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Distribution of Fungi in the Sandy Soil of Egyptian Beaches

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The mycobiota of the sandy soil of Egyptian beaches was investigated in thirty six sand samples collected from nine different localities in Egypt. The filamentous fungi were identified and assigned to thirty one genera and fifty one species. Greater populations as well as a wider spectrum range of fungal genera and species were obtained in sandy soil of Alexandria beach while Balteem beach was the poorest one. The total count of the genus or species was not depended upon cases of isolation. Most of the genera detected belonged to the Deuteromycotina with fewer proportions belonging to the Ascomycotina and Zygomycotina. The genera of highest incidence and their respective numbers of species were: *Penicillium* (35.72%, 6 species) and *Aspergillus* (30.28%, 16 species). The species which showed the highest incidence in all cases was *P. chrysogenum*, followed by *P. citrinum*, *A. flavus*, *Chaetomium murorum* and *Trichoderma viride*. A few number of other genera and species were also detected.

KEYWORDS: Distribution, Egyptian beaches, Fungal population, Sandy soil

Fungi are distributed throughout nature and dispersion persists the species to be in equilibrium with one another, and with other organisms in their habitats. Many of the fungi can be isolated from the air, with their incidence varying according to geographic, environmental or bioclimatic factors such as collection site, time of the years relative air humidity, rainfall, wind speed and proximity to the source where they were produced. Consequently, these factors determine the quality and quantity of the mycobiota existing in aquatic and terrestrial ecosystems (Gambale *et al.*, 1983; Meyer *et al.*, 1983; Oliveira *et al.*, 1993; Tan *et al.*, 1992). Kohlmeyer and Kohlmeyer (1971) and Tan (1985), among others, recorded exclusively marine fungi, but the soil is the typical reservoir of anemophilous fungi (Hawksworth, 1991).

Studies carried out at the interface of marine and terrestrial ecosystems by Bergen and Wagner-Merner (1977), Dabrowa *et al.* (1964), Kishimoto and Baker (1969) and Ristanovic and Miller (1969) refer almost exclusively to fungi representing the soil community, perhaps because this is the most numerous and is favored by greater facility of formation, survival and dispersal of the light propagula of its representative. Beach sand, where fungal conidia are viable under certain specific conditions, can play an important role as a vehicle in the transmission of the infectious processes (Larrondo and Calvo, 1989).

An evaluation of the mycological quality of the sand beaches of the Lisbaa and Vale do Tejo coastal area in Portungal was undertaken in May-October, 1964. The Keratinolytic fungi, yeasts, potential pathogenic and allergic and/or environmental saprophytic fungi were analyzed. The data showed good and satisfactory quality of the sand beaches for the genus *Candida*. The results indicated that the allergic and/or environmental saprophytic fungi were the most common in sand beaches. It is suggested that *Scopulariopsis* and *Candida* could be used as specific indicator organisms of sand beaches quality. A new quality objective is introduced that will contribute to improving sand beaches quality (Mendes *et al.*, 1998). Mendes *et al.* (1993) reported that beach sand showed a higher level of microbiological contamination than sea water. The level of contamination may be related to direct or indirect microbial contamination from beach users.

The predominance of subdivisions: Deuteromycotina, Ascomycotina and Zygomycotina has been observed in coastal soils of California by Dabrowa *et al.* (1964), in coastal soils of Florida by Bergen and Wagner-Merner (1977) and in coastal soils of Hawaii by Kishimoto and Baker (1969). In studies carried out on the water and sand of the Boa Viagem beach, Becife, Brazil, Pinto *et al.* (1992) detected 115 species while Sarquis and Oliveira (1996) isolated 170 species from sandy soil of Ipanema beach. These results showed a much higher species diversity than reported by Moustafa and Al-Musallam (1975) in Kuwait and Bergen and Wagner-Merner (1977) in the U.S.A. These variations may probably be attributed to bioclimatic factors acting on, and/or interfering with, fungal survival and dispersal. It is also possible that the frequency of bathers who carry propagula and leave substance, might create conditions favourable to fungal development, as suggested by Bergen and Wagner-Merner (1977).

The aim of this study is to determine the presence and density of viable fungal conidia in samples of sands

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Table 1. Mean total count of each genus and species isolated from all localities investigated (calculated per mg soil) as well as frequency of occurrence

Fungal species	Mean total count	Frequency (%)	Remark*
Alternaria alternata (Fr.) Keissler	0.12	25	M
Aspergillus	23.82	100	H
A. alutaceus Berkeley and Curtis	0.75	38.89	M
A. awamori Nakazawa	0.01	2.78	R
A. candidus Link.	0.09	11.11	L
A. flavus Link ex. Fries	7.70	97.22	H
A. foetidus (Naka.) Thom and Raper	0.02	2.78	R
A. fumigatus Fresenius.	0.31	11.11	L
A. gluacus Link.	0.58	50	M
A. janus Raper and Thom	0.88	36	M
A. niger Van Tieghem	4.82	94	H
A. sulphureus (Fresenius) Thom and Church	0.04	2.78	R
A. sydowii (Bain. and Sart.) Thom and Church.	7.35	86.11	H
A. terreus Thom	1.03	75	H
A. thomii Smith	0.21	19.44	L
A. ustus (Bain.) Thom and Church	0.01	2.78	R
A. versicolor (Vuill.) Tiraboschi	0.09	22.22	L
A. wentii Wehmer	0.11	13.89	L
Botryotrichum piluliferum Sacc and March.	0.26	44.44	M
Cephalosporium curtipes Saccardo	3.59	61.11	H
Chaetomium murorum Corda	8.60	83.33	H
Circinella simplex van Tieghem	0.03	8.33	R
Cladosporium herbarum (Pers.) Link.	1.58	25	M
Cunnighamella echinulata Thaxter	0.03	8.33	R
Drechslera australiensis Subram and Jain ex. H.B. Ellis.	0.01	5.56	R
Emericella nidulans (Eidam) Wuill.	0.03	5.56	R
Epicoccum purpurascens Ehrenb. ex. Schlecht.	0.02	2.78	R
Fennellia flavipes Wiley and Simmons	0.06	5.56	R
Fusarium moniliforme Sheldon	0.18	5.56	R
Gliocladium roseum (Link) Thom	0.06	2.78	R
Helminthosporium sp. Link ex. Fries	0.01	2.78	R
Humicola grisea Traaen	0.05	2.78	R
Mucor racemosus Fresenius	0.01	5.56	R
Nigrospora sphaerica (Sacchardo) Mason	0.02	2.78	R
Penicillium	28.1	100	H
P. chrysogenum Thom	11.6	97.22	H
P. citrinum Thom	8.40	83.33	H
P. coryophilum Dierckx	1.13	25	M
P. jenseni Zaleski	0.82	22.22	8 L
P. purpurogenum Stoll	1.23	19.44	L
P. brevicompactum Dierckx	4.92	33.33	M
Phoma humicolo Gilman and Abbott	0.02	5.56	R
Scopulariopsis brevicaulis Bainier	0.07	11.11	L
Scytilidium lignicola Pesante	0.02	2.78	R
Sepedomium chrysospermum (Bulliard) Fries	0.02	5.56	R
Spicaria silvatica Oudemans	0.01	2.78	R
Stachybotrys atra Corda	1.47	63.89	H
Staphylotrichum coccosporum Meyer and Nicot.	0.02	2.78	R
Stemphylium solani Weber	0.01	2.78	R
Syncephalastrum racemosum (Cohn) Schroeter	0.08	19.44	L
Thermomyces lanuginosus Tsiklinsky	0.007	2.78	R
Trichoderma viride Persoon.	6.44	91.67	H
Verticillium sp. Nees	0.65	33.33	M
Mycelia sterilia	3.45	77.78	H

*Occurrence Remark : H = high >18 cases out of 36 (>50%), M = Moderate, 9~18 cases out of 36 (25~50%); L = low, 4~8 cases out of 36 (12~25%); R = rare <4 cases out of 36 (<12%).

obtained from different localities of Egyptian beaches.

Materials and Methods

Following the method described by Johnson *et al.* (1959), thirty-six soil samples were collected from the sand beaches of Alexandria, Balteem, Gamsah, Ras El-Bar, Port-Said, Ismailia, Suez, Hargadah and South Sinai in Egypt.

The soil samples were analyzed chemically for the estimation of total soluble salts, organic matter, chloride, electric conductivity and pH value. The dilution plate method was used for the estimation of soil fungi, as described by Johnson *et al.* (1959) but with some modifications. One of these is the use of Menzies (1957) dipper to replace pipettes. Modified Czapek's medium ammended with glucose (10 mg/*l*) instead of sucrose and rose Bengal was added as bacteriostatic agent to the medium at concentration of 1/15000 (Smith and Dawson, 1944) for determination of fungi.

Six plates were used for each sample. They were incubated at 25°C for isolation the fungi. The colonies of slow growing fungi which were about to be overgrown as well as mycelial fragments of some colonies were transferred to Czapek's agar + 0.05% yeast extract, or potato dextrose agar medium. The developing fungi were counted, examined, identified and their numbers were calculated per mg soil in every sample.

Identification of fungal genera and species was carried out according to the following references: Raper and Thom (1949), Raper and Fennell (1965), Booth (1971), Ellis (1971, 1976), Domsch *et al.* (1980), and Moubasher (1993).

Results

Fifty one species belonging to thirty one genera were identified, in addition to the Mycelia sterilia (Table 1). The highest total count of fungi (C = 149.93 colonies/mg soil) was recorded in the samples collected from sandy soil of Alexandria beach, while the lowest total count (C = 44.85 colonies/mg soil) was recorded in the samples of Balteem beach.

Four genera, namely: *Penicillium*, *Aspergillus*, *Chaetomium* and *Trichoderma*, were represented in the sand beaches of the all nine localities but their counts and their frequency were not similar from place to place collected.

Aspergillus showed the broadest spectrum range of the species and it represented sixteen species, followed by *Penicillium* which represented by six species only. Their percentage counts were the highest (30.28% and 35.72% of the fungal total count respectively). In addition, *Chaetomium* (*C. murorum*) was represented by 10.93% while *Trichoderma* (*T. viride*) was represented by 8.05%. On the other hand, each of the rest of genera was represented by one species only and were occupied in 15.02% of the total count of fungi.

The fungi represented in Table 1 showed that, the fungal species of high frequency of occurrence included: *Aspergillus flavus*, *A. niger*, *A. sydowii*, *A. terreus*, *Cephalosporium curtipes*, *Chaetomium murorum*, *Penicillium chrysogenum*, *P. citrinum*, *Stachybotrys atra* and *Trichoderma viride* were recorded in more than 18 cases out of thirty six. The results also showed, *Alternaria alternate*, *Aspergillus glaucus*, *A. janus*, *A. alutaceus*, *Botryotrichum piluliferum*, *Cladosporium herbarum*, *Penicillium corilophylum*, *P. brevicompactum* and *Verticillium* sp. were of moderate occurrence. They were recorded in 9~18 cases out of 36.

The infrequent species of low occurrence, which were isolated from 4~9 cases out of 36; these species were: *Aspergillus candidus*, *A. fumigatus*, *A. thomii*, *A. versicolor*, *A. wentii*, *Penicillium jenseni*, *P. purpurogenum*, *Scopulariopsis brevicaulis* and *Syncephalastrum racemosum*. In addition, *Aspergillus awamori*, *A. foetidus*, *A. sulphureus*, *A. ustus*, *Circinella simplex*, *Cunninghamella echinulata*, *Drechslera australiensis*, *Emericella nidulans*, *Epicoccum purpurascens*, *Fennellia flavipes*, *Fusarium moniliforme*, *Gliocladium roseum*, *Helminthosporium* sp., *Humicola grisea*, *Mucor racemosus*, *Nigrospora sphaerica*,

Table 2. Soil analysis of the different localities, pH value, electric conductivity (E.C.), organic matter content (O.M.C), total soluble salts (T.S.S.), chloride, water content (W.C.), total count of fungi (T.C.), number of genera (No.G.), number of species (No. spp.)

Soil no.	Locality	pH	E.C.	O.M.C.	T.S.S.	Chloride	W.C.	T.C.	No. G.	No. spp.
1	Alexandria	0.06~8.32	700~2480	0.06~0.39	0.05~0.95	0.19~1.255	2.04~27.70	149.93	19	36
2	Balteem	7.85~7.96	1300~1650	0.12~0.18	0.30~0.65	0.64~0.81	12.79~16.69	44.85	9	16
3	Gamsah	7.95~8.15	950~1400	0.06~0.24	0.20~0.45	0.45~0.70	16.6 ~24.52	61.71	8	18
4	Hargadah	8.24~8.28	1400~1900	0.24~0.30	0.35~0.75	0.66~0.93	0.45~9.85	77.86	14	23
5	Ismailia	7.96~8.07	450~2000	0.06~0.21	0.10~0.75	0.19~1.02	14.67~21.36	49.7	13	22
6	Port-Said	7.98~8.47	1280~2500	0.12~0.21	0.65~1.25	0.56~1.40	13.49~32.89	97.13	6	15
7	Ras El-Bar	7.84~8.42	1480~6000	0.06~0.21	0.35~4.00	0.71~4.63	16.14~32.50	52.55	19	31
8	Suez	8.31~8.43	800~1180	0.15~0.27	0.15~0.30	0.33~0.51	6.21~15.34	68.11	8	19
9	South Sinai	7.90~8.99	100~3900	0.06~0.36	0.10~2.75	0.04~1.68	7.46~25.64	106.66	16	33

Table 3. Mean total count per mg soil (T.C.) and number cases of isolation (NCI) of fungi recorded in sand beaches of different localities. 1; Alexandria, 2; Balteem, 3; Gamsah, 4; Hargadah, 5; Ismailia, 6; Port-Said, 7; Ras-El Bar, 8, Suez and 9; South Sinai

Locality / Fungal species	1		2		3		4		5		6		7		8		9	
	TC	NCI	TC	NCI	TC	NCI	TC	NCI	TC	NCI	TC	NCI	TC	NCI	TC	NCI	TC	NCI
Total count	149.93		44.85		61.71		77.8		49.7		97.13		52.51		68.11		106.66	
Alternaria alternate	0.39	3	–	–	–	–	0.2	1	–	–	–	–	0.21	2	–	–	0.23	3
Aspergillus	53.9	9	16.45	2	15.08	3	17.61	2	13.65	3	39.15	4	10.98	4	14.76	2	32.68	7
A. alutaceus	0.04	1	0.17	1	0.92	3	–	–	4.83	3	0.04	1	0.5	2	–	–	0.23	3
A. awamori	0.09	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
A. candidus	–	–	–	–	–	–	–	–	0.42	1	–	–	–	–	–	–	0.36	3
A. flavus	19.5	9	2.71	2	0.81	3	3.79	2	0.83	2	21.87	4	1.40	4	3.33	2	15.19	7
A. foetidus	0.19	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
A. fumigatus	0.41	2	–	–	–	–	–	–	–	–	–	–	0.10	1	2.29	1	–	–
A. gluacus	0.90	4	0.73	2	0.44	2	0.50	1	1.04	2	0.48	2	0.08	1	0.71	2	0.32	2
A. janus	0.36	3	–	–	–	–	4.21	2	–	–	0.69	3	–	–	1.52	2	1.13	3
A. niger	16.41	9	0.84	1	0.58	2	6.37	2	1.28	3	5.19	4	1.19	4	1.85	2	9.71	7
A. sulphureus	0.37	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
A. sydowii	10.77	9	11.79	1	12.14	3	1.96	2	4.61	2	7.40	4	7.50	4	2.67	1	7.27	5
A. terreus	3.14	8	–	–	0.19	1	0.33	2	0.47	1	2.73	4	0.73	4	0.98	2	0.73	5
A. thomii	0.95	3	–	–	–	–	0.29	1	–	–	0.04	1	–	–	0.62	1	0.02	1
A. ustus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.12	1
A. versicolor	0.36	3	0.21	1	–	–	–	–	0.19	2	–	–	–	–	–	–	0.07	2
A. wentii	–	–	–	–	–	–	0.08	1	–	–	–	–	0.04	1	0.79	2	0.04	1
Botryotrichum piluliferum	0.74	5	–	–	–	–	0.17	1	0.42	1	–	–	0.04	1	0.2	1	0.81	6
Cephalosporium curtipes	10.73	6	7.08	2	1.69	1	0.08	1	7.8	3	–	–	1.19	3	0.42	1	3.35	5
Chaetomium murorum	19.8	9	0.42	1	0.56	1	17.88	2	0.29	3	10.98	4	0.04	1	4.13	2	23.31	7
Circinella simplex	0.08	1	–	–	0.11	1	–	–	–	–	–	–	0.08	1	–	–	–	–
Cladosporium herbarum	0.69	3	0.42	1	–	–	3.75	1	–	–	–	–	1.56	3	–	–	7.74	1
Cunninghamella echinulata	0.02	1	–	–	–	–	–	–	–	–	–	–	0.21	1	–	–	0.07	1
Drechslera australiensis	0.05	1	–	–	–	–	–	–	–	–	0.08	1	–	–	–	–	–	–
Emericella nidulans	–	–	–	–	–	–	0.08	1	–	–	–	–	0.21	1	–	–	–	–
Epicoccum purpurascens	–	–	–	–	–	–	0.21	1	–	–	–	–	–	–	–	–	–	
Fennellia flavipes	0.41	1	–	–	–	–	–	–	–	–	–	–	0.13	1	–	–	–	–
Fusarium moniliforme	–	–	–	–	–	–	0.17	1	1.45	1	–	–	–	–	–	–	–	–
Gliocladium roseum	–	–	–	–	–	–	–	–	–	–	–	–	0.5	1	–	–	–	–
Helminthosporium sp.	0.09	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Humicola grisea	-	-	–	–	–	–	–	–	–	–	–	–	0.46	1	–	–	–	–
Mucor racemosus	0.02	1	–	–	–	–	–	–	–	–	–	–	0.10	1	–	–	–	–
Nigrospora sphaerica	–	–	–	–	–	–	0.21	1	–	–	–	–	–	–	–	–	–	–
Penicillium	51.69	9	13.96	2	35.69	3	29	2	9.58	3	34.17	4	23.48	4	28.5	2	26.87	7
P. chrysogenum	10.26	6	5.83	2	10.06	3	6.21	1	4.34	4	21.06	5	16.59	6	12.42	1	17.63	7
P. citrinum	10.28	9	4.42	2	10.97	3	19.38	2	1.33	2	12.83	2	5.73	3	3	1	7.62	6
P. coryophilum	1.69	2	–	–	5.11	1	–	–	2.64	2	0.27	1	0.44	2	–	–	0.02	1
P. jenseni	0.81	3	0.21	1	3.5	1	–	–	–	–	–	–	–	–	1.46	1	1.40	2
P. purpurogenum	1.25	2	3.50	2	5.86	1	–	–	–	–	–	–	0.31	1	–	–	0.17	1
P. brevicompactum	27.40	4	–	–	0.19	1	3.42	2	1.28	1	–	–	0.31	2	11.63	1	0.02	1
Phoma humicola	0.05	1	–	–	–	–	–	–	–	–	–	–	0.10	1	–	–	–	–
Scopulariopsis brevicaulis	0.12	1	–	–	0.14	1	–	–	0.14	1	–	–	–	–	–	–	0.24	1
Scytilidium lignicola	–	–	–	–	–	–	–	–	–	–	–	–	0.21	1	–	–	–	–
Sepedonium chrysosperum	–	–	–	–	–	–	–	–	0.14	1	–	–	–	–	–	–	0.07	1
Spicaria silvatica	–	–	–	–	–	–	–	–	0.11	1	–	–	–	–	–	–	–	–
Stachybotrys atra	1.43	6	–	–	0.33	1	0.67	2	1.31	2	1.375	4	1.08	2	6.33	2	0.71	4
Staphylotriclum coccosporum	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.21	1	–	–
Stemphylium solani	–	–	–	–	–	–	–	–	–	–	–	–	0.10	1	–	–	–	–
Syncephalastrum racemosum	0.20	4	–	–	–	–	0.29	1	–	–	–	–	–	–	–	–	0.20	2
Thermomycos lanuginosus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.06	1
Trichoderma viride	5.09	7	5	2	7.64	3	2.92	2	6.0	2	8.58	4	8.37	4	7.39	2	6.96	7
Verticillium sp.	1.18	4	1.46	1	–	–	–	–	0.14	1	–	–	1.25	1	–	–	1.82	5
Mycelia sterilia	3.66	6	0.33	1	0.47	3	4.75	2	8.67	3	2.79	3	2.69	4	6.17	2	1.54	4

Spicaria silvatica, *Phoma humicola*, *Scytalidium lignicola*, *Sepedonium chyrsosperumum*, *Staphylotrichum coccosporum*, *Stemphylium solani* and *Thermomyces lanuginosus* were of rare frequency of occurrence. Most of genera or species did not show regular correlation between the count and number of cases of isolation.

The results in Table 2 showed that, the highest total counts were recorded in the soil samples collected from sand beaches of Alexandria followed by South Sina and Port Said (C = 149.9, 106.6 and 97.1 colonies per mg dry soil, respectively). These samples were characterized by relative high organic matter content ranged between 0.2~0.4%, total soluble salts from 0.95~2.75%. On the other hand, sand beach of Balteem was appeared to be the poorest one in the total count of fungi. It was characterized by its poverty in organic matter content 0.18%, total water soluble salts (0.65%). pH values of the soil samples reveal no appreciable differences, all are alkaline and the pH ranges from 7.96~8.99.

The results represented in Tables 2 and 3 also showed that, the highest number of genera and species were recorded in soil samples of sand beaches of Alexandria (19 genera and 36 species), where *Aspergillus* (mainly *A. flavus* and *A. niger*) was the dominant genus, Ras El-Bar (19 genera and 31 species), *Penicillium* showed the highest total count which contributed to *P. chrysogenum* and South Sina (16 genera and 33 species), of which *Aspergillus* especially *A. flavus* was the most common. Samples collected from Hargadah and Ismailia show approximately the same number of genus and species (14 genera and 23 species and 13 genera and 23 species, respectively), and also it was similar in case of Gamsah (8 genera and 18 species) and Suez (8 genera and 19 species).

Discussion

The fungi isolated belong to fifty one species and thirty one genera (Table 1). Greater populations as well as a wider spectrum range of fungal genera or species were recorded in sandy soil of beach Alexandria and this was affected by organic matter content and the total water soluble salts. These results were in accordance with Sarquis and Oliveira (1996) and Bergen and Wagner-Merner (1977). The authors reported that these variations might probably be attributed to biocliminatic factors acting on, and/or interfering with, fungal survival and dispersal. It is also possible that the frequency of bathers, who carry propagula and leave substrates, might create conditions favourable for development of fungal community. The level of contamination may be related to direct or indirect microbial contamination from beach users (Mendes *et al.*, 1996).

Genera *Penicillium*, *Aspergillus*, *Trichoderma*, *Chaetomium*, *Stachybotrys* and *Cephalosporium* were of high occurrence (frequency more than 50%), while *Botryotrichum*, *Cladosporium*, and *Verticillium* showed moderate occurrence (frequency, 25~50%) and the other fungal genera showed low and rare occurrence (frequency, 12~25% and <12% respectively). *Penicillium* and *Aspergillus* accounted for about 65.9% of the mean total count. Parallel to this result, Mendes *et al.* (1998) showed that the environmental saprophytic fungi were the most common in the sand beaches of Portugal. Sarquis and Oliveira (1996) reported that the genera of highest incidence recorded in the sandy soil of Iponema beach were; *Aspergillus*, *Penicillium*, *Fusarium* and *Trichoderma*. Also, Jose *et al.* (1994) found that these genera were dominated in 2 sand beaches in Portugal. Moreover, Moubasher and Moustafa (1970), El Dohlob and Abu-Ellil (1978), El-Fallal (1982) and El-Dohlob *et al.* (1985) found that *Aspergillus*, *Penicillium* and *Fusarium* were frequent in Egyptian soil.

The genus *Penicillium* was isolated from all samples, independently of the area, and it was the most abundant genus observed. The data were coincident with those reported by several authors who mention the constant presence of *Penicillium* in the mycoflora from different areas in the world (Almeida and De-Almeida, 1997; Calvo *et al.*, 1980a, b). The species of *Penicillium* genus detected were: *P. chrysogenum*, *P. citrinum*, *P. corilophylum*, *P. jenseni*, *P. purpurogenum* and *P. brevicompactum*. *P. chrysogenum* was the most frequent species (97.22%) while *P. purpurogenum* was the least frequent one. Many of the isolated species belonging to the genus *Penicillium* was part of the atmospheric mycoflora, as it is reported in different studies (Calvo *et al.*, 1979; Gregory, 1973; Guarro *et al.*, 1981; Larronda and Calvo, 1989).

Aspergillus genus was the second in incidence, though its isolation varied in the different beach samples according to the area. *Aspergillus* genus has been cited as one of the fungi which are present in the atmosphere (Calvo *et al.*, 1980a; Meyer *et al.*, 1983; Oliveira *et al.*, 1993; Pinto *et al.*, 1992) and soils of various areas (Calvo *et al.*, 1984; Larronda and Calvo, 1989; Sarquis and Oliveira, 1996). *Aspergillus* showed the broadest spectrum range, it represented by 16 species which included: *A. awamori*, *A. candidus*, *A. flavus*, *A. foetidus*, *A. fumigatus*, *A. glaucus*, *A. janus*, *A. niger*, *A. alutaceus*, *A. sulphureous*, *A. sydowii*, *A. thomii*, *A. terreus*, *A. ustus*, *A. versicolor* and *A. wentii*. The species which showed the highest frequency in all cases was *A. flavus* (97.22%) followed by *A. niger* (94%) and *A. sydowii* (86.11%).

The third place in count and the fourth in percentage frequency was displayed by genus *Chaetomium* which was represented by one species namely *C. murorum* (83.33%). These results were inagreement with those obtained by several authors who mentioned the presence of *Chaetomium murorum* in beach samples (Caretta *et al.*, 1976; Guarro *et al.*, 1981; Larrondo and Calvo, 1989).

Trichoderma spp. (represented by *T. viride*) was less than *C. murorum* in count while higher than *C. murorum* in percentage frequency (91.67%).

It was worth mentioning that the total count of the genera or species in the thirty six soil samples did not always follow the number of case of isolation. The same conclusions were obtained by Moubasher and Moustafa (1970), El-Dohlob *et al.* (1982), Meyer *et al.* (1983), Oliveira *et al.* (1993) and Pinto *et al.* (1992).

Moreover, there was no correlation always between the count and spectrum range of *Aspergillus*, *Penicillum*, *Dematiaceous* and *Hyaline hyphomycetes* species. This was due to deep fluctuations in response to alternation of bioclimatic condition of the atmosphere, chemical and physical properties of the soil.

Thus, we concluded that a small number of genera with wide species diversification predominated among the total population of microflora in the sandy soil of Egyptian beaches, and that they are the same universal dominants isolated from the air by several investigators. Also, peculiar and regional genera and species occurred at variable, but considerably low levels. In addition to these facts, it was pointed out that the distribution of the species belonging to the studied genera varied depending on the climatic conditions, their presence in the atmosphere and chemical analysis of the soils. Thus, it would appear that coastal sands represent a large fungal reservoir whose role is little understood but is possibly important for animals, plants and the marine and terrestrial ecosystems.

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