 Jul 15. PMID: 26433525; PMCID: PMC5406225.
140. Wu P.C., Su H.J. and Lon C.K. Characteristics of in door an outdoor airborne fungi at suburban and urban homes in two seasons. Sci Total Environ, 2000; 253(1-3): 111-118.
141. Wu P.C., Tsai J.C., Li F.C., Lung S.C. and Su H.J. Increased levels of ambient fungal spores in Taiwan are associated with dust events from China. Atmospheric Environment, 2004; 38: 4849-4886.
142. Wu Y.H., Chan C.C., Rao C.Y.,LeeC.T.,HsuH.H.,Chiu Y.H. and Chao H.J. Characteristics, determinants and spatial variations of ambient fungal levels in the subtropical Taipei metropolis. Atmospheric Environment, 2007 ; 41: 2500-2509.
143. Wurtz H., Sigsgaard T., Valbjon O., Doekes G. and Meyer H.W. Dustfall collector – a simple passive tool for Long – term collection of airborne dust : a project under the Danish mould in buil ding, program (DAMIB) In door Air, 2005; 15 (Suppl.9): 33-40.
144. Yeo H.G. and Kim J.H. SPM and fungal spores in the ambient air of West Korea during the Asian dust (yellow sand) period. Atmospheric Environment, 2002; 36(35): 5437-5442
145. Youssef K. H. A., Youssef Y.A. and Youssef H.H. Fungi and thermophilic actinomycetes in the air of the Cancer Institute hospital. Ain shams Sci. Bull, 1980; 22(A,B): 75-88.
146. ZuraimiM.S. and Tham K.W. Indoor air quality and its determinants is tropical child care centers. Atmospheric Environment, 2008; 42 : 2225–2239.
147. Zycha H. Mucorineae VonKryptogamenflora Der Mark Brandenburg. Band VI a: Pilze II Verlag Von. J.Cramer, Weinheim. Johnson reprint corporation, NewYork, 1963; (PP. 264).