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Mycota of Well Waters in Assiut, Egypt

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The distribution and occurrence of aquatic zoosporic and terrestrial fungi were investigated in 21 well waters in Assiut governorate, Egypt. Using a zoospore capture technique, 923 colonies of aquatic freshwater fungi were recovered from well waters, out of which 811 colonies reached sexual maturity. These colonies were assigned to 23 species which belong to 11 genera. The most common genera were *Achlya*, *Saprolegnia* and *Dictyuchus*. Using two types of media, 35 species in addition to 2 varieties of terrestrial fungi which belong to 18 genera were also recovered. The most frequent glucophilic genera (recovered on glucose-Czapek's agar at 28°C) were *Aspergillus*, *Penicillium* and *Fusarium*. The results obtained on cellulose-Czapek's agar at 2°C were basically similar to those on glucose agar and the most frequent genera were *Aspergillus, Penicillium* and *Fusarium* followed by *Chaetomium* and *Cephalosporium*.

KEYWORDS: Egypt, Mycota, Well waters

There have been several studies dealing with the occurrence and distribution of aquatic fungi in fresh water habitats in Egypt (El-Hissy and Khallil, 1989; El-Nagdy and Khallil, 1991; El-Nagdy and Abdel-Hafez, 1990; Khallil *et al.*, 1993; El-Hissy *et al.*, 1982, 1996), however the most important water source for drinking which is known as well waters has not been yet studied. The present experiment was therefore set up in order to investigate the frequency of occurrence and distribution of both strictly aquatic and terrestrial fungi in well waters in the Assiut governorate.

Materials and Methods

Water samples: Twenty-one surface water samples were collected during the winter season of 1998 from some wells in Assiut Governorate, Egypt. Temperature and pH values were recorded at the time of sampling. Total soluble salts and organic matter contents were determined according to the method described by Jackson (1958).

Determination of zoosporic fungi: Aliquots of 20 m*l* of each sample of well water were added to each of ten sterile petridishes. Six sterilized seeds of sesame were put in each petridish as baits and the plates were left at room temperature for 24 h. Thereafter, the colonized seeds were transferred to petridishes containing sterile water and incubated at 20±2°C for 5 weeks. during which the colonized seeds with zoosporic fungi were transferred several times to sterile petridishes containing sterile water. The zoosporic fungi which appeared on the baits were examined, identified, counted and the numbers were calculated per 60 seeds in every sample.

Determination of terrestrial fungi: Two ml of water sample was transferred aseptically into each of ten sterile petridishes. Modified Czapek's Dox agar medium in which glucose (10 g/*l*) or powder cellulose (20 g/*l*) replaced sucrose (20 g/*l*) was used for isolation of glucophilic or cellulose-decomposing fungi, respectively. Rose bengal (1/15000) was used as a bacteriostatic agent. Five plates were used for each medium and the plates were incubated at 28°C for 7~15 days during which the developing fungi were counted, examined and identified. The numbers were calculated per 1 m*l* water in every sample.

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Results and Discussion

The total soluble salts of the well water samples tested ranged from 187~511 mg/*l*, and organic matter content fluctuated between 5.7~22.7 mg/*l*. EL-Nagdy and Abdel-Hafez (1990) found that the total soluble salts of ground water in some ponds of Kharga Oases, Egypt were generally high and widely ranged between 305~983 mg/*l*, whereas the organic matter content ranged between 3.86~7.66 mg/*l*. The PH values of the water samples were all on the alkaline side (7.1~7.8). This is in agreement with the results of ground water fm Kharga Oases, Egypt (El-nagdy and Abdel-Hafez, 1990). Water temperature ranged between 15~21°C.

Zoosporic fungi (recovered on sesame seeds baits) Twenty-three species belonging to 11 genera of zoosporic fungi were collected on sesame seeds baits at 20±2°C (Table 1).

Achlya was the most prevalent genus in water samples and was represented by 239 isolates which reached sexual maturity. These isolates were assigned to 5 species. In addition, 38 isolates failed to produce sexual organs and remained sterile, and it was not possible to give them specific names. In the previous reports in Egypt (El-hissy *et al.*, 1982) *Ach-*

Table 1. Total counts (calculated per 60 seeds in every, sample), and number of isolations of zoosporic fungal genera and species from 21 well water samples using zoospore capture technique

Fungal genera and species	Total count	Number of isolations	Occurrence remark
Total count	923		
Achlya	**277**	21	H
A. colorata Pringsheim	12	2	R
A. dubia Coker	93	15	H
A. prolifera C,G.Nees	67	13	H
A. proliferoides Coker	49	8	M
A. racemosa Hildebrand	18	3	L
Achlya species (non. Sexual)	38	9	M
Allomyces	**76**	10	M
A. arbuscula Butler	48	7	M
A. moniliformis Coker & Braxton	28	3	L
Aphanomyces laevis De Bary	**14**	3	L
Brevilegnia	**22**	4	L
B.diclina Harvey	13	2	R
B.unispeerma (Coker & Braxton) Coker	9	2	R
Calyptralegnia ripariensis Hohnk	**4**	1	R
Dictyuchus	**213**	19	H
D. carpophorus Zopf	7	2	R
D. monosporus leitgeb	33	8	M
D. sterilis Coker	173	19	H
Leptolegnia caudata De Bary	**5**	2	R
Pythiopsis cymosa De Bary	**5**	2	R
Pythium	**59**	6	M
P. debaryanum De Bary	28	4	L
P. thalassium Atkins	8	2	R
Pythium species	23	4	L
Saprolegnia	**243**	20	H
S. anisospora De Bary	13	4	L
S. diclina Humphery	10	3	L
S. ferax (Gruith.) Thuret	162	17	H
S. hypogyna (Pringsheim) De Bary	7	3	L
Saprolegnia species (non-sexual)	51	12	H
Thraustotheca clavata (De Bary) Humphrey	**5**	2	R

H = High occurrence; more than 10 samples.
M = moderate occurrence; between 5~10 samples.
L = Low occurrence; between 34 samples.
R = rare occurrence; less than 3 samples.

lya was almost the most prevalent genus. It contributed to the broadest spectrum of species (5 species + unidentified one), the most common being *Achlya prolifera*, *A. proliferioides* and *A. dubia*. The remaining species were less frequent. These species have previously been recovered from various aquatic habitats in Egypt (EL-Hissy *et al.*, 1982, 1996; El-Nagdy and Abdel-Hafez, 1990; El-Nagdy and Khallil, 1991) and other countries (Alabi, 1971; Hasija and Batra, 1978; Khtulbe, 1980; Rattan *et al.*, 1980; Misera, 1982; El-Nagdy *et al.*, 1992).

Saprolegnia was the second most common genus and was represented by *Saprolegnia anisospora*, *S. diclina*, *S. ferax* and *S. hypogena*, in addition to unidentified one that were of high or low occurrence. Similar results were reported by El-Hissy *et al.* (1982) and El-Hissy and Khallil (1989) from the River Nile near Assiut and Delta region respectively. El-Nasdy, and Abdel-Hafez (1990) Also found that *Saprolegnia* was common in ponds of Kharga Oases. El-hissy (1994) showed that the same genus occurred in high incidence in Tübingen region, Germany. The most dominant *Saprolegnia* species were *S. ferax* and an unidentified species. This is in agreement with the results obtained from the River Nile system in Egypt (El-Hissy *et al.*, 1982; El-Hissy and Khallil, 1989; El-Nagdy and Abdel Hafez, 1990). The remaining *Saprolegnia* species were less frequent. All the recoverable **Saprolegnia** species have previously been isolated from river Nile system in Egypt (El-Hissy *et al.*, 1982; El-Hissy and Khallil, 1989; Khallil *et al.*, 1993). Reports from Poland (Czeczuga, 1995, 1996; Czeczuga and Mazalska, 1996) revealed the isolation of *Saprolegnia* from

Table 2. Total counts (T.C., calculated per m*l* water) or terrestrial fungi, and number of (N.C.I) of genera and species from 21 well water sample recovered on glucose and cellulose Czapek's agar incubated at 28°C.

Fungal genera and species	Glucose			Cellulose		
	T.C.	N.C.I.	O.R.	T.C.	N.C.I.	O.R.
Total count	333.4			202.5		
Acremonnium strictum W. gams	3.5	6	M	1.2	3	L
Alternaria alternata (Fr.) Kreissler	2.8	5	M	1.9	4	L
Aspergillus	179.5	21	H	99.2	20	H
A. clàvatus Desmazieres	0.1	1	R	-	-	-
A. flavus Link:Fr.	21.4	9	M	33.6	18	H
A. flavus var. columnaris Raper & Fennel	1.9	4	L	-	-	-
A. fumigatus Fresenius	75.5	18	H	41.2	19	H
A. nidulans (eidam) Wint	3.4	5	M	0.4	2	R
A. nidulans var. latus Thom & Raper	0.5	2	R	-	-	-
A. niger Van tieghem	55.2	19	H	12.3	10	M
A.sydowi (Bain. & Sart.)Thom & Church	1.4	3	-	2.1	4	L
A. terreus Thom	20.1	12	H	7.6	8	M
Botryotrichum attrogrisem Van Beyma	1.2	3	L	-	-	-
Cephalosporium curtipes Sacc.	2.1	4	L	6.8	10	M
Chaetomium	1.6	5	M	4.8	9	M
C. globosum Kunze: Fr.	1.6	5	M	4.6	9	M
C. spirale Zopf	-	-	-	0.2	1	R
Cladosporium	3.6	7	M	1.3	4	L
C. herbarum (Pers.:Fr) Link	2.1	7	M	0.9	4	L
C. clodosporioides (Fresenius) de Vries	1.5	3	L	0.4	2	R
Fusarium	49.2	17	H	39.6	14	H
F. equiseti (Corda) Saccardo	0.5	2	R	-	-	-
F. moniliforme Sheldon	8.7	7	M	8.2	7	M
F. oxysporum Schlechtendahl ex.fr	18.2	15	H	13.6	8	M
F. solsni (Mart.) Saccardo	21.8	14	H	17.8	13	H
Mucor	1.3	7	M	0.2	1	R
M. circinelloides Van Tiegh.	0.2	2	R	-	-	-
M. racemosus Fesenius	1.1	6	M	0.2	1	R
Paecilomyces varioti Bainier	0.4	2	R	-	-	-
Penicillium	80.4	19	H	41.7	15	H
P. chrysogenum Thom	30.6	16	H	21.4	11	H
P. coryloptilum Dierckx	26.4	11	H	18.8	12	H
P. funiculosum Thom	13.4	10	M	1.1	4	L
P. martensii Bourge	6.8	8	M	-	-	-
P. nigricans (Bainier) Thom	3.4	5	M	0.4	2	R
Phoma glomerata (Corda) Wollen Weber & Hochafel	-	-	-	0.2	1	R
Rhizopus stolonifer Ehrenb. Ex. Fr. Lindt	0.9	4	L	0.4	1	R
Scopulariopis brevicaulis (Sacc.) Bainier	0.4	2	R	0.4	2	R
Stachybotrys chartarum (Ehrenb.:Fr.) Hughes	0.2	2	R	-	-	-
Trichoderma viride Pers.: Fr.	3.5	8	M	2.4	6	M
Trichurus spiralis Hasselbring	-	-	-	0.9	3	L
Ulocladium	0.1	1	R	0.4	2	R
U. botrytis Preuss	-	-	-	0.2	1	R
U. chartarum (preuss) E. Simmons	0.1	1	R	0.2	1	R
Mycetia sterilia (white and dark)	2.4	5	M	1.1	4	L

O.R. = Occurrence remark.
H = High occurrence; more than 10 samples (out of 21).
M = Moderate occurrence; between 5~10 samples.
L = Low occurrence; between 3~4 samples.
R = rare occurrence; less than 3 samples.

different water habitats.

Dictyuchus occupied the third position after Achlya and *Saprolegnia*. It was represented by 3 species of which *D. sterilis* was the most common. *Dictyuchus monosporus* and D. *Carpophorus* were less frequent. Similar results were also obtained from different water habitats in Egypt (El-Nagdy and Abdel-Hafez, 1990; El-Nagdy and Khallil 1991; El-Hissy *et al.*, 1996). Rattan *et al.* (1978) found that species of *Dictyuchus* occur throughout the year but flourished during spring and autumn (19~27°C). Suzuki (1961) and Misera (1982) found that *Dictyuchus* species predominated only in winter months.

Allomyces* and *Pythium were isolated in moderate frequency of occurrence. They represented each by 2 species of which *Allomyces arbuscula* was isolated in moderate occurrence. *Allomyces moniliformis*, *Pythium debaryanznm* and *P. thalassium* were less frequent. Reports from Egypt (El-Nagdy and Abdel-Hafez, 1990); India (Sirvastava, 1967); Saudi Arabia (El-Nagdy *et al.*, 1992) and Germany (El-Hissy, 1994) revealed the isolation of *Allomyces* and *Pythium* from different water habitats.

The remaining genera were less commonly isolated: *Aphanomyces* (*A. laevis*), *Brevilegina* (*B. diclina*, *B. unifsperma*), *Calyptralegnia* (*C. ripariensis*), *Leptolegnia* (*L. caudata*) *pythiopsis* (*P. cymosa*) and *Thraustotherca* (*T. clavata*) (Table 1). These fungi were also recorded from the Nile system and other water habitats in Egypt in low to rare frequency of occurrence (El-Hissy *et al.*, 1982, 1996; El-Hissy and Khallil, 1989; El-Nagdy and Abdel-Hafez, 1990). Reports from Saudi Arabia revealed the isolation of the above species from the Saudi Arabia revealed the isolation of the region (El-Nagdy *et al.*, 1992). All of these species were previously recorded by some investigators in different parts of the world (Suzuki, 1961; Bhargava and Singh, 1965; Alabi, 1973; Karling, 1976; Okane, 1978; Khube, 1980; Czeczuga and mazalska, 1996).

Terrestrial fungi

Thirty-five species in addition to two varieties which belong to 18 genera of terrestrial fungi were recovered from 21 surface water samples collected from wells in Assiut district using two isolation media (glucose and cellulose Czapek's agar at 28°C).

Fungi recovered on glucose-Czapek's aga. Thirty one species in addition to 2 varieties which belong to 16 genera of terrestrial fungi were recovered from the water samples tested (Table 2).

Three genera were isolated in high frequency of occurrence; *Aspergillus* (7 species + 2 varieties), *Penicillium* (5 species) and *Fusarium* (4 species). The most common species were *Aspergillus fumigatus*, *A. niger*, *A. terreus*, *Penicillium chrysogenum*, *P. corylophilum*, *Fusarium oxysporium*, and *F. salani.*

These genera and species were also common in river Nile system (Abdel-Hafez and Bagy, 1985; El-Hissy *et al.*, 1990 and Moharrum *et al.*, 1990) and ground water in Kharga Oases (El-Nagdy and Abdel-Hafez, 1990) in Egypm and other countries (Bärlocher and Kendrick, 1974; Bettucci *et al.*, 1993; Bettucci and Roquebert, 1995). The remaining genera and species were less common (Table 2).

Fungi recovered on cellulose Czapek's aga. The results in Table 2 show that a narrower spectra of genera and species was recovered on cellulose (15 genera and 28 species) than on glucose agar plates (16 genera and 31 species + 2 varieties). The results also, indicate that the terrestrial fungi recovered from well waters on cellulose Czapek's agar were nearly the same as those isolated on glucose Capek's agar medium. The most prevalent genera were *Aspergillus*, *Penici*, *Cephalllium* and *Fusarium* followed by *Chaetomium* and *Cephalosporium*. From these genera *Aspergillus fumigatus*, *A. flavus*, *Penicillium chrysogenum*, *P. corylophilum*, *Fusarium solani*, *Chaetomium globosum* and *Cephalosporium curipes* were the mostprevalent species. These genera and species have also isolated from river Nile system and other substrata in Egypt and Saudi Arabia (El-Hissy *et al.*, 1990; Moharrum *et al.*, 1990; El-Nagdy and Abdel-Hafez, 1990; El-Nagdy *et al.*, 1992). Most Of the species that were recovered in this investigation on cellulose agar are well known as cellulose-decomposers (Tribe, 1961; 1966; Flannigan, 1970; Stewart and Walsh, 1972; EI-Nagdy and Abdel-Hafez, 1990).

It is worth mentioning that some fungi were more frequently recovered on cellulose than on glucose agar and vice versa; also several Fungi were recovered on cellulose and not glucose agar and vice versa (Table 2).

ZoosPoric and terrestrial fungi are always present in large numbers and frequencies in well waters, and there are basic similarities between the mycota of well water and those found in river Nile and its branches (El-Hissy *et al.*, 1982; El-Hissy and Khallil, 1989), Aswan High Dam Lake (El-Hissy *et al.*, 1990; Moharrum *et al.*, 1990), some ponds of Kharga Oases (El-Nagdy and Abdel-Hafez, 1990), water and mud from Ibrahimia canal (Abdel-Hafez and Bagy, 1985) in Egypt and rainfallwater and mud (El-Nagdy *et al.*, 1992) in Saudi Arabia.

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