EFFECTS OF DETERGENTS ON RIVER NILE WATER MICROFLORA

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SUMMARY: Generally, the number of genera and species of microflora were found to be decreased in River Nile water-treated with different doses of detergents. While the counts of the micro-floral populations (bacteria, fungi, algae) were inhibited by detergent treatments, only those of algae, in some cases, were promoted either slightly or markedly. From the results obtained it could be stated that algae are more sensitive to detergents under investigation that bacteria and fungi while they could not tolerate the high levels used (5 or 10g/L). This may be due to the rise in water pH which was observed to be significantly reduced to 4.2 and 2.7, respectively.

Gram positive cocci were highly sensitive to all doses of all detergents used while Gram positive bacilli were inhibited by the low doses and completely suppressed in response to all mixture doses and to high doses of the other detergents. No stimulatory effect on bacteria by any detergent was observed. With regard to fungi, it was found that some species were more sensitive to detergents than the others. Some species were inhibited by some detergents and promoted by the others. Penicillium chrysogenum was the most tolerant species and could be regarded as detergent tolerant fungus and may be used as a biological indicator for water pollution by detergents.

It was also observed that some algal species were very sensitive to all detergents used while others were tolerant to the same detergents and sensitive to others. It was also observed that a third group of algae were resistant to high doses of different detergents. These could be considered as detergent-tolerant species and regarded as biological indicators of pollution.

Key Words: Microflora, detergent sensitivity, detergent resistance.

INTRODUCTION

The wide application of detergents leads to the accumulation of these compounds in water bodies, irrigation canals and agricultural soils. Environmental disturbances from such compounds induce changes in the structure and function of biological systems, As a result, many biologists have attempted to judge the degree and severity of pollution by such compounds by analyzing changes in biological systems.

The toxic effects of the detergents were studied by Sturm and Payne (22) on fish, by Hall (8), Payne and Hall (17), and Abdel-Hamid (1) on phytoplankton, by Hryhoryeva (9), Solovera *et. al.* (21), and Goebel *et. al.* (7) on bacteria, by Lee (11) and El-Sharouny (6) on soil fungi.

Several authors stated that certain species may be abundant in polluted water and such species could be regarded as pollution tolerant organisms and used as biological indicators for water pollution (2,15,16,18, 20,24,25).

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From the review of the literature it is concluded that no reports on the effects of the commercial detergents on the microflora (algae, bacteria and fungi) of the Nile water of Egypt have been done. It therefore seems important to obtain information on the inhibitory or stimulatory effect of the detergents and to what extent they may affect the numbers and composition of such flora.

MATERIALS AND METHODS

Sampling

Samples of water were collected from River Nile at Assiut area, Egypt in November 1992. Analysis of the following parameters have been determined according to the methods recommended by Mackerth *et. al.* (12), water temperature (22°C), pH (7.2), dissolved oxygen (6.5 mgL^{-1}), chloride (15 mgL^{-1}), bicarbonate (136 mgL^{-1}), carbonate (91 mgL^{-1}), phosphate-phosphorus (0.81 mgL^{-1}), sulphate-sulphur (2.1 mgL^{-1}), nitrate-nitrogen (1 mgL^{-1}), sodium (20.1 mgL^{-1}), potassium (2.8 mgL^{-1}), calcium (30 mgL^{-1}), magnesium (40 mgL^{-1}), total hardness (70 mgL^{-1}) and total suspended matter (80 mgL^{-1}).

Treatment of water with detergents

Four detergents (3 with Egyptian origin and 1 Saudi Arabian) were used in the current work named; Biocleana (produced by the Middle Eastern Company for chemical Industry with license from Home S.P.A. Latina, Italy); Lang produced by Egyptian Industries for synthetic Detergents, Al Sharif Group); Omo (produced by Libarifico Misr Egypt, with license from Uniliefere Export, LTD, Bristol, England), and Tide (produced by the Modern Industries Company, Dammam, Saudi Arabia). A mixture of equal amounts of the four detergents was also used. Three concentrations of each detergent (1.5 and 10 gL^{-1}) were used but the two high concentrations were lethal to all phytoplanktonic algae, so the concentrations were lowered in case of algae (0.1, 0.5 and 1 gL^{-1}). The microflora (bacteria, fungi and algae) were then analyzed. For bacteria and fungi, the detergent-treated water were analyzed 24 h after treatment on nutrient agar (for bacteria) and Czapek Dox agar and Sabouraud dextrose agar (for fungi). The following references were used for fungal identification: Pitt (19), Domsch *et. al.* (5) and Kozakiewez (10). For algae, the water samples treated with detergents were incubated at 25°C in an illuminated incubator (4000 lux) for 14 days after which the algae were counted and identified and the results were expressed as organisms per ml as recommended by Munawar (14), Viner (23), Biswas (3) and Crayton and Sommerfeld (4).

RESULTS

Effects of detergents on bacteria

The total counts of bacterial flora were significantly decreased by the all concentrations of all detergents (including the mixture) used. The detergents' mixture was highly toxic to bacterial flora since no bacteria were recorded at all concentrations of the mixture. Also, the high dose (10g/L water) of all detergents, but Omo, were lethal to bacteria. Gram positive cocci were very sensitive to all detergents at all doses used. With regard to Gram positive bacilli, they were completely absent in Nile water treated with the three doses of the detergents' mixture while decreased gradually with the increase of the detergents' doses till disappearance at the high one (10 g/L) of all detergents, but Omo. Such results have been reported previously by Hryhoryeva (9) and Solovera *et. al.* (21).

Effects of detergents on fungi

It could be observed that the total counts of fungal flora were mostly decreased by the increase of the detergents concentrations in Nile water while in one case when Omo detergents was used at the low dose (1 g/L), the counts were induced to increase on the account of significantly increase of the counts of two genera named *Paecilomyces* (P. lilacinus) and Penicillium (and in particular *P. chrysogenum*). In all cases, it was noted that the number of fungal genera and species were lowered by the gradual increase of the detergents concentrations. Such results have been reported on soil fungi by El-Sharouny (6) where he noted that Sodium Dodecyl Benzene Sulfonate (SDBS, which constitutes the main bulk of the most common detergents in Egypt) exerted a depressive effect on the total cellulose decomposing fungi.

Some fungi were completely disappeared from the Nile Water treated with all doses of all detergents used (including the mixture) such as: *Mucor racemosus, Nectria haematococca* and *Verticillium lateritium*. Others were also sensitive to all, except the low dose(s) of Biocleana: *Aspergillus ustus, A. zonatus,*

Table 1: Effect of some detergents on the numbers and compositions of bacterial and fungal flora at River Nile water.*

Microflora	Biocleana							Tide						Lang						Omo						Mixture					
		1 g/L		5		10		1		5		10		1		5		10		1		5		10		1		5		10	
Bacterial Flora		C	%	C	%	C	%	C	%	C	%	C	%	C	%	C	%	C	%	C	%	C	%	C	%	C	%	C	%	C	%
Gram positive bacilli	140	100	- 29	7	- 95	-	-	130	- 7	-	-	-	-	29	- 79	15	- 89	3	- 98	35	- 75	3	- 98	-	-	-	-	-	-	-	-
Gram positive cocci	1548	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total counts of bacteria	1688	100	- 94	7	99.6	-	-	130	- 92.3	-	-	-	-	29	- 98.3	15	- 99.1	3	- 97.9	35	97.9	3	- 99.8	-	-	-	-	-	-	-	-
Fungal Flora																															
Acremonium strictum W. Gams	5	11	+ 120	-	-	-	-	-	-	3	- 40	-	-	-	-	-	-	-	-	8	+ 60	-	-	-	-	2	- 60	-	-	-	-
Alternaria alternata (Fr.)	2	-	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0	-	-	-	-
Keissler	442	363	- 18	-	- 59	-	- 98	20	- 96	2	- 99	4	- 90	-	-	13	- 97	22	- 95	170	- 62	1	- 99	-	-	35	- 92	-	-	-	-
Aspergillus	2	1	50	180	-	1		-	-	-	-	3	+ 50	-	-	-	-	-	-	-	-	1	- 50	-	-	2	0	-	-	-	-
A. alutaceus Berk. & M. A. Curtis	5	-	- 73	-	-	4		-	-	-	-	-	-	-	-	-	-	-	-	115	+ 2200	-	-	-	-	-	-	-	-	-	-
A. candidus Link	334	90	-	-	- 83	2	- 99	10	- 96	2	- 99	1	- 99	-	-	6	- 98	10	- 97	4	- 98	-	-	-	-	21	- 94	-	-	-	-
A. flavo-furcatis Bat. & Maia	1	-	-	58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	-	-	-	-
A. fumigatus Eresenius	13	29	+ 123	17	+ 31	-	- 69	3	- 77	-	-	-	-	-	-	-	-	-	-	3	- 77	-	-	-	-	-	-	-	-	-	-
A. niger Van Tieghem	2	25	+ 1150	52	+ 2500	-	0	2	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. orzyzae (Ahlb.)Cohn.	21	93	+ 343	2	- 90	-	-	3	- 86	-	-	-	-	-	-	7	- 67	10	- 52	-	-	-	-	-	-	4	- 81	-	-	-	-
A. parasiticus Speare	1	71	+ 7000	45	+ 4400	-	-	-	-	-	-	-	-	-	-	-	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
A. sydowii (Bainier & Sartory) Thom & Church	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31	+ 288	-	-	-	-	7	- 13	-	-	-	-
A. tamarii Kita	48	48	0	5	- 90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	- 98	-	-	-	-	-	-	-	-	-	-
A. terreus Thom & Church	3	2	- 33	-	-	-	-	2	- 33	-	-	-	-	-	-	-	-	1	- 67	16	+ 433	-	-	-	-	-	-	-	-	-	-
A. ustus (Bainier) Thom & Church	3	2	- 33	1	- 67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A. zonatus Kwon & Fennell	1	2	+ 100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cladosporium	10	5	- 50	-	-	-	-	1	- 90	-	-	-	-	2	- 80	-	-	-	-	-	-	-	-	-	-	6	- 40	-	-	-	-
C. cladospporioides (Fres.) de Vries	5	4	- 20	-	-	-	-	1	- 80	-	-	-	-	2	- 60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C. splaerospermum Penz.	5	1	- 80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	+ 20	-	-	-	-
Emericella nidulans (Eidam) Vuill.	31	19	- 39	1	- 97	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mucor racemosus Pres.	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nectria haematoccocca Berk. & Br.	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Paecilomyces lilacinus (Thom) Samson	1	-	-	-	-	-	-	-	-	- 20	-	-	-	-	-	-	-	-	-	30	+ 2900	5	+ 400	-	-	-	-	-	-	-	-
Penicillium	38	40	+ 5	22	- 42	-	-	38	0	-	- 47	4	- 90	5	- 87	5	- 87	3	- 92	441	+ 1061	21	- 68	1	- 97	45	+ 18	14	63	1	- 97
P. brevicompactum Dierckx	2	-	-	-	-	-	-	1	- 50	-	-	-	-	-	-	1	- 50	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P. chrysogenum Thom	9	34	+ 278	22	+ 144	-	-	37	+ 311	20	+ 122	4	- 56	5	- 44	4	- 56	3	- 67	441	+ 4800	12	+ 33	1	- 89	23	+ 1566	14	+ 56	1	- 89
P. pinophilum Hedgcock	3	5	+ 67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22	+ 633	-	-	-	-
P. velutinum van Beyma	24	1	- 96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phialophora richardsiae (Nanf.) Contant	43	25	- 42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	- 93	-	- 95	-	-
Rhizopusb stolonifer (Ehrenb.) Lind	1	2	+ 100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichoderma sp.	1	1	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Verticillium lateritium Berkeley	1	-	-	-	- 9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total counts of fungi	584	466	- 20	203	- 65	7	- 99	59	- 90	25	- 96	8	- 99	7	- 99	18	- 97	25	- 96	657	+ 13	18	- 97	1	- 99.8	93	- 84	16	- 97	1	- 99.8
Total number of fungal genera	13	8		3		1		3		3		2		2		2		2		4		3		1		6		2		1	
Total number of fungal species	26	19		9		8		8		3		3		2		4		5		9		3		1		11		2		1	

*C=Counts of microorganisms were calculated colonies/3 ml Nile water for bacteria and colonies/9 ml for fungi.

%=Percentage of increase or decrease in counts comparing with control (=non-terated water).

Table 2: A list of species and their counts of some Nile phytoplankton populations recorded in cultures augmented with various concentrations of detergents after 14 days incubation period (algal counts X 10 cells/m).

Algal Groups and Species *	Start Inculum	Control	Biocleana						Tide						Lang						Omo						Mixture					
			0.1		0.5		1.0		0.1		0.5		1.0		0.1		0.5		1.0		0.1		0.5		1.0		0.1		0.5		1.0	
			C	%	C	%	C	%	C	%	C	%	C	%	C	%	C	%	C	%	C	%	C	%	C	%	C	%	C	%	C	%
Chlorophyta :																																
Actinastrum gracillinum G.M. Smith.	4	5	7	+ 40					3	- 40					5	0					7	+ 40					8	+ 60	5	0		
Ankistrodesmus falcatus(Corda) Ralfs	4	6	6	0					6	0					4	- 33	3	- 50			6	0	2	- 67			7	+ 16	5	- 16		
A. bibrianus(Nag.) Rab.	5	9	1	- 88	1	- 88															1	- 88					2	- 77				
A. spiralis(Turner) Lemm.	2	2	2	0	2	0																					3	+ 50				
A. convolutus(Nag.) Rab.	3	7	8	+ 14	5	- 28																										
Botryococcus braunii	5	8	8			0									5	- 28																
Chlorella sp.	10	13	22	+ 69	36	+ 176	41	+ 215	9	+ 13					7			- 13			5	- 38			+ 223		11	+ 38	5	- 38		
Chlorococcum humicola Lemm.	7	7	8	+ 14	9	+ 28	11	+ 64	15	+ 15	17	+ 30	31	+ 138	16	+ 23	18	+ 38	31	+ 138	11	- 15	18	+ 38	42	+ 86	10	- 23	13	0	40	+ 207
Cosmarium aciculare Menegch.	2	6	7	+ 17	7	+ 17			9	+ 28	9	+ 28	17	+ 142	10	+ 43	8	+ 14	11	+ 64	11	+ 64	16	+ 128	13		15	+ 114				
C. reniforme Lundell.	2	4	5	+ 25	7	+ 75			7	+ 17	7	+ 17			6			0			8	+ 33					7	+ 17	4	- 33		
Crucigenia benestrata Morren.	1	3																			4	0					5	+ 25				
Dactylococcus bicaudatus Nageli.	2	5	6	+ 20	6	+ 20	3	- 40	4	- 20	7	+ 40			5	0	4	- 20	8	+ 60	11	+ 266					8	+ 166				
Eudorina elugans Ehr.	1	2	4	+ 100	5	+ 150	3	+ 50	2	0	1	- 50			3	+ 50					9	+ 80	7	+ 40			3	- 40	1	- 80		
Gonium pectorale Chod.	2	2	3	+ 50					5	+ 150	1	- 50			4	+ 100					6	+ 200	3	+ 50								
Kirchneriella contorta (Schmidle) Bohlin.	6	10	13	+ 30	16	+ 60	8	- 20	7	- 30	9	- 10	11	+ 10	8	- 20	11	+ 10	13	+ 30	5	+ 150					7	+ 250				
Lagerheimia ciliata (Lag.) Chodat.	8	11																			7	- 30	7	- 30			10	0	11	+ 10		
Micractinium pusillum Presenius	7	13	16	+ 28					13	0					11	- 15					10	- 23	11	- 15								
Docystis lacustris Snow.	10	12	13	+ 8	15	25			11	- 8	8	- 33			7	- 41	11	- 8			8	- 33	8	- 33			13	+ 8				
O. solitaria West.	8	9	9	0	8	- 11																										
Pandorima morum (Müll) Bory	2	2	5	+ 150	6	+ 200	11	+ 450	4	+ 100	4	+ 100	5	150	3	+ 50	5	+ 150	7	+ 250	2	0	1	- 50			6	+ 200	5	+ 150		
Pediastrum boryanum Menegh.	7	8	11	+ 38	13	+ 62	16	+ 100	9	+ 13	11	+ 38	13	+ 62	8	0	10	+ 25	13	+ 62	7	- 13	5	- 38		+ 266	3	- 12	7	- 13		
Scenedesmus acuminatus(Lagerh.) Chod.	3	3	6	+ 100	8	+ 166	11	+ 266	4	+ 33	4	+ 33	9	+ 200	6	+ 100	8	+ 166	11	+ 266	4	+ 33	8	+ 166	13	- 83	6	+ 100	9	+ 200		
S. bifugatus G.M. Smith	2	6	7	+ 17	13	+ 116	20	+ 233	5	- 17	4	- 33	1	- 83	4	- 33	3	- 50	3	- 50	2	- 77	2	- 77	1		4	- 33	3	- 50		
S. curvatus Chod.	11	14	17	+ 21	17	+ 21	16	+ 14	9	- 36	5	- 64	4	- 71	6	- 57	3	- 79			5	- 64	2	- 86			5	- 64	4	- 71		
S. dimorphus Lemm.	8	9	11	+ 22	12	+ 33	11	+ 22	11	+ 22					8	- 11					13	- 44					9	0	4	- 55		
S. obliquus (Turp.) Kütz	7	7	10	+ 43	13	+ 86	15	+ 114	7	0	9	+ 29			8	+ 14	7	0			10	+ 43	8	+ 14			11	+ 57	13	+ 86		
S. quadricauda (Chod.) G.M. Smith	5	5	7	+ 40	15	+ 200	16	+ 220	3	- 40	2	- 60	8	+ 60	4	- 20	6	+ 20			15	+ 200					13	+ 160				
Spirogyra inflata Kütz	2	6	6	0	8	+ 33	3	- 50	4	- 67					8	+ 33					3	- 50										
Stigeoclonium tenue Arch.	1	3	3	0	6	+ 100	8	+ 166	4	+ 25					3	0					2	- 33					5		+ 66			
Tetraedron minimum A. Braun. Hgsg.	1	5																														
Tetraspora cylinderica (W. West)	1	4	5	+ 25																												
Westella sp.	1	6	8	+ 33	9	+ 50	10	+ 66	7	+ 17	11	+ 83	17	+ 183	13	+ 117	13	+ 117			11	+ 83	16	+ 166			16	+ 166	16	+ 166		
Ulathrix zonata Zonata	1	2	3	+ 50	5	+ 150																					1	- 50			40	
Total	141	204	228	242		203			158		108		116		154		110		97		183		114		69		183		105			
Bacillariophyta :																									+ 154						20	
Amphora ovalis Kütz	3	6	8	+ 33	8	+ 33	13	+ 116	11	+ 83	11	+ 83	6	0	6	0	8	+ 33	11	+ 83	11	+ 83	13	+ 116	15		12	+ 100	16	+ 166		+ 233
Bacillaria paradona Gmelin	5	9	11	+ 22	9	0			8	- 11					11	+ 22	6	- 44			10	+ 11					8	- 11	6	- 44		
Biddulphia Loevis (Ehrbg)	2	2	6	+ 200	5	+ 150	5	+ 150	3	+ 50	2	0			3	+ 50	2	0			3	+ 50	1	- 50		+ 28	1	- 50	1	- 50	13	
Caloniis amphisbaera (Bory) Clev.	3	7	11	+ 64	10	+ 43	13	+ 86	8	+ 14	10	+ 43	10	+ 43	6	- 14	5	- 28	4	- 43	3	- 57	7	0	9	- 33	8	+ 14	13	+ 86		+ 86
Cocconies costata Gregory	1	9	15	+ 66	9	0	6	- 33	9	0	9	0	9	0	11	+ 22	8	+ 11	5	- 44	7	- 22	6	- 33	6	+ 136	4	- 55	8	- 11	40	
Cyclotella austrica (Rerag.) Hust	2	11	17	+ 55	22	+ 100	31	+ 118	18	+ 64	22	+ 100	25	+ 127	11	0	16	+ 46	30	+ 173	21	+ 91	18	+ 64	26	+ 54	13	+ 18	24	+ 118	20	+ 263
Cymbella vertricosa Kütz	3	11	13	+ 18	18	+ 64	19	+ 73	15	+ 36	13	+ 18	17	+ 127	22	+ 100	27	+ 146	26	+ 154	13	+ 18	18	+ 46	19		16	+ 63	22	+ 100		+ 81
Fragilaria capucina Desm.	1	8	8	0					6	- 25					4	- 25																
Gyrosigma attenuatum Kütz Cl.	2	7	13	+ 86	17	+ 142	18	+ 156	3	- 57					4	- 43					1	- 86										
Melosira distans (Ehr.)	4	6	9	+ 50											9	+ 50											3	- 50				
M. granulata (Ehr.)	2	2	4	+ 100																												
M. islandica (D. Müll)	7	7	8	+ 14											5	+ 150					6	+ 200					1	- 50				
Nevicula oblonga Kütz	5	8	8	0	10	+ 26															3	- 61										
N. muticopsis Van Heurch.	3	3	7	+ 133	9	+ 200			13	+ 333					16	433					11	- 61										
Nitzschia amphibia Grun.	8	10	13	+ 30	30	+ 200	32	+ 220	13	+ 30	16	+ 60	22	+ 120	15	+ 50	19	+ 90	21	+ 110	17	+ 266				+ 90	8	+ 133	11	+ 266		
N. palea Wand M	11	11	16	+ 45	16	+ 45	15	+ 36	13	+ 18	13	+ 18	19	+ 72	18	+ 63	18	+ 63	19	+ 72	18	+ 70	19	+ 90	19	+ 150	20	+ 100	22	+ 120	36	+ 260
Synedra ulma (Ehr.)	7	8	8	0	15	+ 88	22	+ 175	10	+ 25	11	+ 38	11	+ 38	11	+ 38	10	+ 25	16	+ 100	18	+ 125	19	+ 138	20		21	+ 90	18	+ 63	31	+ 181
Total	69	125	175		178		174		130		107		130		137		101		134		142		114		136		11	+ 38	13	+ 78	11	+ 38
Cyanophyta :																											126		154			
Anabaena variablis Ralfs F.	3	5	6	+ 20	9	+ 80																										
Chroococcus turgidus (Kütz) Nag.	5	5	7	+ 40	4	- 20	4	- 20	6	+ 20					4	- 20					9	+ 80					7	+ 40				
Oscillatoia aghardhii Gromant.	10	11	20	+ 81	31	+ 181	38	+ 245	22	+ 100	27	+ 145			16	+ 45	18	+ 63	18	+ 63	11	0	17	+ 55	18	63	9	- 18	11	0	20	+ 81
O. formosa Bory	8	10	11	+ 10	13	+ 30	16	+ 60	11	+ 10	11	+ 10	10	0	16	+ 60	17	+ 70	22	+ 120	18	+ 80	15	+ 50	20	+ 100	11	+ 10	16	+ 60	31	+ 210
O. limose Lemm.	6	10	20	+ 100	19	+ 90	17	+ 70	18	+ 80	11	+ 10	13	+ 30	10	0	11	+ 10	11	+ 10	13	+ 30	11	+ 10	11	+ 10	8	- 20	10	0	16	+ 60
O. splendida Greville	3	5	11	+ 120	12	+ 140	15	+ 200	7	+ 250	9	+ 350									11	+ 120	16	+ 220								
Phormidium mölle Kütz	5	10	13	+ 30	18	+ 80	20	+ 100	10	0	11	+ 10			8	- 20	10	0			11	+ 10					13	+ 30	11	+ 10		
Spriulina laxa G.M. Smith	1	4	4	0	11	+ 225	16	+ 300	3	- 25	2	- 50			6	+ 50					4	0	5	+ 25			4	0	3	- 25		
Total	33	60	92		117		126		67		71		23		60		50		51		67		59		49		52		51		67	
Number of species	58	58	55		46		33		43		30		20		45		28		19		47		29		15		44		31		11	
Total number of organisms	243	389	495	+ 8	537	+ 1	503	+ 1	355	- 8	286	- 26	269	- 30	351	- 10	267	- 31	282	- 28	392	+ 1	287	- 28	255	- 34	361	- 7	310	- 20	218	- 29

C=Absolute counts, %=% of increase or decrease, * Filamentous and colanial organisms were counted as one organism.

Emericella nidulans, Penicillium velutinum, Rhizopus stolonifer and *Trichoderma sp.*; of Omo: *Aspergillus candidus* and Paecilomyces lilacinus; of mixture: *Alternaria alternata* and *Aspergillus flavo-furcatis.* A toxic effect of SDBS on several soil fungi such as *Fusarium oxysporum* and *Trichoderma* sp. has been reported by El-Sharouny (6).

Most of the remaining fungi were recorded to be sensitive to detergents particularly at the high dose used (10 g/L) such as: *Aspergillus alutaceus, A. flavus, A. tamarii, A terreus, Cladosporium cladosporioides, C. sphaerospermum, Penicillium brevicompactum and Phialophora richardsiae.*

Stimulatory effects of most detergents used on some fungal species were observed during the current study. Tide induced only *Penicillium chrysogenum* to increase its counts by the low two doses. On the other hand Biocleana induced several fungal species to increase their numbers particularly at the low dose(s) such as: *Acremonium strictum, Aspergillus fumigatus, A. niger, A. oryzae, A. parasiticus, A. zonatus, Penicillium chrysogenum, P. pinophilum* and *Rhizopus stolonifer.* Omo promoted several fungal populations as: *Acremonium strictum,* Aspergillus candidus, A. sydowii, A. terreus, Paecilomyces lilacinus and Penicillium chrysogenum. The detergent mixture also induced both Cladosporium sphaerospermum and Penicillium chrysogenum populations while lang has no stimulatory effect on any fungus recorded (Table 1). Aspergillus niger and Penicillium chrysogenum showed significant promotion by some SDBS doses applied by El-Sharouny (6) on soil fungi.

It could be concluded that the lang is the most toxic detergent used during the current study on fungal population (numbers and composition) since no stimulatory effect was recorded for any fungi. The other detergents named Biocleana, Tide, Omo and the mixture acted either as inhibitors for most fungi or promoters for the others. Also, it could be noted that Penicillium chrysogenum was the most tolerant fungus for the detergents used, so it could be regarded as detergent-(pollution-) tolerant fungal species.

Effects of detergents on the phytoplankton

In all cases, the numbers of genera and species of algae were found to be gradually decreased in Nile water treated with the different concentrations of detergents (including the mixture) under investigation. With regard to the counts of different algal species, mostly they were decreased with the increase of the detergents' concentration but in some cases, they were raised either slightly or significantly by some doses of some detergents (Table 2). Yamane (26) reported that nonionic and anionic washing agents may exhibit an inhibitory effect upon algal growth. Stimulatory effect of detergents on the growth of algae such as Pandorina morum has been recorded (1). Such results have been obtained previously by Adam *et. al.* (2) and Mohammed *et. al.* (13) working on closed pond water and Nile water receiving industrial wastes at Assiut, respectively.

Only two algal species belonged to Chlorophyta named *Lagerheimia ciliate* and *Tetrahedron minimum* were found to be sensitive to all doses of all detergents used. Other three species: two belonged to Chlorophyta and one to Bacillariophyta were sensitive to all doses of all detergents except for the low dose (0.1 g/L) of Biocleana: *Melosira islandica* and *Tetraspora cylindrica* and for the low two doses (0.1 and 0.5 g/L) of Biocleana: *Oocysts solitaria.*

Two algal genera of each of Chlorophyta (*Crucigenia fenestrata and Gonium pectorale*) and Bacillariophyta (*Fragillaria capucina, Melosira distans and M. granulata*) were sensitive at least to the high two doses (0.5 and 1 g/L) of all detergents.

Ten algal species that could tolerate all detergents' doses were found one from chlorophyta (Chlorella sp.) seven from Bacillariophyta (*Amphora avalis, Caloneis amphisbaena, Cyclotella austrica, Cymbella vertricosa, Nitzschia amphibia, N. palea and Synedra ulna*) and two from Cyanophyta (*Oscillatoria formosa and O. limosa*). These species could be considered here as pollution-(detergents-) tolerant species and could be regarded as biological indicators of water pollution. Most of the above species were reported previously as pollution-tolerant species (2,15).

Stimulatory effects of detergents on algae (represented by the increase in their numbers) were observed during the current study on fourteen algal species mostly by all doses of all detergents used *Chlorella sp., Chlorococcum humicola, Pandomina morum, Scenedesmus acuminata, Westella sp., Cyclotella austrica, Cymbella verticosa, Nitzschia amphibia, N. palea, Synedra ulna, Oscillatoria aghardii, O. formosa, O. limosa* and *Amphora ovalis.* At the same time some algal species were stimulated by some detergents and inhibited by others (Table 2). Such results have been reported by Yamane (26) and Abdel-Hamid (1).

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