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Mycoflora of some medicine plants growing in the Egyptian eastern desert

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In total 40 species of fungi belonging to 16 genera were isolated from 2 media: glucose and cellulose--Czapek's. The collective fungal spectrum varied from one plant to another where the highest total count (1903 colonies/g) was obtained from *Artemisia cina* leaves on glucose-Czapek's and the lowest count (308 colonies) was recorded from *Solenostemma argel* root on glucose-Czapek's as well. The total number of fungi species varied with the variation of the tested plant.

INTRODUCTION

The saprophytic activity of microorganisms on leaf surface has been described by many investigators (Last, 1955; Dickinson, 1965; DiMenna, 1971; McBride, 1971; Pugh, Buckley, Mulder, 1972; Dickinson, Watson, Wallace, 1974; Kirk, 1982).

In Egypt, few investigations on the leaf and root surfaces have been conducted. Moustafa (1971) when searching for the origin of air fungal flora, compared the fungi species of the leaf surfaces of some plants, *Eucalyptus, Ficus* and *Zea* with those of soil and air. He concluded that the similarity between air borne and the leaf surface fungi would add further support to the view that the fungal spores come from the surface of plants rather than from the soil. Abdel-Fattah et al. (1977) who studied the mycoflora of root and leaf surfaces of broad-bean plants cultivated in Oases, observed that the phyllosphere contributed the broadest spectrum of species followed by rhizosphere, phylloplane and rhizoplane.

The eastern desert of Egypt, comprises about one-third of the Egyptian area, characterized by a wide variation of wild herbs and trees. A few inhabitants (Bedwen) live in these arid areas and earn their living by selling some medicinal herbs. Among these valuable herbs, *Artemisia, Cymbopogon* sp. and *Solenostemma* are used for treatments of many diseases such as disorders of the digestive system, allergy, liver, kidney and eye diseases.

The aim of the present work was to identify and determine the occurrence (number) of fungi species which contaminate some herbs. This may serve as an aid in determining the fungal species responsible for the deterioration of plants and those which produce harmful metabolites.

MATERIAL AND METHODS

Sixty samples (250 g each) of *Artemisia cina*, *Cymbopogon* sp. and *Solenostemma argel* were collected (10 samples of leaves and 10 samples of roots of each plant) randomly from different places in the east part of the desert. The samples were transferred to the laboratory in clean plastic bags and were stored at 3-5°C.

The dilution plate method was used as described by A b d e l - H a f e z (1981). One ml of the wash was transferred to a sterile Petri dish and cooled glucose or cellulose Czapek's agar and rose bengal (1/15000) as a bacteriostatic agent were added (M o u b a s h e r et al., 1971). Ten plates were used for each sample (5 plates for each medium). Plates were incubated at 28°C for 7 days and the developing colonies were identified, counted and calculated per g dry weight of leaf or root sample.

RESULTS AND DISCUSSION

In total 40 species and one variety belonging to 16 genera of were isolated from leaves and roots of *Artemisia cina*, *Cymbopogon* sp. and *Solenostemma argel*.

Altogether 33 species of fungi were recovered on glucose-Czapek's agar; 26 species belonging to 13 genera were collected from *Artemisia cina* phyllosphere and rhizosphere samples. The total number of species isolated from phyllosphere and rhizosphere samples of *Cymbopogon* sp. were 18 (and 1 var.) and 12 species (and 1 var.) respectively. In case of *Solenostemma argel* 17 species (and 1 var.) and 13 species of fungi were isolated from phyllosphere and rhizosphere samples respectively.

Aspergillus spp. were the most common species. They were encountered in all the samples except for some rhizosphere samples of *Solenostemma argel*. It was represented by 9 species (and 1 var.) and was noted in 65.48 % and 56.88 % of the total phyllosphere and rhizosphere samples of *Artemisia* respectively. In addition, they comprised 67.17 % and 53.11 % of *Cymbopogon* sp. samples and 63.90 % and 62.01 % of *Solenostemma argel* samples (Tabl. 1). *Aspergillus flavus*, *A. fumigatus* and *A. niger* were the most common species in all the samples, but *A. ochraceus* occurred less frequently and was recorded only from 20 % of phyllosphere samples of *Cymbopogon* sp.

El-Sharouny (1988), who was working on the phyllosphere fungi of *Mariophyllum spicatum*, isolated 28 species. Moharrum et al. (1989) recorded a total of 57 species from anise and fennel seeds. Moreover, most of these species were previously isolated from phyllosphere and phalloplane of cultivated (Abdel-Gawad, 1978; Abdel-Wahab, 1981), desert (El-Maghraby, 1980) and some medicinal plants (Abdel-Gawad, 1984).

Penicillium was recorded from all the plants. The most common species were *P. corylophilum*. *Penicillium* spp. which colonized 60 % and 65 % of anise and fennel seeds respectively (Moharrum, Abdel-Mallek, Abdel-Hafez, 1989), but El-Sharouny (1988) collected *Penicillium* spp. from *Myriophyllum spicatum* leaves in 58.3 % of the samples.

Alternaria was recorded from all the plants (Tabl. 1). El-Sharouny (1988) reported that *Alternaria* sp. was the most common fungi noted in the phyllosphere mycoflora of *Myriophyllum spicatum*. It was also recovered from the leaf surfaces of *Typha latifolia* (Pugh, Mulder, 1971) and on *Eucalyptus viminalis* (Cabral, 1985). – *Cladosporium* colonised only the phyllosphere samples of all the investigated plants (Tabl. 1). *C. herbarum* occurred abundantly in the phyllosphere samples of *Cymbopogon* sp. Moreover, *C. herbarum* occurred quite frequently on the leaves of *Myriophyllum spicatum* as previously reported by El-Sharouny (1988). – *Chaetomium olivaceum* occurred only in the samples of *Artemisia*.

Culvularia comprised the basic mycoflora of the studied plants. *C. lanata* was collected from 60 % of the rhizosphere samples of both *Artemisia* and *Cymbopogon* but it did not occur in rhizosphere samples of *Solenostemma argel*. However it was noted in 20 % and 40 % of the phyllosphere samples of *Cymbopogon* and *Solenostemma argel* respectively. The remaining species of *Curvularia* were less frequently encountered on the investigatd plants (Tabl. 1). Moubasher, El-Naghy, Abdel-Fattah (1971) and Abdel-Fattah, Moubasher, Abdel-Hafez (1977) reported that the species of the genus *Curvularia* comparised the basic mycoflora on the leaf surface of *Citrus* and broad-bean plants respectively. – *Drechslera* was frequently encountered on both *Artemisia cina* samples and on rhizosphere samples of *Cymbopogon* sp. (Tabl. 1). El-Sharouny (1988) observed that *Drechslera* was among the moderately encountered species on *Myriophyllum spicatum* species.

Fusarium was encountered commonly only on *Artemisia cina* and *Solenostemma argel* samples. *F. moniliforme* and *F. solani* was isolated from phyllosphere and rhizosphere samples of *Artemisia* respectively (Tabl. 1). Moharrum, Abdel-Mallek, Abdel-Hafez (1989) noted that *Fusarium* spp. was moderately encountered on anise and fennel plants. – *Trichoderma viride* was recorded from *Artemisia cina*, *Cymbopogon* sp. and *Solenostemma argel* samples. All the species of *Trichoderma* occurred less frequently on phyllosphere samples of *Solenostemma argel* (Tabl. 1). – *Stachybotrys astra* was isolated from phyllosphere and rhizosphere samples only of *Artemisia cina* and *Solenostemma argel*.

Table 1

Proportion of fungi in every sample (% C) and frequency per 10 samples (% F) of occurrence of fungi species isolated from glucose and cellulose agar at 28°C

Species	*Artemisia cina*								*Cymbopogon* sp.								*Solenostemma argel*							
	Glucose				Cellulose				Glucose				Cellulose				Glucose				Cellulose			
	Phyllo.		*Rhizo.*		*Phyllo.*		*Rhizo.*		*Phyllo.*		*Rhizo.*		*Phyllo.*		*Rhizo.*		*Phyllo.*		*Rhizo.*		*Phyllo.*		*Rhizo.*	
	C	F	C	F	C	F	C	F	C	F	C	F	C	F	C	F	C	F	C	F	C	F	C	F
Aspergillus	65.48	100	56.88	100	50.43	100	64.84	100	67.17	100	53.11	100	53.58	100	51.65	100	63.90	100	62.01	90	37.06	100	40.82	80
A. candidus Link	1.58	40	0.87	30	0.26	10	–	–	–	–	–	–	–	–	–	–	0.56	10	–	–	–	–	–	–
A. clavatus Desmaz.	0.74	30	0.36	20	–	–	–	–	1.68	40	–	–	–	–	–	–	–	–	–	–	–	–	–	–
A. flavus Link	14.19	100	8.77	80	8.48	70	7.67	70	30.23	100	19.59	90	13.32	80	20.40	70	18.19	50	28.90	70	13.71	60	19.81	80
A. flavus var. *columnaris* Raper & Fennel	4.20	80	1.01	50	1.56	60	5.78	60	6.88	70	10.94	40	7.43	60	8.82	50	4.94	30	–	–	0.76	20	–	–
A. fumigatus Fres.	21.60	100	23.04	100	32.01	100	42.83	100	9.49	80	16.47	90	29.59	80	17.28	70	20.00	80	15.91	50	17.26	40	17.63	70
A. nidulans (Eidam) Wint	0.16	20	–	–	–	–	–	–	0.34	20	–	–	–	–	–	–	–	–	–	–	–	–	–	–
A. niger Tieghem	10.98	80	21.81	90	6.40	40	6.77	80	16.54	80	5.65	40	3.22	40	5.15	40	17.14	80	17.21	50	5.33	30	3.38	20
A. ochraceus Withelm	–	–	–	–	–	–	–	–	0.25	20	–	–	–	–	–	–	–	–	–	–	–	–	–	–
A. terreus Thom	3.94	60	–	–	–	–	–	–	0.25	20	0.46	20	–	–	–	–	–	–	–	–	–	–	–	–
A. sydowi (Bain et Sart) Thom et Church	3.84	50	1.01	30	1.73	60	1.79	40	3.19	90	–	–	–	–	–	–	3.12	50	–	–	–	–	–	–
Alternaria	1.31	70	9.93	100	1.38	50	6.97	80	1.68	40	10.94	100	6.31	60	9.74	100	3.38	40	8.67	60	4.57	40	9.66	70
A. alternata (Fries) Keissl.	1.31	70	9.93	100	1.04	30	6.37	70	1.68	40	10.94	100	6.31	60	9.74	100	3.38	40	8.67	60	4.57	40	7.49	50
A. chlamydospora Mouchacca	–	–	–	–	0.35	20	0.60	40	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2.17	40
Cladosporium	1.16	70	–	–	0.26	20	–	–	7.05	100	–	–	–	–	–	–	3.38	40	–	–	–	–	0.48	10
C. cladosporioides (Fres.) de Vries	0.74	40	–	–	–	–	–	–	3.27	60	–	–	–	–	–	–	1.04	10	–	–	–	–	–	–
C. herbarum (Pers.) Link	0.42	50	–	–	0.26	20	–	–	3.78	80	–	–	–	–	–	–	2.34	10	–	–	–	–	0.48	10
Chaetomium	0.53	60	0.14	10	3.03	80	1.20	70	–	–	–	–	6.03	70	4.23	80	–	–	–	–	–	–	4.59	70
C. globosum Kunze: Fries	0.11	10	–	–	1.30	50	0.90	40	–	–	–	–	4.91	70	0.74	30	–	–	–	–	–	–	1.93	50
C. olivaceum Cooke et Ellis	0.42	40	0.14	10	1.73	70	0.30	10	–	–	–	–	1.12	50	3.49	70	–	–	–	–	–	–	2.66	60

Curvularia	0.58	30	3.84	80	0.35	20	1.10	20	0.84	20	1.50	70	0.28	10	1.65	40	4.16	50	–	–	0.51	10	–	–
C. lanata (Wakker) Boed.	–	–	0.80	60	0.26	20	0.90	20	0.50	20	1.27	60	0.28	10	1.65	40	3.64	40	–	–	0.51	10	–	–
C. ovoidea (Hiroe et Watn)	0.11	10	0.51	20	–	–	–	–	–	–	0.23	10	–	–	–	–	0.52	10	–	–	–	–	–	–
C. tuberculata Jain	0.47	20	2.54	80	0.09	10	0.20	10	0.34	20	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Drechslera	2.36	90	6.16	90	1.82	70	0.90	60	–	–	0.46	20	2.10	60	11.76	70	–	–	–	–	–	–	8.21	70
D. halodes (Drechsl.) Subram.) et Jain	0.74	60	1.09	60	1.30	60	–	–	–	–	–	–	2.10	60	11.76	70	–	–	–	–	–	–	6.76	70
D. spicifera (Bain.) v. Arx	1.63	70	5.07	50	0.52	40	0.90	60	–	–	0.46	20	–	–	–	–	–	–	–	–	–	–	1.45	40
Penicillium	15.45	100	2.32	100	10.03	100	3.29	100	1.09	40	6.91	80	5.47	70	0.55	10	2.34	50	2.27	50	3.30	60	0.72	10
P. chrysogenum Thom	4.78	60	0.72	40	6.06	90	0.80	40	–	–	–	–	3.37	70	–	–	–	–	1.62	40	–	–	0.72	10
P. citrinum Thom	2.31	50	0.43	20	0.43	20	–	–	–	–	–	–	–	–	–	–	–	–	0.65	10	–	–	–	–
P. corylophilum Dierckx	6.31	90	1.01	10	3.55	60	2.49	60	1.09	40	6.91	80	2.10	40	0.55	10	1.56	40	–	–	2.28	40	–	–
P. jenseni Zaleski	1.31	40	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.78	20	–	–	–	–	–	–
P. nigricans (Bain.) Thom	0.74	40	0.14	10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.02	20	–	–
Fusarium	6.94	100	6.74	80	6.31	80	2.09	60	–	–	–	–	5.47	70	2.76	70	6.49	30	1.62	40	2.54	70	2.42	40
F. moniliforme Scheldon	2.31	60	1.74	50	1.64	40	0.40	20	–	–	–	–	0.56	20	2.02	60	6.49	30	1.62	40	2.03	60	0.97	40
F. oxysporum Scheldon: Fr.	3.94	40	0.36	30	0.35	20	0.20	20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
F. solani (Mort.) Sacc.	0.68	40	4.64	80	4.33	80	1.49	60	–	–	–	–	4.91	70	0.74	20	–	–	–	–	0.51	10	1.45	40
Humicola	–	–	0.58	50	–	–	1.59	80	–	–	–	–	0.56	30	–	–	–	–	–	–	–	–	2.66	50
H. grisea Taaen	–	–	0.58	50	–	–	1.59	80	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
H. fuscoatra Taaen	–	–	–	–	–	–	–	–	–	–	–	–	0.56	30	–	–	–	–	–	–	–	–	2.66	50
Trichoderma	0.21	30	1.09	60	3.22	80	12.45	100	1.43	70	9.79	90	2.24	90	15.44	90	1.88	40	4.55	60	17.51	100	28.74	100
T. viride	0.21	30	1.09	60	2.96	80	12.05	100	1.43	70	9.79	90	2.24	90	15.44	90	1.54	30	4.55	60	17.51	100	28.74	100
Trichoderma sp.	–	–	–	–	0.26	30	0.40	20	–	–	–	–	–	–	–	–	0.34	10	–	–	–	–	–	–
Stachybotrys	0.42	60	1.52	80	2.78	90	5.08	90	–	–	–	–	–	–	–	–	0.34	10	10.06	50	4.82	60	2.17	50
S. atra Corda	0.42	60	1.52	80	2.78	90	5.08	90	–	–	–	–	–	–	–	–	0.34	10	8.12	50	4.82	60	2.17	50
S. chartarum (Ehrenb. ex Link) Huges	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.95	40	–	–	–	–
Paecilomyces *variotii* Bain.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3.57	60	–	–	–	–
Rhizopus *stolonifer* Ehrenb. ex Link	4.77	90	9.06	100	–	–	–	–	5.71	90	9.22	90	0.42	10	–	–	–	–	–	–	–	–	–	–
Scopulariopsis	0.26	40	0.80	60	3.46	70	0.50	30	5.04	80	–	–	16.13	100	2.21	40	12.99	80	7.14	70	22.84	70	–	–
S. brevicaulis (Sacc.) Bain.	0.26	40	0.80	60	3.29	70	0.50	30	5.04	80	–	–	16.13	100	2.21	40	12.99	80	4.22	60	22.84	70	–	–
S. brumpti Salvanet-Duval	–	–	–	–	0.17	10	–	–	–	–	–	–	–	–	–	–	–	–	2.92	50	–	–	–	–
Mucor *hiemalis* Wehmer	0.63	50	0.65	40	–	–	–	–	10.08	100	8.06	90	–	–	–	–	–	–	–	–	–	–	–	–
Verticillium sp.	–	–	–	–	–	–	–	–	–	–	–	–	1.40	50	–	–	–	–	–	–	–	–	–	–
Total	1903		1380		1156		1004		1191		868		713		544		385		308		394		414	

Rhizopus stolonifer colonized phyllosphere samples only of *Artemisia cina* and *Cymbopogon* sp. (Tabl. 1). – *Scopulariopsis brevicaulis* was isolated from the three investigated plants; it did not occur in the rhizosphere samples of *Cymbopogon argel*. – *Mucor hiemalis* was recorded from phyllosphere and rhizosphere samples of *Artemisia cina* and *Cymbopogon* sp. (Tabl. 1).

The remaining fungal species, including *Humicola* sp., *Stachybotrys chartarum*, *Paecilomyces variotii*, *Scopulariopsis brumptii* and *Verticillium* sp. were less frequently encountered.

The results of studies obtained from cellulose-Czapek's agar (Tabl. 1) were basically similar to those from glucose Czapek's agar.

The total counts of saprophytic fungi of leaf and root surfaces of both *Artemisia* and *Cymbopogon* were higher on glucose-Czapek's agar than on cellulose--Czapek's agar (1903 and 1380 colonies/g compared to 1156 and 1004 in case of phyllosphere and rhizosphere of *Artemisia* respectively) and (1191 and 866 compared to 713 and 544 colonies in case of phyllosphere and rhizosphere samples of *Cymbopogon* respectively). In case of *Solenostemma argel* a slight decline in the number of fungi species was recorded on glucose-Czapek's medium in comparison with the cellulose-Czapek's agar (385 and 308 compared to 394 and 414 colonies/g of leaves and roots respectively).

The total number of species in both tested plants varied on the two isolation medium (26 and 22 species on cellulose-agar compared to 34 and 27 species on glucose-agar in case of leaf and root samples of *Artemisia* spp. respectively). In total, 15 and 14 species were isolated from cellulose-agar and 19 and 13 species occurred on glucose agar on leaves and roots of the same plant. Altogether 13 and 16 fungi species were found on cellulose-agar and 18 and 13 species were isolated from glucose-agar on leaves and roots of *Solenostemma argel* respectively.

The number of *Aspergillus* species was slightly lower on cellulose-Czapek's agar. – *Alternaria chlamydospora* was isolated only on cellulose-Czapek's agar from *Artemisia* and *Solenostemma* samples. The frequency of occurrence of both *Chaetomium* spp. *Trichoderma* spp. and *Stachybotrys atra* was higher on cellulose--Czapek's agar. These species were previously reported as cellulose decomposers (Flannigan, 1970; Stewart, Walsh, 1972; Abdel-Hafez, Abdel--Kader 1980; Abdel-Gawad, 1984; Badran, 1986).

The mycoflora of the investigated plants was not specific, since fungi species were recovered with variable densities and frequencies from different types of plants and grains in Egypt and abroad. In addition common pathogenic fungi species occurred abundantly such as *A. fumigatus*, *A. flavus* and *Fusarium* species. These fungi cause serious deteriorations of plants (Christensen, Kaufmann, 1965, 1969; Maheshwari et al., 1985) and produce mycotoxins (Moubasher, El-Kady, Fargally, 1977; Dawit, Berhanu, 1985). Moreover the present results showed

that *Solenostemma argel* was the least hospitable plant followed in a descending manner by *Cymbopogon* sp. and *Artemisia cina*.

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