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Response of Nile Water Phytoplankton to the Toxicity of Cobalt, Copper and Zinc

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Abstract: The tolerance limits of Nile water phytoplankton to cobalt, zinc and copper was investigated. The results of this study show that the lower doses of tested metals enhanced the growth of Nile phytoplankton which is represented by increase in cell number. On the other hand the moderate and higher concentrations of these metals markedly inhibited the growth of Nile phytoplankton. The pigment fractions of Nile water phytoplankton under various levels of the three metals responded more or less in a similar trend to that of cell number. Regarding species composition, total disappearance of some species with metal treatments was observed, when the number of other species increased.

Key words: Heavy metals, phytoplankton, River Nile, toxicity

INTRODUCTION

Many pollutants like pesticides, oil hydrocarbons, heavy metals as well as thermal and radioactive pollution can get into aquatic environments after direct or indirect release from industries, agriculture and households (Mutlak *et al*., 1979). As an important group of these various chemical substances, heavy metals may be deposited into all ecosystems. Phytoplanktons (microalgae), the primary producers at the base of the aquatic food chain, are the first targets to be affected by heavy metal pollution. There are more studies on heavy metals toxicity to the structure of the phytoplanktonic communities. Earlier work on heavy metal toxicity (Butcher, 1932, 1955; Whitton, 1970; Say and Whitton, 1981) dealt with discharges of copper works effluent into the River Churnet.

Lasheen *et al*. (1990) was used the algal assay procedure bottle test to investigate the effect of Cd, Cu and Cr (VI) on the growth of Nile water algae. The results of this investigation indicated that Cd has slight inhibitory effects on algal growth at low concentration (0.05 mg L^{-1}), while it was inhibiting algal growth at higher concentration (> 1.0 mg L^{-1}). In contrast, Cu and Cr did not affect algal growth in all investigated concentrations. Combinations of Cd with Cu and Cr seemed to interact synergistically. The synergism between Cd and Cu was more pronounced than between Cd and Cr. Clear changes in the diversity and redundancy of algal structure took place after metal addition. The inhibitory effect of the studied metals was in the following order: Cd-Cu > Cd - Cr > Cd > Cu > Cr. Aly (1995) studied the impact of certain heavy metals on some physiological and morphological characteristics of Nile water phytoplankton. Fathi and El-Shahed (1998) studied the response of Nile water phytoplankton to mercury and copper toxicity. On the other hand, Shehata *et al*. (1999) investigated the toxic effect of multi metals mixture which exist simultaneously in aquatic ecosystem on natural phytoplankton assemblages (green algae, blue-green algae and diatoms). The data showed that Nile water algae has ability to remove and accumulate metals in the following order therefore Zn > Cd > Ni > Cu > Cr. In addition, phytoplankton has ability to recover from the stress of metals when eliminated from the media and the recovered biomass was nearly equivalent to that before exposing to metals stress. The overall effect of metals mixture depending on the type and number of metals, the algal community structure and ratio between different morphological forms of algae (unicellular, colonial and filamentous).

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Akira *et al*. (2005) studied the sensitivity of nine marine microalgal species (consisting of five divisions and seven genera) to the five heavy metals, Cu (II), As (V), Sb (III), Pb (II) and Cd (II). Copper sulphate treatment is widely used as a global and empirical method to remove or control phytoplankton blooms without precise description of the impact on phytoplanktonic populations. Recently, Anne-H *et al*. (2006) studied the effects of two copper sulphate treatments on natural phytoplanktonic communities sampled in the spring and summer seasons, were assessed by indoor mesocosm experiments. They reported that the effect on phytoplanktonic community structure and composition was dependent on seasonal variation. This could be related to differences in community composition and thus to species sensitivity to copper and to differences in copper bioavailability between spring and summer.

No much work had been published concerning the toxicity of heavy metals to phytoplanktonic communities. Therefore the main objective of this investigation are to study the tolerance limits of Nile water phytoplankton to some selected metals (cobalt, Zinc and copper) and the changes might took place in species composition, diversity and redundancy of community structure.

MATERIALS AND METHODS

Surface water samples collected (9 am), in 10 L containers which were taken directly to the laboratory for experiments. The sampling site is located directly south of El-Minia Bridge. The samples for these experiments were collected in February 2005. The phytoplankton of Nile water sample was concentrated by sedimentation. A standard initial inoculums of the concentrate water sample was inoculated to culture flasks (500 mL each) that contained 100 mL of nutrient medium Chu' 10 (Nichols, 1973).

The culture flasks were supplied with various concentrations of Cobalt, Copper and Zinc ranging 10^{-6} to 10^{-9} M, these concentrations were suggested after some preliminary experiments. All culture flasks were incubated at 25°C and a light intensity of 500 Lux for 10 days. After the incubation period the algae were filtered through glass fiber filter for pigments determinations and 10 mL was fixed with Lugol's solution for counting and identification of phytoplanktonic organisms.

Pigments content were determined spectrophotometrically according to Jeffrey and Humphery (1975). The phytoplanktonic organisms were quantitatively counted after fixing and preserving with Lugol´s solution and 4% neutral formalin. The counts of phytoplanktonic algae (unicellular, colonial or filaments) were performed using Sedgewick-Rafter cell and the results were then expressed as counts per liter. The algal taxa were identified according to standard references, including Smith (1950), Desikachary (1959), Fott (1972), Bourrelly (1981), Prescott (1987), Komarek and Fott (1988) and Krammer and Lange-Bertalot (1986, 1988, 1991a, b).

RESULTS AND DISCUSSION

Three experiments were performed to study the influences of Co^{2+}, Cu^{2+} and Zn^{2+} on the growth and genera composition of Nile water phytoplankton. Co^{2+}, Cu^{2+} and Zn^{2+} were added alone to the experiments medium (Chu' 10 medium) at concentration 10^{-6}, 10^{-7}, 10^{-8} and 10^{-9} M. Prior to the experiments, the initial concentration of chlorophyll a, b and c were 1.048, 0.461 and 0.040 μg L^{-1}, respectively and the numbers in each identified algal group, chlorophyceae, bacillariophyceae and cyanophyceae were 1.31, 2.27 and 0.94×10^{6} L^{-1}.

The data presented in Table 1 clearly demonstrated that cobalt supply generally had a favorable effect on the growth and therefore on the pigment content in the treated samples. The data further shows that little difference was observed in the pigment content, between the control (cobalt-free

Table 1: Effect of cobalt, copper and zinc on total number and pigments content (μg L^{-1}) of Nile water phytoplankton at various concentrations

Metal conc. (M)	T. number (No. $\times10^6$ L^{-1})	Pigment content (μg L^{-1}) Chl. a	Chl. b	Chl. c
Cobalt				
0.00	7.79	1.06	0.40	0.02
10^{-9}	14.75	2.00	0.60	0.08
10^{-8}	14.21	1.62	0.99	0.02
10^{-7}	13.20	1.67	0.79	0.03
10^{-6}	5.00	1.63	0.70	0.04
Copper				
0.00	8.06	3.11	1.27	0.16
10^{-9}	17.03	3.15	1.36	0.14
10^{-8}	11.04	1.89	0.63	0.16
10^{-7}	4.47	1.20	0.87	0.18
10^{-6}	3.89	1.33	0.97	0.05
Zinc				
0.00	9.74	1.11	0.72	0.01
10^{-9}	13.35	3.15	1.36	0.14
10^{-8}	12.91	1.89	0.87	0.16
10^{-7}	11.34	1.20	0.63	0.18
10^{-6}	7.97	0.56	0.25	0.06

Table 2: Effect of cobalt, copper and zinc on the percentage composition of the main algal groups of Nile water phytoplankton at various concentrations

Metal conc. (M)	Percentage of algal group Chlorophyceae	Cyanophyceae	Bacillariophyceae	Total
Cobalt				
0.00	71.52	19.70	8.78	100
10^{-9}	83.67	11.86	4.47	100
10^{-8}	80.51	15.83	3.66	100
10^{-7}	82.80	13.34	3.86	100
10^{-6}	72.82	22.32	4.86	100
Copper				
0.00	67.25	2.47	30.28	100
10^{-9}	82.91	0.29	16.80	100
10^{-8}	86.86	2.62	10.51	100
10^{-7}	53.02	4.70	42.28	100
10^{-6}	55.78	5.65	38.57	100
Zinc				
0.00	80.49	11.29	8.22	100
10^{-9}	85.62	6.29	8.09	100
10^{-8}	80.40	11.77	7.83	100
10^{-7}	85.54	7.66	6.80	100
10^{-6}	56.58	32.12	11.30	100

medium) and the samples treated with different doses of cobalt. The data further shows that total numbers of Nile water phytoplankton was highest at all cobalt treatments in compare to the control value. The maximum count (14.75×10^6 L^{-1}) was detected at the culture supplemented by 10^{-9} M Co^{2+}, whereas the minimum (5.0×10^6 L^{-1}) at 10^{-6} M culture. In general the total count of algae increased or decreased to a small extent as compared with the control. From another point of view the total percentage composition of the three main phytoplankton groups shows that chlorophyceae dominated the phytoplankton (between 72.82 and 83.67%) in all treated culture. Bacillariophyceae ranked second and Cyanophyceae ranking third (Table 2).

The culture treated with 10^{-9} M of copper had a little stimulatory effect on the pigment synthesis compared to the control (cobalt-free culture). However, the copper supplementation significantly reduced the tested growth parameters (Pigment content and total number) of Nile water phytoplankton in a concentration dependent manner (Table 1). The drop was more prominent at the larger (10^{-8} M; 10^{-7} M; 10^{-6} M) than smaller doses (10^{-9} M). It is clear that the inhibition went parallel to increase in metal concentrations. The highest total algal number was associated with a notable increase in Chlorophyceae growth. On the other hand, Chlorophyceae was represented the most prevalent group throughout the incubation period. The higher percentage of Chlorophyceae was found to be 86.86% at concentration 10^{-8} M. On the other hand Bacillariophyceae was fluctuated and Cyanophyceae was reduced (Table 2).

The data of Table 1 reveal a marked and progressive activation in the biosynthesis of pigment up to the level of 10^{-8} M Zinc, followed by a prominent drop at 10^{-6} M or above. The total species number was highest at the culture supplemented by 10^{-9}, 10^{-8} and 10^{-7} M Zinc compared with the control. The highest total number was associated with a notable increase in Chlorophyceae. On the other hand the data of Table 2 shows the dominated of Chlorophycease with percentage composition fluctuated from 58.58 to 85.54%. In case of Cyanophyceae, the stimulatory effect was noticed at higher concentrations (10^{-6} M). Bacillariophyceae had no regular trend with respect to genera composition.

Generally, the results of this study show that the lower doses of tested metals enhanced the growth of Nile phytoplankton which is represented by increase in cell number. On the other hand the moderate and higher concentrations of these metals markedly inhibited the growth of Nile phytoplankton. The pigment fractions of Nile water phytoplankton under various levels of the three metals responded more or less in a similar trend to that of cell number. This indicates that all the tested metals had interfered with the metabolic pathways. Khalil (1997) reported that the growth of *Phormidium fragile* decreased with increased concentration of mercury from 0.01 to 1.5 mg L^{-1}. Fathi *et al*. (2000) reported that the higher doses of cobalt, mercury and vanadium strongly affected the growth criteria of *Scenedesmus bijuga* and *Anabaena spiroides*. The inhibitory effects of heavy metals on pigment accumulation, noticed in this investigation particularly at higher doses, may be attributed to inhibition of reductive steps in their biosynthetic pathway (De Filippis *et al*., 1981). Okamoto *et al*. (2001) reported that heavy metals are able to induce oxidative stress in chloroplasts of the unicellular alga *Gonyaulax*, particularly under acute conditions in addition to oxidative damage to proteins and lipids occurred in cells. The observed concentration-dependent reduction in pigments content and total number of phytoplankton are in good agreement with the findings of Fathi (1995), Hofner *et al*. (1987), Rai *et al*. (1991), Shehata *et al*. (1999), Fathi *et al*. (2000), Fathi (2002), Sponza (2002) and Fathi *et al*. (2005).

Table 3 contains the identified phytoplanktonic species in the cultures supplemented by Cobalt. Forty two genera were identified; 23 belong to Chlorophyceae, 8 to Cyanophyceae and 11 to Bacillariophyceae. Thirty three species out of this total number (42 genera) were found to grow in the Cobalt-free culture. At treated cultures the maximum number of algal species was found to be 30 at 10^{-9} M culture, whereas the minimum was found to be 21 at 10^{-6} M culture. At all Cobalt treated culture seven algal species were present in a high occurrence (*Chlorella* sp., *Closterium pritebaradiamum*, *Scenedesmus acuminatus* (lagerh.) Chod.; *S. acutus* var. *acutus* Meyen; *S. quadricauda* (Turp.); *S. quadricauda longispina*; *Cyclotella meneghiniana* Kütz). On the other hand Cobalt supply had a favorable effect on the growth of some species such as *Ankistrodesmus falcatus* Ralfs; *A. fusiformis* Corda; *A. gracilis* Korshikor; *Dictyosphaerium pulchellum* wood; *Elakatothrix biplex* Hindax; *Tetraedron minmum*; *Phormidium* sp.; *Fragilaria copunica* Desmazieres; *Melosira granulate* (E hr.) Ralfs; *Tabellaria* sp. Other genera were present in low numbers or totally disappeared in all treated culture.

With respect to genera composition of the Nile water phytoplankton treated with various concentrations of Copper (Table 4), the results clearly shows that, *Ankistrodesmus falcatus*, *A. gracilis*, *Closterium pritebaradiamum*, *Coleastrum combricum*, *Dictyosphaerium pulchellum*, *Elakatothrix biplex*, *Monoraphidium convolutum*, *Scenedesmus acuminatus*, *S. acutus*, *S. quadricauda*,

Table 3: The influence of cobalt on the species composition of the Nile water phytoplankton at various concentrations (No. $\times10^4$ L^{-1})

Algal species	I	Co^{2+} (M)				
		0	10^{-9}	10^{-8}	10^{-7}	10^{-6}
Chlorophyceae						
Actinastrum hantzschii Hag	0.20	18	4			
Ankistrodesmus falcatus ralfs	0.20	29	47	29	8	2
Ankistrodesmus fusiformis corda	0.01	25	39	16	7	12
Ankistrodesmus gracilis korshikor	0.01	2	22	15	15	10
Chlorella sp.	0.20	38	230	149	159	82
Closterium pritebaradiamum	0.02	51	132	157	119	63
Coleastrum combricum Archer	0.02	15	3	10	8	12
Cosmarium sp.	0.01					
Dictyosphaerium pulchellum wood	0.04	25	10	11	9	2
Elakatothrix biplex Hindax	0.02	18	28	17	29	5
Kirchneriella sp.	0.01	34	38	33	3	
Monoraphidium arcuatum (Kors.) Hind.	0.02	4	19	9		13
Monoraphidium convolutum Corda	0.02	10	25	18	4	
Oocystis parra	0.10					
Pediastrum duplex Meyen.	0.04	2	2			
Pediastrum simplex Meyen.	0.04	5	2			
Scenedesmus acuminatus (lagerh.) Chod.	0.08	24	67	84	79	20
Scenedesmus acutus var. *acutus* Meyen	0.10	84	151	112	154	36
Scenedesmus quadricauda (Turp.)	0.06	107	294	281	231	62
Scenedesmus quadricauda longispina	0.04	23	102	145	152	34
Selenastrum bibraianum Reinsch	0.02					
Staurastum uniseratum Nnygaard	0.04	5	6	10	5	
Tetraedron minmum (A.Br.) Hansg.	0.01	51	13	39	88	17
Cyanophyceae						
Cylindro spermum sp.	0.20	3				
Gloeocapsa sp.	0.20	3	2	2	3	
Merismopedia elegans Braun	0.40	14	5			
Microcystes sp.	0.04					
Oscillatoria sp.	0.02	25				
Phormidium sp.	0.02	23	59	48	46	23
Rivularia sp.	0.04					
Spirulina sp.	0.02	2				
Bacillariophyceae						
Coccinus sp.	0.20					
Cyclotella meneghiniana kutzina	0.60	24	59	71	100	53
Cymatopleura solea var. apiculata	0.20					
Fragilaria construens	0.40		5	14	8	31
Fragilaria capunica Desmazieres	0.20	12	19	14	10	7
Melosira granulate (E hr.) Ralfs.	0.40	15	14	17	18	20
Navicula pupula	0.20	9	3			
Pinularia sp.	0.01	2		15		
Rhopalodia gibba	0.02	76	48	69	24	20
Syndra ulna Ehrenbery	0.02					
Tabellaria sp.	0.02	19	27	21	10	7
Total No. of species	42.00	33	30	26	24	21

I = Start inoculums

Cyclotella meneghiniana, *Fragilaria construens*, *Melosira granulate* and *Tabellaria* sp., were the most frequent genera in the control and in the Copper treated samples. The counts of some genera, namely *Closterium pritebaradiamum*, *Coleastrum combricum*, *Scenedesmus acutus*, *S. quadricauda* and *Cyclotella meneghiniana* show that the low dose of copper 10^{-9} M had a stimulatory effect on the growth of these algae. However this stimulatory effect was partially eliminated with increasing copper concentrations. On the other hand there was no regular trend in counts of the other genera, some treatments were promotive and some were depressive. Results also showed that some phytoplanktonic species had disappeared totally in all Copper treatments such as, *Actinastrum hantzschii* Hag;

Table 4: The influence of copper on the species composition of the Nile water phytoplankton at various concentrations (No. $\times 10^4$ L^{-1})

		Cu^{2+} (M)				
Algal species	I	0	10^{-9}	10^{-8}	10^{-7}	10^{-6}
Chlorophyceae						
Actinastrum hantzschii Hag	0.20					
Ankistrodesmus falcatus ralfs	0.20	2	8	9		
Ankistrodesmus fusiformis corda	0.01	2	20	21		
Ankistrodesmus gracilis korshikor	0.01	5	52			
Chlorella sp.	0.20					
Closterium pritebaradiamum	0.02	178	533	416	90	109
Coleastrum combricum Archer	0.02	11	4	14	8	
Cosmarium sp.	0.01					
Dictyosphaerium pulchellum wood	0.04	21	24	7	3	5
Elakatothrix biplex Hindax	0.02	20	33	31	5	6
Kirchneriella sp.	0.01	4	36	22		
Monoraphidium arcuatum (Kors.) Hind.	0.02	4				
Monoraphidium convolutum Corda	0.02	38	4	12		
Oocystis parra	0.10	2				
Pediastrum duplex Meyen.	0.04	4				
Pediastrum simplex Meyen.	0.04	2				
Scenedesmus acuminatus (lagerh.) Chod.	0.08	24	42	12	14	5
Scenedesmus acutus var. *acutus* Meyen	0.10	44	127	145	57	40
Scenedesmus quadricauda (Turp.)	0.06	159	434	165	42	33
Scenedesmus quadricauda longispina	0.04	35	83	95	14	18
Selenastrum bibraianum Reinsch	0.02					
Staurastum uniseratum Nnygaard	0.04	3				
Tetraedron minmum (A.Br.) Hansg.	0.01		12	3		
Cyanophyceae						
Cylindrospermum sp.	0.20	19		3		
Gloeocapsa sp.	0.20					
Merismopedia elegans Braun	0.40		4			
Microcystes sp.	0.04					
Oscillatoria sp.	0.02					
Phormidium sp.	0.02			26	21	22
Rivularia sp.	0.04					
Spirulina sp.	0.02	2				
Bacillariophceae						
Coccinus sp.	0.20		2			
Cyclotella meneghiniana kutzina	0.60	155	236	71	124	83
Cymatopleura solea var. *apiculata*	0.20					
Fragilaria construens	0.40	4	35	31	23	23
Fragilaria capunica Desmazieres	0.20	3				
Melosira granulate (E hr.) Ralfs.	0.40	12	12	12	25	12
Navicula pupula	0.20	14				
Pinularia sp.	0.01	4				
Rhopalodia gibba	0.02	39	9	12	11	12
Syndra ulna Ehrenbery	0.02					
Tabellaria sp.	0.02	13	4	20	4	8
Total No. of species	42.00	28	21	19	14	13

I = Start inoculums

Chlorella sp., *Cosmarium* sp., *Selenastrum bibraianum* Reinsch, *Gloeocapsa* sp., *Microcystes* sp., *Oscillatoria* sp., *Rivularia* sp., *Cymatopleura solea*, *Synedra ulna* (Table 4).

Regarding to species composition on the cultures with Zinc, a total disappearance of some species was observed, when the number of other species increased (Table 5). The results show that 30 species out of the total number (42 genera) were found to grow in the control culture. *Chlorella* sp, *Dictyosphaerium pulchellum* Wood, *Scenedesmus acuminatus* (Lagerh.) Chod., *S. acutus* var. *acutus* Meyen, *S. quadricauda* (Turp.), *S. quadricauda longispina*, *Phormidium* sp. and *Cyclotella meneghiniana* Kütz were the most prevailing genera in all Zn treated cultures. On the other hand some

Table 5: The influence of zinc on the species composition of the Nile water phytoplankton at various concentrations (No. $\times 10^4$ L^{-1})

		Zn^{2+} (M)				
Algal species	I	0	10^{-9}	10^{-8}	10^{-7}	10^{-6}
Chlorophyceae						
Actinastrum hantzschii hag	0.20	2	32	2	2	40
Ankistrodesmus falcatus ralfs	0.20	49	37	18	62	12
Ankistrodesmus fusiformis corda	0.01	4	27	32	36	
Ankistrodesmus gracilis korshikor	0.01	32	44	21	40	
Chlorella sp.	0.20	131	151	174	226	86
Closterium pritebaradiamum	0.02	66	64	73	37	
Coleastrum combricum Archer	0.02	11	14	15	13	12
Cosmarium sp.	0.01					
Dictyosphaerium pulchellum wood	0.04	53	67	32	44	23
Elakatothrix biplex Hindax	0.02	42	34	73		
Kirchneriella sp.	0.01	12	14	8	15	4
Monoraphidium arcuatum (Kors.) Hind.	0.02	2	8	98	34	2
Monoraphidium convolutum Corda	0.02	13	37	21	10	16
Oocystis parra	0.10					
Pediastrum duplex Meyen.	0.04					
Pediastrum simplex Meyen.	0.04	4	2	10		
Scenedesmus acuminatus (lagerh.) Chod.	0.08	53	50	73	72	32
Scenedesmus acutus var. *acutus* Meyen	0.10	91	221	177	139	90
Scenedesmus quadricauda (Turp.)	0.06	114	193	306	134	57
Scenedesmus quadricauda longispina	0.04	67	147	107	93	45
Selenastrum bibraianum Reinsch	0.02					
Staurastum uniseratum Nnygaard	0.04	4	7	2	7	
Tetraedron minmum (A.Br.) Hansg.	0.01	29		3	37	32
Cyanophyceae						
Cylindrospermum sp.	0.20		4	20	12	10
Gloeocapsa sp.	0.20					
Merismopedia elegans Braun	0.40	2	8	6	5	
Microcystes sp.	0.04					
Oscillatoria sp.	0.02	50				
Phormidium sp.	0.02	58	72	126	70	80
Rivularia sp.	0.04					
Spirulina sp.	0.02					
Bacillariophceae						
Coccinus sp.	0.20					
Cyclotella meneghiniana kutzina	0.60	22	73	69	27	12
Cymatopleura solea var. *apiculata*	0.20					
Fragilaria construens	0.40	4				
Fragilaria copunica Desmazieres	0.20	4				
Melosira granulate (E hr.) Ralfs.	0.40	2	9	20	16	12
Navicula pupula	0.20	13				
Pinularia sp.	0.01	2				
Rhopalodia gibba	0.02					
Syndra ulna Ehrenbery	0.02	12	19	8	13	
Tabellaria sp.	0.02	21	7			
Total No. of species	42.00	30	25	25	23	17

I = Start inoculums

species such as *Ankistrodesmus falcatus* Ralfs; *A. fusiformis* Corda; *A. gracilis* Korshikor; *Coleastrum combricum* Archer; *Monoraphidium arcuatum* Hind.; *Monoraphidium convolutum* Corda; *Melosira granulate* were present in low numbers., whereas other were totally disappeared.

It is known that the different organisms, however, have different sensitivities to the same metal and the same organisms may be more or less damaged by different metals (Fathi and Falkner, 1997). Regarding species composition, total disappearance of some species with metal treatments was observed, when the number of other species increased. In case of disappearance a direct toxic effect indicating a sensitivity of some species to used metals as, *Actinastrum hantzschii* Hag; *Chlorella* sp., *Cosmarium* sp., *Selenastrum bibraianum* Reinsch, *Gloeocapsa* sp., *Microcystes* sp., *Oscillatoria* sp., *Rivularia* sp., *Cymatopleura solea*, *Synedra ulna*. However in case of increase, metal resistant and tolerant species as *Ankistrodesmus falcatus*, *A. gracilis*, *Closterium pritebaradiamum*, *Coleastrum combricum*, *Dictyosphaerium pulchellum*, *Elakatothrix biplex*, *Monoraphidium convolutum*, *Scenedesmus acuminatus*, *S. acutus*, *S. quadricauda*, *Cyclotella meneghiniana*, *Fragilaria construens*, *Melosira granulate* and *Tabellaria* sp., were appeared. On the other hand the highest total number was associated with a notable increase in Chlorophyceae. Foster (1982) and Fathi (1995) revealed that resistance to heavy metals may be a phenomenon occurring especially among these green algae. Bacillariophyceae appeared to be sensitive to metal treatments, whereas Cyanophyceae had no regular trend in their response to heavy metals treatments, which confirm the results of Noriko *et al*. (1989), Fathi and El-Shahed (1998) and Shehata *et al*. (1999). This species-dependent metal sensitivity and the ecosystem-dependent metal availabilities might influence the composition of phytoplankton communities. Thus, we can concluded that metal availability might play a selective role in phytoplankton succession.

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