

MYCOFLORA OF WATER POOLS IN THE VICINITY OF SOME ANCIENT PHARONIC TEMPLES IN UPPER EGYPT

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SUMMARY: Seventy species in addition to an unidentified isolate belonging to forty-three fungal genera were isolated during this investigation. From these fungi, 18 species in addition to an unidentified isolate of Pythium are related to 12 zoosporic fungal genera and 52 species to 23 terrestrial fungal genera. Saprolegnia ferax, Allomyces arbuscula and Pythium undulatum were the most common genera among the zoosporic fungi whereas Gibberella fujikuroi, G. intricans and Aspergillus niger were the most common terrestrial fungal species. The samples of Abidos temples (Sohag) were the richest with zoosporic fungal species whereas the samples of the sacred lake (El-Karnak temple) were the richest with terrestrial fungal species on two used media (glucose and cellulose Czapek's agar media. There are no specific fungal flora concerning these historical areas. There are variations concerning the frequency and population of zoosporic and terrestrial fungi according to the type of sample (Water or mud) as well as to the site of sampling and to the type of media (glucose and cellulose).

Key words: Microflora, saprolegnia ferax, allomyces arbuscula, pythium undulatum, gibberella fujikuroi.

INTRODUCTION

In Egypt, the occurrence and distribution of aquatic fungi in various habitats were extensively studied (5-11, 14, 19, 20). However, no efforts were performed to study the aquatic (neither zoosporic nor terrestrial) fungi inhabiting water localities in the vicinity of ancient pharonic temples in upper Egypt. Thus, this investigation represents an attempt to bridge this gap.

MATERIALS AND METHODS

Five surface water samples and 5 submerged mud samples were collected from each locality of the following:

- a. Sacred lake in El-Karnak temple (Luxor).
- b. The water wells in El-Karnak temple.
- c. Cleopatra bath in addition to other water areas in Dandara temple (6 Km west of Qena City).
- d. Water areas in Abidos temple (6 Km West of El-Baliana city, Sohag district).

The water samples were collected in sterile conical flasks (each one liter) and the mud samples were collected in clean plastic bags.

The water temperature and the pH values of water and mud samples were determined in situ.

For the recovery of zoosporic fungi from water and mud samples, the baiting technique using sesame and hemp seeds, maize grains and pollen grains (18) was used. The seeded plates were incubated at $20 \pm 2^\circ\text{C}$ for 3-6 weeks during which the growing fungi were examined, identified and counted. Five replicates were used for each sample. For the determination of fungal population, the zoosporic fungal species appearing on one plate was counted as one colony. For the recovery of terrestrial fungi from water, 1 ml, using sterile Menziess's (22) dipper of each water sample, was transferred to a 9 cm sterile petri dish containing about 20 ml of agar medium. Ten plates were used for each sample (5 glucose and 5 cellulose Czapek's agar medium). Rose bengal was added as a bacteriostatic agent (26). The plates were incubated at 28°C for 2 weeks during which the growing colonies were examined, identified and counted.

For the recovery of terrestrial fungi from mud samples, 5 gms of each sample were transferred to a sterile flask (250 ml) containing 100 ml sterilized distilled water. Flasks were shaken gently in a rotating motion for ten minutes. One ml of wash water of each sample was experimented as previously mentioned.

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RESULTS AND DISCUSSION

Seventy species, in addition to an unidentified isolate, belonging to forty-three fungal genera (1962 colonies) were isolated during this investigation (Tables 1 and 2). From these fungi, 18 species in addition to an unidentified isolate of *Pythium* are related to 10 zoosporic fungal genera (108 colonies) and fifty-two species related to thirty-three terrestrial fungal genera (1854 colonies). The water temperature of collected samples ranged between 21 and 24°C and the pH values fluctuated between 6.9 and 8.1.

Zoosporic fungi

Eighteen species, in addition to unidentified species of *Pythium* related to 10 zoosporic fungal genera yielding 108 fungal colonies were recovered during this investigation (Table 1). The broadest spectrum of species was recorded in the samples collected from Abidos temple (15 species) in Sohag and Sacred lake (14 species) in Karnak temple. *Saprolegnia* (7 species) and *Pythium* (2 species and an unidentified one) were the most common genera (23 and 8 samples out of 40 samples respectively) whereas *Olpidiopsis* (*O. Saprolegnia*) was of rare occurrence (2 samples only out of 40). *Saprolegnia ferax*, *Allomyces arbuscula* and *Pythium undulatum* were the predominant species and were represented in 15.0%,

12.50% and 12.50% of total samples respectively, whereas *Saprolegnia unispora* appeared only in one mud sample which was collected from Abidos temple.

As regard the samples collected from the sacred lake, it was observed that 9 species (Table 1) were recovered from water samples but did not appear in mud samples. Conversely, 4 species (*Allomyces arbuscula*, *Pythium species Saprolegnia ferax* and *S. parasitica*) were isolated from mud samples only but they were completely absent in water samples. *Saprolegnia litoralis* was recovered from water as well as from mud samples.

Concerning the samples collected from the water wells of K. T., eight zoosporic fungal species were isolated from water (5 species) and mud (3 species) samples (Table 1).

The Dandara temple, 9 species were recovered from the water (7 species) and mud (2 species namely, *Achlya flagellata* and *Pythium thalassium*) samples which were collected from the water wells.

In Abidos, 15 species emerged from water (10 species) and mud (5 species) samples which were collected from wells. All these zoosporic fungi (Table 1) were previously in Egypt (9-10,18-21).

In general, it can be said that there are variations concerning the frequency and population of zoosporic fungi according to the type of sample (water or mud) as well as to the site of sampling (Table 1).

Terrestrial fungi

During this investigation, 52 species belonging to 33 terrestrial fungal genera (1854 colonies) were isolated from water samples (21 species related to 15 genera yielding 337 colonies on glucose and 33 species related to 26 genera yielding 540 colonies on cellulose-Crapek's agar medium) and mud samples (21 species related to 15 genera contributing 293 colonies on glucose and 15 species related to 22 genera yielding 384 colonies on cellulose agar medium).

Nine species were isolated only from water samples but they were completely absent in mud samples. On the other side, 5 species emerged only from mud and completely missed in water samples (Table 2).

In comparison between the two used media, it was found that 11 species were isolated only on glucose and missed on cellulose-agar. Conversely, 21 species were recovered on cellulose whereas completely absent on glucose-agar medium.

The highest fungal populations were recorded in the samples collected from the sacred lake (203 colonies on glucose and 289 on cellulose) whereas the lowest in samples collected from the water wells of the Dandara temple (141 colonies on glucose and 127 on cellulose). The samples of Abidos temple contributed 429 colonies (152 on glucose and 277 on cellulose).

Table 1: Monthly records of aquatic phycomycetes recovered from surface water (W) and submerged mud (M) samples collected from El-Ibrahimia canal during the period from December 1981 to November 1983.

	Sacred lake (in K.T)		Karnak water wells		Dandara water wells		Abidos water wells										
	W	M	W	M	W	M	W	M									
Total	25	5	13	5	13	5	8	5	21	5	2	5	25	5	11	5	
Achlya	2	1	0	0	3	2	0	0	5	2	1	1	3	2	0	0	
A. racemosa Hildebrand	0	0	0	0	0	0	0	0	5	2	0	0	3	2	0	0	
A. flagellata Coker	2	1	0	0	3	2	0	0	0	0	1	1	0	0	0	0	
Aphanomyces	4	3	0	0	0	0	0	0	0	0	0	0	2	1	0	0	
A. leavis de Bary	4	3	0	0	0	0	0	0	0	0	0	0	2	1	0	0	
Allomyces	0	0	3	2	0	0	2	1	0	0	0	0	0	0	3	2	
A. arbuscula Butler	0	0	3	2	0	0	2	1	0	0	0	0	0	0	3	2	
Calyptralegnia	2	1	0	0	0	0	0	0	3	1	0	0	0	0	0	0	
C. achlyoides (Coker and Couch) Coker	2	1	0	0	0	0	0	0	3	1	0	0	0	0	0	0	
Chytriomycetes	0	0	0	0	3	2	0	0	0	0	0	0	3	2	0	0	
C. hyalinus Karling	0	0	0	0	3	2	0	0	0	0	0	0	3	2	0	0	
Olpidiopsis	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
O. saprolegniae (Braun) Cornu and Coker	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Polyphagus	0	0	0	0	3	1	0	0	0	0	0	0	4	2	0	0	
P. euglenae Nowakowski	0	0	0	0	3	1	0	0	0	0	0	0	4	2	0	0	
Pythiopsis	3	2	0	0	0	0	0	0	0	0	0	0	2	1	0	0	
P. cymosa de Bary	3	2	0	0	0	0	0	0	0	0	0	0	2	1	0	0	
Pythium	2	1	4	2	2	1	4	2	2	1	1	1	1	0	0	4	2
P. undulatum Petersen	2	1	0	0	0	0	4	2	1	1	0	0	0	0	2	1	
P. thalassium Atkins	0	0	0	0	2	1	0	0	0	0	1	1	0	0	0	0	
Pythium species	0	0	4	2	0	0	0	0	0	0	0	0	0	0	2	1	
Saprolegnia	9	4	6	3	2	1	2	1	12	5	0	0	11	7	4	2	
S. ferax (Grüith) Thuret	0	0	3	1	0	0	2	1	5	2	0	0	4	2	0	0	
S. furcata Maurizio	2	1	0	0	0	0	0	0	3	1	0	0	2	1	2	1	
S. diclina Humphrey	1	1	0	0	0	0	0	0	0	0	0	0	2	2	0	0	
S. hypogyna (Pringsheim) de Bary	3	1	0	0	0	0	0	0	2	1	0	0	1	1	0	0	
S. litoralis Coker	3	1	2	1	0	0	0	0	2	1	0	0	2	1	0	0	
S. parasitica Coker	0	0	1	1	2	1	0	0	0	0	0	0	0	0	0	0	
S. unispora (Coker and Couch) Seymour	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	

Table 2: Total counts (TC) and the number of cases of isolations (N) of terrestrial fungi isolated from surface (W) submerged mud (M) samples collected from ancient pharonic temples in upper Egypt on glucose and cellulose agar medium at 28°C.

	Sacred lake						Karnak water wells						Dandara water wells						Abidos water wells						Total											
	Glucose			Cellulose			Glucose			Cellulose			Glucose			Cellulose			Glucose			Cellulose			Water			Mud								
	W	M	N	W	M	N	W	M	N	W	M	N	W	M	N	W	M	N	W	M	N	W	M	N	W	M	N	W	M	N	W	M	N	W	M	N
	TC	N	TC	N	TC	N	TC	N	TC	N	TC	N	TC	N	TC	N	TC	N	TC	N	TC	N	TC	N	TC	N	TC	N	TC	N	TC	N	TC	N	TC	N
Total	91	112	175	114	85	49	117	114	87	54	62	65	74	78	186	91	337	20	540	20	293	20	384	20												
<i>Acremonium strictum</i> W. Gans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	3	0	0	0	0	15	3	0	0	0	0								
<i>Alternaria alternata</i> (Fries) Keissler	0	0	0	14	3	5	1	7	1	0	0	0	9	2	0	0	4	1	5	1	0	0	0	0	0	0	0	0	11	2	23	5				
<i>Aspergillus</i>	21	4	15	3	8	3	13	3	14	4	8	1	0	0	0	0	21	5	10	2	0	0	9	2	5	2	7	2	7	1	5	2				
<i>A. clavatus</i> Desmazieres	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	5	2	0	0	0	0	0	0	0	0	0	0	5	2	3	2				
<i>A. flavus</i> Link	6	2	3	1	0	0	0	10	3	0	0	0	0	0	0	0	0	0	0	0	4	1	0	0	0	0	0	0	16	5	0	0				
<i>A. fumigatus</i> Fresenius	0	0	0	5	1	10	2	0	0	8	1	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	3	1	5	1				
<i>A. niger</i> van Tieghem	15	3	12	3	0	0	0	4	1	0	0	0	0	0	0	18	4	10	2	0	0	9	2	0	0	3	1	7	1	0	0	37				
<i>A. terreus</i> Thom	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	2	0	0				
<i>Botrydioploida thecbromae</i> Pat.	0	0	0	0	0	0	0	0	0	0	0	0	17	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	2	0	0				
<i>Botryotrichum atrigriseum</i> van Beyma	0	0	0	0	0	0	0	0	0	0	0	0	7	1	0	0	0	0	0	0	0	3	1	0	0	3	1	10	2	10	2	3				
<i>Chaetomium</i>	12	3	0	0	0	0	0	0	0	0	0	0	7	2	1	7	1	0	6	1	10	3	0	0	0	3	1	0	0	19	4	13				
<i>C. globosum</i> Kunze ex Fries	12	3	0	0	0	0	0	0	0	0	0	0	7	1	0	0	0	0	0	0	0	0	0	0	0	3	1	0	0	19	4	0				
<i>C. piluliferum</i> Daniels	0	0	0	0	0	0	0	0	0	0	0	0	7	2	1	0	0	0	0	0	6	1	10	3	0	0	0	0	0	0	13	3				
<i>Cladosporium</i>	18	2	22	2	2	1	5	1	3	1	8	1	10	2	0	0	0	0	14	2	0	0	0	0	0	6	1	22	3	7	1	21				
<i>C. cladosporioides</i> (Fres.) de Vries	18	2	22	2	0	0	5	1	3	1	0	0	10	2	0	0	0	0	0	0	6	1	0	0	0	0	0	22	3	7	1	21				
<i>C. sphaerospermum</i> Penzig	0	0	0	2	1	0	0	0	0	8	1	0	0	0	0	0	14	2	0	0	0	0	0	0	0	6	1	0	0	0	0	2				
<i>Cochliobolus lunatus</i> Nelson and Haasis	0	0	10	2	0	0	0	0	0	7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	0	0	0	0	28				
<i>Cunninghamella elegans</i> Lendner	2	1	5	1	10	3	0	0	0	4	1	0	0	0	0	0	0	0	7	2	0	0	0	0	0	0	0	0	2	1	17	5				
<i>Cylindrocarpon destructans</i> (Zins.) Scholten	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	3	0	0	0	0	0	0	0	0	0	0	0	0	12	3				
<i>Dactyliella rhompospora</i> Grove	0	0	0	0	4	2	3	1	0	0	0	0	7	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	14	3	18	5				
<i>Emericella nidulans</i> (Eidam) Vuillemin	0	0	0	0	0	0	0	12	3	0	0	0	0	0	0	0	5	2	0	0	0	0	0	0	0	0	0	0	12	3	0	5				
<i>Fusariella indica</i> Roy and B. Rai Fusarium	0	0	0	10	2	15	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	2	0	0				
<i>F. oxysporum</i> Schlecht ex Fr.	0	0	0	0	20	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	2	0	0	0	0	0	2				
<i>Gibberella</i>	10	2	14	4	55	5	30	5	30	5	17	3	50	5	35	4	5	1	0	0	0	0	47	5	28	4	0	0	62	5	20	2				
<i>G. acuminata</i> Wr.	0	0	0	15	2	0	0	0	0	0	0	0	0	0	0	0	0	0	22	3	0	0	0	0	0	0	0	0	0	0	15	2				
<i>G. fujikuroi</i> (Sawada) Wollenw	0	0	0	0	4	5	20	4	0	0	17	3	50	5	10	1	0	0	0	0	0	0	0	0	0	0	0	0	32	4	20	2				
<i>G. intricans</i> Wollenw	10	2	14	4	0	0	10	2	0	0	0	0	15	3	5	1	0	0	0	0	25	3	15	2	0	0	0	30	4	0	30	5				
<i>G. pulicaris</i> (Fries) Sacc.	0	0	0	0	0	0	0	30	5	0	0	0	0	0	0	0	0	0	0	0	0	0	13	2	0	0	0	0	43	7	0	0				
<i>Mucor</i>	13	2	5	2	20	4	13	3	7	1	2	1	0	0	7	2	4	1	3	1	10	2	3	1	6	1	3	1	12	3	8	1				
<i>M. circinelloides</i> van Tiegh.	0	0	0	5	2	3	1	7	1	2	1	0	0	0	7	2	0	0	3	1	0	0	0	0	6	1	0	0	0	0	13	2				
<i>M. hiemalis</i> Wehmer	0	0	0	15	2	10	2	0	0	0	0	0	0	0	0	0	10	2	3	1	0	0	0	0	12	3	8	1	0	0	37	7				
<i>M. racemosus</i> Fresenius	13	2	5	2	0	0	0	0	0	0	0	0	0	0	4	1	0	0	0	0	0	0	0	0	0	3	1	0	0	0	17	3				
<i>Mycosphaerella tassiana</i>	0	0	0	4	1	0	0	0	0	0	0	0	0	0	11	3	0	0	0	0	0	0	3	1	0	0	0	0	14	4	4	1				
<i>Myrothecium verrucaria</i> (Albe & Sch.) Ditmar	0	0	0	0	5	1	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	2	1				
<i>Nectria haematococca</i> Berk. and Br.	0	0	10	2	0	0	0	0	0	0	0	0	5	1	20	2	0	0	15	3	10	2	0	0	0	0	0	0	0	0	15	3				
<i>Neosartorya fisherii</i> (Wehmer) Malloch & Cain	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	2	0	0	0	0	0	0	4	1	0	0	0	0	11	3				
<i>Papulospora sepedonioides</i>	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	1	7	1	0	0	12	1				
<i>Preuss Penicillium</i>	2	1	12	3	4	1	8	1	0	0	0	0	0	0	0	15	3	0	0	0	0	0	0	0	15	4	0	0	16	2	0	0				
<i>P. brevicompactum</i> Dierckx	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3				
<i>P. chrysogenum</i> Thom	2	1	9	2	0	0	0	0	0	0	0	0	0	0	15	3	0	0	0	0	0	0	0	0	0	0	0	0	17	4	0	0				
<i>P. corylophilum</i> Dierckx	0	0	0	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	20	3	0	0	0	0	0	0	0	0	0	0	4	1				
<i>P. oxalicum</i> Currie and Thom	0	0	0	0	0	8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	2	0	0	0	0	16	2				
<i>P. viridicatum</i> Westling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	4	0	0	0	0	0	0	0	0	15	4	0	0				
<i>Pestalotia pezizoides</i> de Not.	0	0	0	0	0	4	1	0	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	13	2	0	0	0	0	16	3				
<i>Pleospora herbarum</i> (Fr. & Fl.) Rabenh.	0	0	0	15	2	3	1	0	0	0	0	0	0	0	0	0	0	0	4	1	0	0	0	0	0	0	0	0	15	2	0	0				
<i>Rhinochloidiella schulzarii</i> (Link) Matsushima	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	2	10	5	0	0	0	0	0	0	0	0	0	0	7	2				
<i>Scopulariopsis</i>	4	1	9	2	7	2	0	0	0	0	0	0	9	1	13	2	2	1	0	0	3	1	0	0	4	1	0	0	17	3	26	7				
<i>S. brevicaulis</i> (Sacc.) Bainier	0	0	9	2	0	0	0	0	0	0	0	0	0	0	13	2	2	1	0	0	0	0	0	0	4	1	0	0	13	2	15	4				
<i>S. brumptii</i> Salvanet-Duval	0	0	0	0	7	2	0	0	0	0	0	0	0	0	9	1	0	0	0	0	0	0	0	0	4	1	0	0	0	0	11	3				
<i>S. candida</i> (Gueguen) Vuillemin	4	1	0	0	0	0	0	0	0	0	0	0	0	0																						

mum) were of rare frequency of occurrence.

Gibberella fujikuroi, *G. intricans* and *Aspergillus niger* were the predominant species (Table 2).

The broadest spectra of species were isolated on cellulose from the water samples which were collected from sacred lake (17 species related to 14 genera), mud samples (17 species related to 11 genera), and from water samples (14 species and 13 genera) of Abidos temple.

The narrowest spectrum of species was recorded in mud samples (7 species and 7 genera) which were collected from water wells of El-Karnak temple and Dandara temple on glucose as well as from water samples collected from the water wells of El-Karnak temple on cellulose Czapek's agar medium.

It can be said that these historical areas have no specific fungal flora. All these fungi (Tables 1 and 2) were previously recovered from various habitats in different geographical regions (3, 4, 16, 17, 23-25, 27) and in Egypt (1, 2, 10-15, 19, 20).

However there are some variations (Table 2) concerning the fungal density (populations), fungal species and frequency depending on the locality of sampling, the type of sample (water or mud) as well as the used media (glucose or cellulose Czapek's agar).

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