

BIOLOGICAL AND CHEMICAL EVALUATION OF SOME DRINKING WATER SITES ON THE RIVER NILE, EGYPT

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ABSTRACT

A total of 225 representative water samples, from 3 different sites, was collected from Helwan, Giza and Rod El-Farag drinking water treatment plants in the greater Cairo city. In all water samples, fluorine, mercury, lead and cadmium were not detected. While chlorine, nitrate, chromium, nickel, zinc and copper were found. The raw water of river Nile recorded high counts of all the examined microorganisms. After water treatments, almost all the pathogenic bacteria could not be detected except *Bacillus cereus* and cyanobacteria. Results indicated that pathogenic bacterial isolates are belonging to the genera *Staphylococcus*, *Salmonella* and *Aeromonas*. Also, *B. cereus* was isolated from all water samples. The examined bacteria were inhibited by the culture filtrates of the different cyanobacterial isolates. *Mycobacterium phlei*, *B. subtilis* and *Listeria monocytogenus* were the most inhibited by the cyanobacterial filtrates, particularly, when the filtrates were concentrated by lypholization. It is, therefore, concluded that fresh water cyanobacteria is a possible source of water contamination that may harmfully affect the drinking water quality. Therefore, it could be suggested that such approach must be considered in water treatment plants.

Key words: *bacterial pathogens, chemical pollution, Cyanobacteria, drinking water, River Nile.*

1. INTRODUCTION

Drinking water is an important resource around the globe. Little research has been focused on identifying the bacteria in water distribution systems or how treatment techniques could alter the composition (Wagner and Loy, 2002). Although the majority of bacterial organisms are probably killed by the chlorination process, during peak microbial water concentration periods and during turbidity events, disinfection effectiveness could be potentially compromised. The majority of these culturable bacteria described in drinking water networks are included in the phylum *Proteobacteria* and to a lesser extent in the phyla *Actinobacteria*, *Firmicutes* and *Bacterioidetes* (Norton and LeChevallier, 2000). Some of the commonly detected genera include *Pseudomonas*, *Caulobacter*, *Aeromonas*, *Acinetobacter* and *Bacillus*. Also, bacterial species that cause gastrointestinal illness in people may include: *Campylobacter* sp., *Clostridium perfringes*, *Corynebacterium* sp., *Escherichia coli*, *Salmonella* sp., and *Yersinia enterocolitica* (Adam *et al.*, 2005 ; Lehtola *et al.*, 2007).

Cyanobacteria form dense growth known as blooms in eutrophicated waters. The presence of

these blooms in freshwater bodies can pose a significant threat to the health of humans and animals, as certain species of cyanobacteria can produce toxins. The most important cyanobacterial toxins are the microcystins, which are produced by *Microcystis*, *Planktothrix* and *Anabaena* (Carmichael, 1994).

Production of drinking water complying with international quality standards does not necessarily ensure good drinking water for the consumer (Stefan *et al.*, 2006). Composition of the autochthonous microbial community may promote the survival and growth of hygienically relevant and potentially pathogenic bacteria (LeChevallier, 1990). Several studies helped to characterize some bacteria residing in bulk water (Emtiazi *et al.*, 2004) or in biofilms at various points in the drinking water supply system (Lee and Kim, 2003). The majority of bacterial cells in natural communities are either nonculturable by current cultivation methods or present in a viable but-nonculturable state (Oliver, 2000). Thus, the real composition and dynamics of bacterial communities in drinking water distribution systems are far from being assessed and understood in detail.

The present study was planned to evaluate the microbiological and chemical traits of some drinking water supplies in both Cairo and Giza cities. Samples were collected from the raw water of river Nile before three major water treatment plants and from the treated water out of these plants as well as from different sites among the drinking water supplies network.

2. MATERIALS AND METHODS

2.1. Samples collection and preparation

Samples were collected from three major drinking water treatment plants, two in Cairo and one in Giza cities. The total was 225 representative samples each of the raw water source (H1, G1 and R1). The treated water outlet from each plants (H2, G2 and R2) and the distribution network water (H3, G3 and R3), were investigated (Table 1). The distribution of network water was sampled from tap water in three different areas in Helwan (H), Giza (G) and Rod El-Farag (R). Sodium thiosulfate was added to neutralize residual chlorine in drinking water samples. Samples were collected three times in August, November 2007 and January 2008. Water samples were stored in ice box during transportation to the laboratory, then immediately analyzed.

Table (1): Description of raw water sources and treatment processes in the 3 water distribution systems.

Treatment plant	Samples type	Samples No.	The total volume of water produced m ³ /day	Distribution area
Helwan	Raw water (H1)	15	370.000	Helwan, Hadayk Helwan, Kafr El Elo, Elmshroaa El Amriky and 15 May
	Treated water (H2)	15		
	Tap water* (H3)	45		
Giza	Raw water (G1)	15	150.000	Giza, Bolak Eldakror, El Haram, El-Malik Faisal
	Treated water (G2)	15		
	Tap water* (G3)	45		
Rod El-Farag	Raw water (R1)	15	900.000	Rod El-Farag, Ramsis, El Sabteah
	Treated water (R2)	15		
	Tap water * (R3)	45		

*Tap water at different sites within each distribution system

2.2. Physico-chemical analyses

Measurements of water pH, temperature, electrical conductivity (EC) and total soluble salts (TSS) were tested using a pH meter (Cole-parmer pH bench-top) model MX-59003-20 and EC meter (Cole-parmer EC bench-top) model MX-19950-00.

The anions and heavy metals were determined according to Black (1965), while the concentration of nitrates was measured using a standard autoanalyzer.

The concentration of chromium (cr), nickel (ni), mercury (hg), cobalt (Co), zinc (zn), copper (cu), lead (pb) and cadmium (cd) were determined by inductivity coupled spectrometer plasma (ICP), Plasma 400.

2.3. Microbiological analyses

2.3.1. Enumeration, isolation and identification of microorganisms from water samples

The standard agar plate method was used for the determination of total viable counts on glucose- yeast extract agar (Postage, 1969). Plates were incubated at 37°C for 48 h.

Colstridia and *Bacillus cereus* were enumerated as described by Difco (1984) and Holt et al., (1994), respectively. Counts of staphylococci were determined using Baird-parker agar (Baird Parker, 1962) and identified according to Holt et al., (1994). The MPN of total and fecal coliform were obtained using MacoConkey broth medium incubated at 37 °C and 44.5 °C for 24 h, respectively (Difco, 1984). Existence of *Salmonella* was detected according to A.O.A.C. (1998) and identified according to Holt et al., (1994). The *Aeromonas* were determined following the method of Rippey and Cabelli (1979) and were confirmed to genus *Aeromonas*

according to Monfort and Baleux (1990) and the *Aeromonas* sp were identified according to Popoff (1984). The presence of typically *Vibrio* colonies were examined (APHA, 1985) in all tested water sample.

2.4. Cyanobacteria isolation and identification

2.4.1. Culturing of cyanobacteria

Liquid enrichment cultures were prepared for various water samples using liquid Allen and Arnon's medium (Allen and Arnon, 1955). Several successive transfers were made on the same

medium and all isolates were subjected to purification and identified according to Rippka *et al.*, (1979).

2.4.2. Maintenance and culturing conditions

All isolates obtained were maintained under photoautotrophic growth conditions in Allen and Arnon's medium (Allen and Arnon, 1955). Both enrichment and stock cultures were grown under continuous illumination, with Philips Fluorescent white lamps, at a relatively low light intensity (400-500 lux) and incubated at 30°C.

2.4.3. Cyanobacterial metabolites assay

Three cyanobacterial isolates were inoculated in Allen and Arnon broth, incubated at 30 °C in light intensity about 400, 500 lux for 30 days and

2.4.4. Disc diffusion method

Disc diffusion method was carried out to determine the antimicrobial activity according to Sleigh and Timburg (1981). Antimicrobial activity was measured as diameter (mm) of growth inhibition zones around loaded filter disc.

Statistical analyses were carried out using SAS (1990). Variables having a significant differences were compared using Duncan's multiple range test (Duncan, 1955).

3. RESULTS AND DISCUSSION

3.1. Physical and chemical analyses of water samples

Table (2): Some properties of the tested water samples .

Samples	pH			Samples Temperature (°C)			E.C. (m mohs/cm)			T.S.S. (ppm)		
	August*	November	January	August	November	January	August	November	January	August	November	January
H1	8.0	8.26	8.13	32	20.1	26.05	0.51	0.419	0.464	234.6	192.7	213.6
H2	7.9	8.18	8.04	31	20	25.5	0.52	0.434	0.477	239.2	199.6	219.4
H3	8.0	8.20	8.10	29	20	24.5	0.52	0.43	0.475	239.2	197.8	218.5
G1	7.9	8.18	8.04	32.5	22.1	27.3	0.52	0.454	0.487	239.2	208.8	224.0
G2	7.0	8.23	7.61	31	22	26.5	0.53	0.444	0.487	243.8	204.2	224.0
G3	7.2	8.30	7.75	28	22	25	0.53	0.44	0.484	242.8	202.4	222.6
R1	8.1	8.28	8.19	33	23.5	28.2	0.45	0.431	0.465	229.5	198.2	213.9
R2	8.0	8.30	8.15	32	23.8	27.9	0.50	0.43	0.465	230.0	197.8	213.9
R3	8.2	8.32	8.26	29	22.5	25.7	0.50	0.43	0.465	230.0	197.8	213.9

* Five samples collected at each sampling date

centrifuged to separate biomass. The culture supernatants were used for studying their antimicrobial active metabolites against a number of microorganisms using the disc diffusion method (Abdel-Moein and Barakat, 2005). The test microorganisms representing Gram-negative bacteria (*E. coli*, *Pseudomonas aerogenosa*, *Salmonella typhimurium*), Gram-positive bacteria (*Micrococcus spp.*, *Bacillus subtilis*, *Sarcina spp.*, *Staphylococcus aureus*, *Listeria monocytogenes*) and acid fast bacteria (*Mycobacterium phlei*) were used in the present study. Such strains were obtained from the Department of Agricultural Microbiology, Fac. Agric., Cairo University and grown in a nutrient glucose agar medium.

The chemical analysis of the different water samples (Tables 2 and 3) reveals that the pH of the water which ranged between 7.0 and 8.2 and the temperature differed according to the time of sampling from 20 to 32.5 °C. Treatment of the river Nile raw water reduced the E.C and the total soluble salts (T.S.S.). This, obviously, was due to the partial removal of some of the suspended and soluble salts from the raw water during treatment process.

Regarding the heavy metal contents of the examined water, the drinking water was free from Hg, Co, Pb and Cd, while, Cr and Cu existed in concentrations ranged between 0–651.12 and 2.3–84.13 µg/l, respectively. In addition, zinc and Ni

were detected in all samples but in lower quantities e.g. 1.51–48.91 and 0–59.47 $\mu\text{g/l}$, respectively compared with Cr and Cu. In some cases, the heavy metal contents of raw water increased by treatment processes. This observation

cfu/ml in raw water samples. In this respect, the lowest microbial count was observed in water samples taken from Giza treatment plant while the highest was recorded in the raw water sample from Helwan. However, their counts were reduced

Table (3): Anions, cations and heavy metals ($\mu\text{g/L}$) content of the collected water samples.

Water samples*									
	G1	G2	G3	R1	R2	R3	H1	H2	H3
Anions									
Cl	18.00	4.00	3.00	9.00	1.00	1.00	7.00	7.00	5.00
NO ₃	331.00	11.00	10.00	335.00	16.00	16.00	13.00	333.00	333.00
Cation									
NH ₄	778.00	443.00	390.00	617.00	130.00	120.00	361.00	370.00	330.00
Heavy metals									
Cr	3.22	530	531	651.12	1.39	1.6	ND	1.10	1.2
Ni	1.05	218.83	213	594.77	ND	ND	297.39	185.16	186.18
Zn	1.51	48.91	49.3	4.97	3.01	3.3	12.01	2.54	2.6
Cu	3.17	84.13	84.70	2.66	66.32	66.90	2.52	2.33	2.8

* For explanation refer to Table (1); ND, not determined.

is in conformity with that reported by El-Gendi (2003) indicating the increase in heavy metal contents of drinking water due to the processes of water treatments.

3.2. Microbiological analyses of water samples

The occurrence of microbial pathogen in raw, treated or tap water poses a considerable human health hazard. Water-borne human diseases are considered as a major limiting factor in drinking water quality. Different microbial densities in water samples are presented in Tables (4, 5 and 6) and Fig. (1). Data show that the total microbial count ranged between 0.5×10^7 and 2.9×10^7

to a minimum of 0.2×10^2 cfu/ml⁻¹ as a result of water treatment in Rod El-Farag. This trend was also observed with regard to the total count of spore-forming bacteria. The traditional indicators of water pollution e.g., total and faecal coliforms, *E. coli*, *Salmonella* and *Staphylococcus* were detected in all samples of raw water but not in the treated water (Tables, 5 and 6). This might indicate the efficiency of the water treatment processes in the examined plants. In this respect, the river Nile water at Helwan area was less polluted than the other sites. This could be suggested by comparing the counts of the total,

Table (4): Total viable count and total spore-forming bacteria (cfu ml⁻¹) in raw and treated water samples.

	Total count					
	Raw water ($\times 10^7$)			Treated water ($\times 10^2$)		
	August	November	January	August	November	January
Giza	2.90	1.00	1.40	1.30	0.50	0.60
Rod El-Farag	2.30	0.80	1.90	0.50	0.00	0.40
Helwan	1.20	0.50	0.70	0.70	0.20	0.50
LSD (0.05)	0.358	0.132	0.212	0.154	0.052	0.085
	Spore forming					
	Raw water ($\times 10^7$)			Treated water ($\times 10^2$)		
	August	November	January	August	November	January
Giza	1.90	1.00	1.30	0.40	0.20	0.30
Rod El-Farag	1.40	0.20	0.90	0.30	0.20	0.00
Helwan	1.70	0.50	1.60	1.30	0.20	0.40
LSD(0.05)	0.296	0.199	0.231	0.156	Ns 0.035	0.058

ns, non significant.

faecal coliforms and staphylococci in the raw water at all sites.

Pathogenic *B. cereus* and *Clostridium* sp. were detected in relatively high numbers in all raw water samples (Table, 6), while drinking water samples were clostridia free. Unexpectedly, *B. cereus* was observed in all the tested tap water samples but in low numbers of 1 and 5 x 10¹ cfu/ml.

waters (El-Taweel, 2003). Also Harakeh *et al.*, (2006) isolated *E.coli* and *Salmonella* from fresh water in Lebanon. While Hamner *et al.*, (2007) detected *E.coli* serotype O157:H7 from the Ganges river in India. In addition, El-Taweel and Shaban (2001) reported the presence of some pathogenic bacteria in drinking water from some tested drinking water treatment plants in Egypt.

However, Aeromonds and *Vibrio cholera* were

Table (5): Count (cells/ml) of total and faecal coliform in water samples.

Water samples	Coliform (cells/ml)					
	Total			Faecal		
	August	November	January	August	November	January
G1	1.5 x 10 ⁷	1 x 10 ⁷	1.3 x 10 ⁷	1 x 10 ⁷	0.8 x 10 ⁷	0.9 x 10 ⁷
R1	1.5 x 10 ⁷	0.8 x 10 ⁷	1.5 x 10 ⁷	1 x 10 ⁷	0.2 x 10 ⁷	0.3 x 10 ⁷
H1	1 x 10 ⁷	0.7 x 10 ⁷	0.9 x 10 ⁷	0.8 x 10 ⁷	0.2 x 10 ⁷	0.8 x 10 ⁷

Table (6): Total count of some pathogenic bacteria in water samples.

Water samples	<i>Clostridium</i> c.f.u. ml ⁻¹ .	<i>Staphylococcus</i> sp. c.f.u. ml ⁻¹ .	<i>Bacillus cereus</i> c.f.u. ml ⁻¹ .	<i>Salmonella</i> sp.	<i>E. coli</i> Cell. ml ⁻¹	<i>Vibrio cholera</i>	<i>Aeromonas</i> sp. c.f.u. ml ⁻¹ .
G1	2.5 x 10 ⁴	9.0 x 10 ²	4.2 x 10 ²	D	1.3 x 10 ⁷	ND	8 x 10 ²
G2	ND	ND	2 x 10 ¹	ND	ND	ND	ND
G3	ND	ND	2 x 10 ¹	ND	ND	ND	ND
R1	2.5 x 10 ⁴	1.8 x 10 ²	1.2 x 10 ⁸	D	0.3 x 10 ⁷	ND	2 x 10 ³
R2	ND	ND	7 x 10 ¹	ND	ND	ND	ND
R3	ND	ND	1 x 10 ¹	ND	ND	ND	ND
H1	2.5 x 10 ³	8 x 10 ²	60 x 10 ²	D	8 x 10 ⁷	ND	7 x 10 ²
H2	ND	ND	ND	ND	ND	ND	ND
H3	ND	ND	5 x 10 ¹	ND	ND	ND	ND
LSD (0.05)	0.327	0.200	0.421		0.512		1.558

D = Detected, ND = not detected

The presence of *B. cereus* in these samples could be attributed to that *Bacillus*, being able to form endospores of high persistence against harsh conditions and can tolerate the different processes applied during water treatment. Previous reports indicated the possible existence of some G-negative bacteria in some Egyptian drinking

not found in both treated water and tap water samples, while Aeromonds was found in raw water without evidence for the presence of *Vibrio cholera*. The presence of the pathogen *Aeromonas hydrophilia* in fresh water was reported in USA (Katz and Smith, 1980) and in Egypt (El-Taweel, 2003).

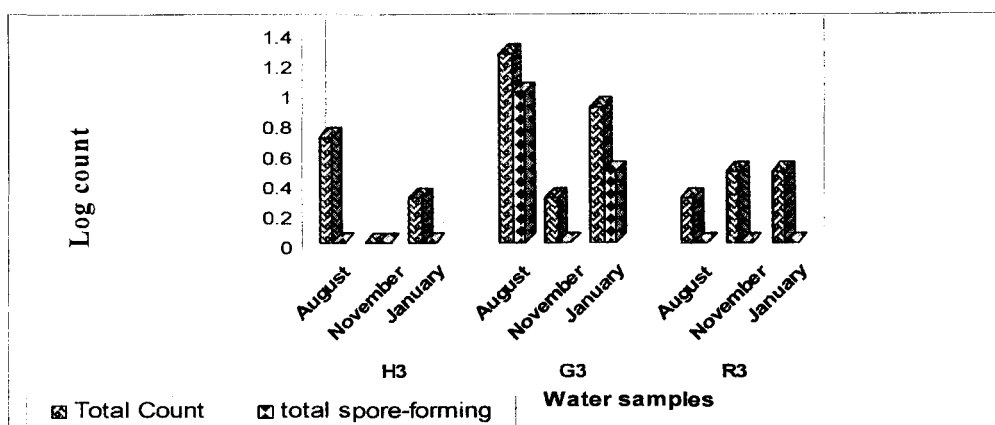


Fig. (1): Total viable count (log counts) and total spore-forming bacteria in tap water.

3.3. Identification of bacterial isolates

Two hundred bacterial isolates were obtained from representative colonies developed on the specific media of *Staphylococci*, *Salmonella*, *B. cereus* and *Aeromonas*. Isolates were purified and examined for cultural, morphological and biochemical characteristic (Fig. 2). Fifty three Gram-positive, catalase positive cocci were isolated from plates of the specific media for counting staphylococci in raw water samples. These isolates were differentiated according to

Holt *et al.*, (1994) into *Micrococcus* spp. (25%) and *Staph. aureus* (75%). Drinking water samples were free from *Staph. aureus* and all the identified *Staph. aureus* strains were originated from the raw river Nile samples taken from Giza (33.4%) and Rod El-Farag (66.6%). This might refer to heavy water pollution of the river Nile water stream at Rod El-Farag and Giza locations. *B. cereus* (75 strains) was isolated from all water samples except to the treated water samples from Helwan. Strains were confirmed as *B. cereus* as

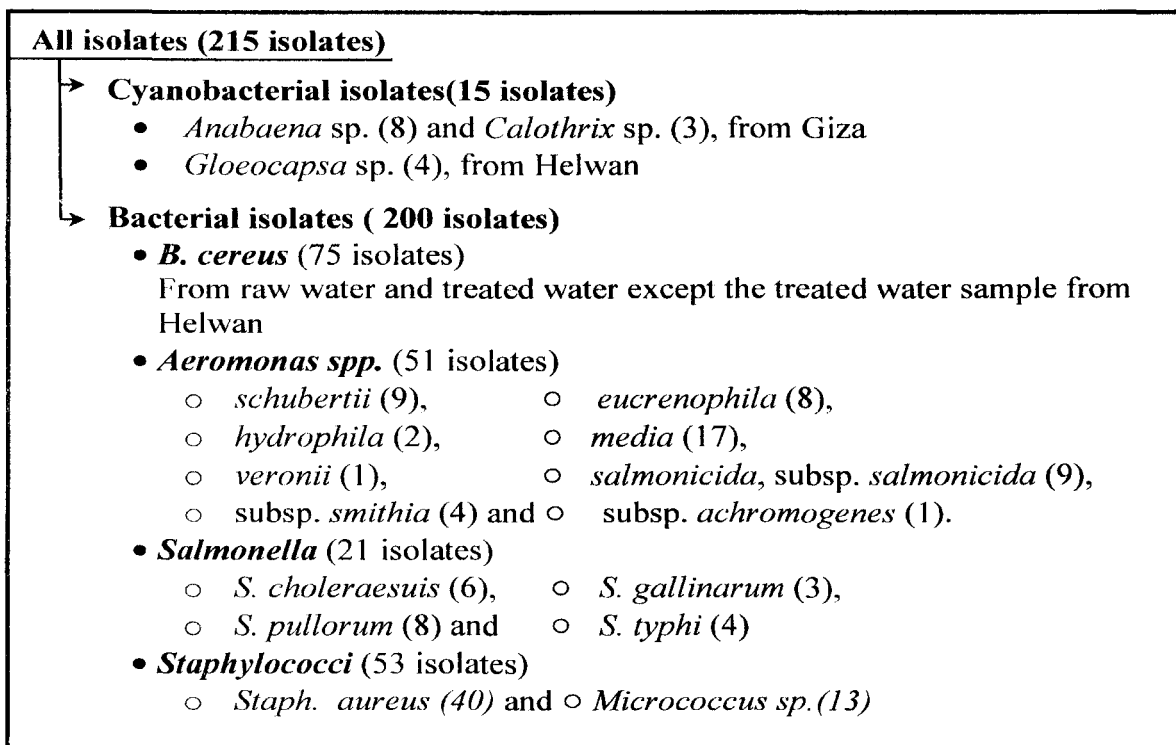


Fig. (2): Description of microbial isolates obtained from the tested water samples (Number of isolates from each species is shown between brackets).

described by Sneath *et al.*, (1986).

B. cereus, have the ability to form endospores with extraordinary persistence against harsh conditions which might explain the high frequency occurrence of such health-hazardous bacterium in raw water from all sampling sites and treated water samples from Giza and Rod El-Farag. Water treatment processes seemed to be insufficient for complete elimination of *B. cereus* from treated water which suggests considerable concern of this bacterium in water quality standards. The presence of *B. cereus* in drinking water samples at the distribution system in Helwan might indicate the recontamination of treated water through the distribution network.

Twenty one isolates of *Salmonella* were exclusively recovered from raw water samples. The isolates were differentiated according to Holt *et al.*, (1994) into four species; *S. choleraesuis* (28.6%), *S. gallinarum* (14.2%), *S. pullorum* (38%) and *S. typhi* (19.1%). The raw water of Helwan harbored *Salmonella* of the four species while no *S. pullorum* strains could be obtained from Giza site and *S. choleraesuis* was not distinguished in raw water from Rod El-Farag. Fifty one isolates of *Aeromonas* spp. were identified according to Popoff (1984) and El-Taweel (2003). Their traits related to *A. schubertii* (17.6%), *A. eucrenophila* (15.7%), *A. hydrophila*

(3.9%), *A. media* (33.3%), *A. veronii* (2%), *A. salmonicida*, subsp. *Salmonicida* (17.6%), subsp. *Smithia* (7.9%) and subsp. *Achromogenes* (2%).

3.4. Isolation and identification of cyanobacteria from water samples

Many species of cyanobacteria have the potentiality to produce toxins that present a hazard to human health. Some genera can produce offensive taste and odours, and hence cause problems in drinking water derived from an affected source (Ouellette and Wilhelm, 2003). A total of 15 cyanobacterial isolates was identified according to Rippka *et al.*, (1979) as *Anabaena* sp., *Calothrix* sp. and *Gloeocapsa* sp. The *Anabaena* sp., *Calothrix* sp. were isolated from raw water at Giza plant, while, *Gloeocapsa* sp. was isolated from raw water and treated water at Helwan. Zakaria (2007) isolated the toxic cyanobacterial strains *i.e.* *Cylindrospermopsis raciborskii* and *Raphidiopsis mediterranea*, which produce hepatotoxin and neurotoxin, respectively, in Egyptian fresh water.

3.5. Antimicrobial activities of some cyanobacterial metabolites

Three isolates of cyanobacteria were examined for the production of their metabolites in liquid cultures adopting the disc diffusion method (Table, 7).

Table (7): Antimicrobial activities of cyanobacterial metabolites.

Bacterial Strains	Diameter of clear zone of inhibition (mm)							LSD (0.05)
	Control	C I		C II		C III		
		M	C	M	C	M	C	
Gram- negative bacteria								
<i>E. coli</i>	0	ND	3.00	ND	2.00	ND	1.00	0.03
<i>Pseudomonas aerogenosa</i>	0	ND	2.00	ND	1.00	ND	2.00	0.02
<i>Salmonella typhimurium</i>	0	ND	3.00	ND	2.00	ND	ND	0.044
Gram- positive bacteria								
<i>Micrococcus</i> sp.	0	ND	5.00	ND	4.00	ND	4.00	0.06
<i>Bacillus subtilis</i>	0	2.00	7.00	ND	5.00	ND	4.00	0.075
<i>Sarcina</i> sp.	0	ND	1.00	ND	3.00	ND	2.00	0.03
<i>Staphylococcus aureus</i>	0	ND	1.00	ND	1.00	ND	2.00	0.016
<i>Listeria monocytogenes</i>	0	ND	4.00	ND	3.00	ND	2.00	0.044
Acid fast bacteria								
<i>Mycobacterium phlei</i>	0	2.00	4.00	2.00	5.00	ND	2.00	0.057

C I = *Anabaena* sp., C II = *Calothrix* sp., C III = *Gloeocapsa* sp.,
M = Filtrated Metabolites, C = Concentrated filtrated metabolites (10 times).
ND = Not detected activity at this concentration. Each value represents the mean of 3 replicates.

The crude culture supernatants had no effect on growth of all tested microorganisms except with *B. subtilis* and *M. phlei* cultures where the diameters of growth inhibition zones were 2 mm. Therefore, the crude culture supernatants were concentrated by dehydration using the freeze drying method.

The concentrated supernatant suppressed growth of all the test bacterial members. *Bacillus subtilis* showed higher sensitivity towards the concentrated supernatant. Among cyanobacteria, *Anabaena* sp. produced the most antimicrobial active metabolites forming a growth inhibition zone of 7 mm diameter in *Bacillus subtilis* culture plates. Cyanobacteria produce a wide variety of chemically unique secondary metabolites including toxins that have a harmful effect on other tissues, cells or organisms (Carmichael, 1992) and may function as protective compounds (Demott et al., 1991). Cyanobacteria toxins are grouped into cyanotoxins and biotoxins based on the type of bioassay used to screen for their activity. Cyanotoxins are not highly lethal to animals but have a wide spectrum of bioactivity against algae, bacteria, fungi and mammalian cell lines which are used to detect them especially tumour cell lines. (Carmichael, 1992).

Biotoxins assayed with small animals (mice or aquatic invertebrates) and have been responsible worldwide for repeated cases of sickness and death in livestock, pets and wild life after ingestion of water containing toxic algae. Biotoxins include neurotoxins which are commonly produced by the *Anabaena* and *Oscillatoria* species, while hepatoxins are produced by the *microcystis* and *Cylindrospermopsis* (Ouellette and Wilhelm, 2003). In this concern, Ronald et al.,(2005) isolated approximately 70 microcystins (cyclic hepatotoxins) variants. The obtained results indicate that the antagonistic activities of cyanobacterial metabolites produced by the examined isolates of *Anabaena* sp., *Calothrix* sp. and *Gloeocapsa* sp. needs further studies on the optimal conditions for maximal production of such metabolites by the different cyanobacterial isolates. Isolation, chemical fractionation and biological assays of these metabolites are also required in order to clarify their mode of action against human cells which might lead to a possible pharmaceutical applications.

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التقييم الحيوي الكيميائي لبعض محطات مياه الشرب علي نهر النيل بمصر

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ملخص

اجري هذا البحث لدراسة بعض الخصائص الحيوية والكيميائية لعدد ٢٢٥ عينة مياه اخذت من ٣ محطات مياه شرب رئيسية هي حلوان والجيزة وروض الفرج بالقاهرة الكبرى. وقد دلت النتائج على ان جميع العينات خالية تماما من الفلور، والزئبق والرصاص والكاديوم، في حين كان كل من الكلور والنترات والكروميوم والنيكل والزنك والنحاس موجودة بنسب مختلفة في عينات المياه المختبرة.

كذلك أتضح من النتائج ان مياه نهر النيل قبل معاملتها احتوت على اعداد كبيرة من الكائنات الحية الدقيقة، بينما اختفت جميع الميكروبات الممرضة التابعة لاجناس *Staphylococcus*, *Salmonella*, *Aeromonas*، وتم عزل *Bacillus cereus* و *cyanobacteria* من عينات المياه المأخوذة من محطات المياه تحت الدراسة.

من ناحية اخري، اوضحت النتائج ان كل انواع البكتريا المختبرة تم تثبيطها براشح سلالات السيانو بكتريا المعزولة من عينات المياه المختلفة و كانت *Mycobacterium phlei*، *Listeria monocytogenus* و *B. subtilis* اكثرهم تأثرا. وقد اكدت نتائج هذا البحث على ان وجود السيانوبكتريا في مياه نهر النيل تعتبر احد مصادر التلوث الحيوي للمياه والتي يمكنها التأثير على صلاحية مياه النهر للشرب، لذلك فإنه يوصي بضرورة التقييم المستمر لوجود السيانو بكتريا في محطات مياه الشرب.

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