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Prevalence of algae in water Plants of Kafr El-Sheikh Governorate, Egypt

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Keywords

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potable water plants.

Abstract

In this study, Water samples were collected from ten different regions comprising the main ten cities of Kafr El-Sheikh Governorate during October 2011 to September 2012. The results showed remarkable differences among various sites. Forty eight (48) genera of algae were isolated and identified from the potable water samples. They were 13 genera of Diatoms, 25 genera of green algae and 10 genera of blue green algae. Mostly, green algae are found (25 genera), followed by diatoms (13genera), then blue-green algae (10 genera).In all months diatoms exceed the other two groups in numbers. Diatoms numbers of all outlet water plants ranged between 10 CFU/ml in month January 2012 in outlet of Kaleen plant to 1225 CFU/ml in the same month in outlet of Dessouq water plant. So high ratio of algae remove was 98.99% in month 1/2012 (January) at Kaleen water plant.

1. Introduction

Water is the most important thing for both human and the equilibrium of natural life. Every person needs approximately 2 L of clean drinking water per day (Yassi *et al.*, 2001).

The standards for drinking water can be attributed to two main criteria: (1) the absence of objectionable taste, odor and color; (2) the absence of substances with adverse physiological effects (Adejuwon and Mbuk, 2011).

Therefore, water has to meet up with certain physical, chemical and microbiological standards, that is, it must be free from diseases producing microorganisms and chemical substances, perilous to health before it can be termed potable (Ihekoronye and Ngoddy,1985).

The health concerns associated with chemical constituents of drinking-water differ from those associated with microbial contamination and arise primarily from the ability of chemical constituents to cause adverse health effects after prolonged periods of exposure. There are few chemical constituents of water that can lead to health problems resulting from a single exposure, except through massive accidental contamination of a drinking water supply. On the contrary, algal and bacterial contaminations are the most common and widespread health risk associated with drinking water (WHO, 1996).

In developing nations, more than 250 million new cases of waterborne diseases are reported annually. This has resulted in high morbidity and mortality rates, especially in young children (Emde and Finch, 1991).

Drinking water should contain no algae. Algae can affect water characteristics, such as alteration of organoleptic properties (Codony *et al*., 2003). They produce mutagenic and carcinogenic substances which cause chronic effect on human physiology (Ledra and Prosperi, 1996). Certain cyanobacteria can produce toxins with pernicious health effects diarrhea **(**Sivonen, 1996), to cite as an example, as an acute effect and cancer in the ultimate instance (Rose *et al*., 1999).Whereas, diatoms generally produce obstructions in filters because of their silicon frustules (Shehata *et al*.,2008).

High and low molecular weight extracellular algal compounds have been identified, including amino acids, peptides, fatty acids, carbohydrates, and vitamins (Sundh *et al*., 1992).

Cyanobacteria are aquatic and photosynthetic unicellular microorganisms (Botos and Wlodawer, 2003; Laura *et al*., 2008).

Cyanobacteria are growing in a wide range of habitats and were named for the bluegreen pigment, phycocyanin. Usually, they grow in large colonies include unicellular, colonial, and filamentous forms and can be considered as one of the largest and most important groups of bacteria on earth. Cyanobacteria that lack toxins are widely used as food supplement as well as in complementary and alternative medicine (Gao, 1998; Liu, 2009). Generally, algae are widely dispersed throughout lakes and rivers at relatively low population densities; however, its population is liable to rapidly grow with the increase in nutrients in surface waters (Henderson *et al*., 2008).

This may result in dissolved oxygen depletion, high water turbidity and eventually, the degradation of aquatic ecosystem(Manahan, 2000; Abou *et al*., 2007; Shen *et al*., 2011; Wang *et al*., 2013).

As well, this may cause acute disturbance in taste, odor and induce toxins under stressful environmental conditions (Shehata *et al*., 2008; Heng *et al*., 2009; Shen *et al*., 2011).

In a conventional water treatment plant, uncontrolled algae blooms may clog screens and rapid sand filters and hinder the drinking water supply system**(**Babel and Takizawa, 2011; Wu *et al*., 2011). On the other hand and due to their microscopic size, algae may penetrate filters and reside within the domestic drinking water supply storage systems and excrete extra-cellular organic products that may lead to an increase in the coagulant demand, impair the final water disinfection process and promote microbial re-growth in the water distribution systems **(**Ma and Liu, 2002; Babel and Takizawa, 2011; Wu *et al*., 2011). Subsequently, reduction of surface water algae during the initial stages of treatment is preferred to maintain acceptable final water quality **(**James and Conrad, 2004; Henderson *et al*., 2008; Babel and Takizawa, 2011; Wu *et al*., 2011).

This is mainly because the removal of algal cells as suspended solids may reduce the associated soluble toxins that may impair the physicochemical water treatment systems.

The general techniques applied for algal-control in drinking water treatment systems were discussed **(**APHA, 2005; Henderson *et al*., 2008; Gao *et al*., 2010; Babel and Takizawa, 2011; Wu *et al*., 2011; Devrimci *et al*., 2012). Of these operations, coagulation/ flocculation is regarded as the main process for algae removal as it has the ability to remove suspended solids through particle destabilization while flocculation allows for solid separation either through settling or flotation, and filtration (James and Conrad, 2004; Henderson *et al*., 2008; Gao *et al*., 2010; Shen *et al*., 2011; Devrimci *et al*., 2012).

However, due to its small size and low specific gravity, algae removal may not be effectively achieved through using chemical coagulation alone (Devrimci *et al*., 2012).

Therefore, chemical pre-oxidants (such as ozone, chlorine dioxide, chlorine, or permanganate) are required to enhance coagulation as they have the capacity to inactivate algal cell (Ma and Liu, 2002; Chen and Yeh, 2005; Henderson *et al*., 2008; Shehata *et al*., 2008; Heng *et al*., 2009; Gao *et al*., 2010). Overall, chlorine is the preferred pre-oxidant because it is a powerful water disinfectant that is safer to apply; is more economical than other algaecides and is less time-consuming in application **(**Shen *et al*., 2011). Nevertheless, it was reported that algae may consume large quantities of chlorine and thus reduce the free chlorine available to control bacteria if they persist after treatment (Shen *et al*., 2011). On the other hand, it was reported that overdosing of preoxidants must be avoided as it can cause algal cell lyses and release undesirable toxins or offensive taste and odor associated compounds (Henderson *et al*., 2008; Heng *et al*., 2009).

In Egypt, a typical drinking water treatment system comprises stages of pre chlorination, flocculation/ coagulation with alum, filtration (sand and carbon filters), post-chlorination and settling in distribution tanks (Donia, 2007), in this set-up, pre-chlorination is regarded as the most important stage for the control of bacteria and algal growth(El-Shinnawy *et al*., 2000; Donia, 2007; Badawy *et al*., 2012), in this respect, a number of studies were conducted to investigate the contribution of this stage towards the formation of disinfection by-products in the final treated waters and to set recommendations for its application (El-Shinnawy *et al*., 2000; Donia, 2007; Badawy *et al*., 2012).

The aim of the present study is to evaluate the efficiency of drinking water treatment in ten plants in Kafr El-Sheikh Governorate especially for algae treatment.

2. Materials and Methods

2.1. Sampling sites:

All water samples were collected from raw (inlet) and treated (outlet) plants in Kafr El-Sheikh Governorate, Egypt, as indicated in Fig (1) including Kafr El-Sheikh, Ebshan , Fowa , Metobas, Kaleen, Dessouq , El-Read, El-Hamoul, Baltem and Sedi-Salem as indicated in Table (1). These sampling sites were chosen to cover all water plants.

2.2. Sampling collection:

Water samples (240) were collected from Kafer El-shiekh, during october, 2011 to September 2012.

During 12 months, the collection, preservation, physicochemical analysis and biological examination of water samples were performed in accordance with the Standard Methods for the Examination of Water and Wastewater (Eaton and Franson, 2005). Samples for microbiological analysis were taken by sterile stoppered glass bottles contain 0.1 ml of 10% sodium thiosulphate per 120 ml sample was added to all containers used for sampling chlorinated supplies to neutralize the residual chlorine. Samples were placed in iced containers and transported as rapidly as possible to the laboratory and samples analysis were completed within 4 h of sampling on using aseptic techniques to avoid sample contamination When the sample is collected, leave ample air space in the bottle (at least 2.5 cm) to facilitate mixing by shaking, before examination (Zobell,1941; Vandonsel and Geldreich, 1971).

2.3. Algae analysis

Ten ml sample of raw or treatment water was centrifuged for 10 min at 4000 rpm by Centrifuge. (HERMLE a product of HERMLE LABORTECHNIK, Type: Z 200 A, Germany). The supernatant discarded, and then the pellet was dissolved in 1 ml of saline water, which was transferred to Sedgwick–rafter counting chamber (Wildco, 1801-A10, Germany) that was covered by a slide cover. Algae were counted using Inverted microscope OPTIKA, Italy (Model: XDS-2) and fitted with colour video camera attached to TV monitor. The count was done from the TV monitor (DELL, model no: E178WFPC LCD monitor 43 cmm (17), USA, (APHA, 2005).

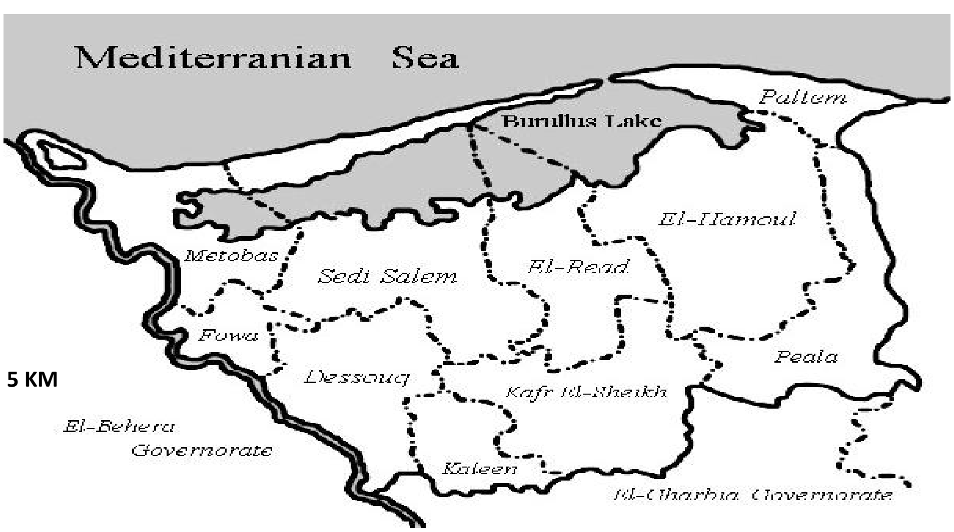

Figure 1: Sampling Sites of Kafr El-Sheikh Governorate.

Table 1: Description of sampling locations in this study.

S.No	Location of sampling	Inlet source	Capacity m^3/day	Source type
1	Kafr El-Sheikh	Mitt Yazaid canal	86400	Surface water
2	Ebshan	Almasrra sea	69120	
3	Fowa	Nile River	129600	
4	Metobas	Nile River	86400	
5	Kaleen	Nachert sea	19008	
6	Dessouq	Nile River &Alqdhabh canal	86400	
7	El-Read	Al-Qassed tail canal	30240	
8	El-Hamoul	Tera sea	103680	
9	Paltem	Tera sea	51840	
10	Sedi-Salem	Saidi Sea	20736	

3. Results and Discussion

3.1. Quantitative Estimation of Phytoplankton

Microscopic quantitative analysis of phytoplankton in collected tap water showed that they belong to three main divisions: Chlorophyta (green algae), Cyanophyta (blue-green algae) and Bacillariophyta (diatoms). Tables (2 to 23) lists the genera of each division, The most abundant phytoplanktons genera are the green algae (25 genera), followed by diatoms (13 genera), where as blue green algae are present with lowest abundance (10 genera). On the other hand, some examined outlet samples are free from blue green algae (Cyanobacteria).

Cyanobacterial harmful algae constitutes a group of organisms, which widespread success in aquatic systems cannot be explained by any single factor. It has been suggested that several factors synergistically enhance the growth of cyanobacteria compared with other phytoplankton at certain times (Hyenstrand , 1999).

Carmichael and Falconer, (1993) stated that species within certain Genera of Cyanobacteria namely; *Anabaena, Hapalosiphon, Microcystis, Nostoc* and *Oscillatoria* produce cyclic peptide hepatotoxins called microcystins that cause liver damage in both mammals and fish thus constitutes a risk for human being.

In Egypt the harmful algae species recorded were *oscillatory* and *Microcystis* (El-Manawy and Amin, 2004; Marzouk *et al*.,2013).

3.2. Algal Count after treatment:

The grouping of phytoplankton, green algae, blue-green algae and diatoms varied in their numbers and types for different months of the study year in the water plants as show in Table (2 - 23). In all months diatoms exceed the other two groups in numbers. Diatoms numbers of all outlet water plants ranged between 10 CFU /ml in month 01/2012 in outlet of Kaleen plant to 1225 CFU/ml in the same month (01/2012) in outlet of Dessouq water plant, this was followed by green algae which ranged between 5 CFU /ml in month 1/2012 in outlet of Kaleen plant to 840 CFU/ml in month 02/2012 in outlet of Dessouq water plant, while the lowest number was observed for blue green algae which ranged between zero in month 10/2011 in outlet of fowa water plant , also in month 12/2011 in outlet of water plants (Sidi Salem, El-Read, and Paltem) then also zero in month 01/2012 in outlet of water plants (Kaleen and Dessouq) then also zero in month 02/2012 in outlet of Kaleen water plant to 350 CFU/ml in month 06/2012 in outlet of Metobas water plant. Present of algae attributed to the presence of sewage plants drain on the Nile directly without treatment (BY PASS) and many industrial companies on EL-RAHAWY Drain then to the Rosetta Branch nearly 20,000,000 cubic meters per day with a fixed amount of water in the Nile River and the amount of pollutants are increasing every hour (Abo-State *et al*., 2014 a, b).

Most of these algae are totally dependent on light as a source of energy for growth and for this reason; their presence in drinking water systems is expected as an anecdotal fact and may be attributed to treatment limitations (Francesc *et al*.,2003).

Table (2): Algae count and evaluation of water treatment efficiency from 01/10/2011 to 30/10/2011

Plants	Diatoms	Green algae	Blue Green	Total	Ratio of removal
Kafr El-Sheikhinterance	1350	435	45	1830	87.43169
Kafr El-Sheikh outlet	130	85	15	230	
Ebshan interance	740	460	120	1320	87.12121
Ebshan outlet	110	40	20	170	
Fowa interance	260	190	40	490	86.73469
Fowa outlet	25	40	0	65	
Metobas interance	2100	130	90	2320	92.02586
Metobas outlet	135	35	15	185	
Kaleen interance	295	185	80	560	71.42857
Kaleen outlet	60	60	40	160	
Desouk interance	1300	650	120	2070	84.78261
Desouk outlet	200	90	25	315	
El-Read interance	1370	450	55	1875	92.8
El-Read outlet	90	35	10	135	
El-Hamoul interance	1400	485	45	1930	91.19171
El-Hamoul outlet	110	40	20	170	
Paltem interance	1970	215	60	2245	93.76392
Paltem outlet	100	35	5	140	
Sedi Salem interance	455	375	140	970	86.08247

Table (3): Algae count and evaluation of water treatment efficiency from 01/11/2011 to 30/11/2011

Plants	Diatoms	Green	Blue Green	Total	Ratio of removal
Kafr El-Sheikh interance	1530	100	75	1705	91.20235
Kafr El-Sheikh outlet	120	20	10	150	
Ebshan interance	1340	160	90	1590	90.25157
Ebshan outlet	65	60	30	155	
Fowa interance	1260	480	180	1920	85.67708
Fowa outlet	110	115	50	275	
Metobas interance	1310	100	30	1440	83.33333
Metobas outlet	180	50	10	240	
Kaleen interance	1170	85	65	1320	84.09091
Kaleen outlet	90	70	50	210	
Desouk interance	1445	120	50	1615	89.47368
Desouk outlet	120	30	20	170	
El-Read interance	1755	70	90	1915	93.47258
El-Read outlet	40	35	50	125	
El-Hamoul interance	900	260	40	1200	83.33333
El-Hamoul outlet	90	80	30	200	
Paltem interance	2070	410	210	2690	89.59108
Paltem outlet	200	50	30	280	
Sedi Salem interance	1430	170	50	1650	85.45455
Sedi Salem outlet	110	90	40	240	

Table (4): Algae count and evaluation of water treatment efficiency from 01/12/2011 to 30/12/2011

Plants	Diatoms	Green	Blue Green	Total	Ratio of removal
Kafr El-Sheikh interance	1200	1400	100	2700	91.85185
Kafr El-Sheikh outlet	100	100	20	220	
Ebshan interance	4160	1135	440	5735	84.82999
Ebshan outlet	125	720	25	870	
Fowa interance	2650	440	140	3230	88.79257
Fowa outlet	215	105	42	362	
Metobas interance	690	360	55	1105	76.92308
Metobas outlet	110	130	15	255	
Kaleen interance	820	305	165	1290	84.34109
Kaleen outlet	107	70	25	202	
Desouk interance	915	840	170	1925	80.51948
Desouk outlet	170	155	50	375	
El-Read interance	1000	900	90	1990	89.94975
El-Read outlet	90	110	0	200	
El-Hamoul interance	1320	2800	200	4320	90.27778
El-Hamoul outlet	220	150	50	420	
Paltem interance	1900	2000	80	3980	92.71357
Paltem outlet	110	180	00	290	
Sedi Salem interance	1160	445	180	1785	95.51821
Sedi Salem outlet	40	40	00	80	

Table (5): Algae count and evaluation of water treatment efficiency from 01/01/2012 to 30/01/2012

Plants	Diatoms	Green algae	Blue Green	Total	Ratio of removal
Kafr El-Sheikh interance	1220	930	200	2350	88.08511
Kafr El-Sheikh outlet	130	100	50	280	
Ebshan interance	1135	760	465	2360	82.20
Ebshan outlet	255	110	55	420	
Fowa interance	6380	2090	460	8930	84.10974
Fowa outlet	620	594	205	1419	
Metobas interance	680	1120	300	2100	91.90476
Metobas outlet	90	70	10	170	
Kaleen interance	950	290	250	1490	98.99329
Kaleen outlet	10	5	0	15	
Desouk interance	3445	865	410	4720	70.86864
Desouk outlet	1225	150	0	1375	
El-Read interance	1035	205	70	1310	92.36641
El-Read outlet	55	40	5	100	
El-Hamoul interance	900	470	200	1570	85.35032
El-Hamoul outlet	140	40	50	230	
Paltem interance	880	900	300	2080	83.41346
Paltem outlet	130	130	85	345	
Sedi Salem interance	225	990	90	1305	81.6092
Sedi Salem outlet	100	80	60	240	

Table (6): Algae count and evaluation of water treatment efficiency from 01/02/2012 to 28/02/2012

Plants	Diatoms	Green	Blue Green	Total	Ratio of removal
Kafr El-Sheikh	1655	255	185	2095	64.6778
Kafr El-Sheikh outlet	420	220	100	740	
Ebshan interance	810	245	42	1097	81.76846
Ebshan outlet	80	110	10	200	
Fowa interance	1220	375	155	1750	82.28571
Fowa outlet	150	130	30	310	
Metobas interance	1275	313	100	1688	54.68009
Metobas outlet	365	300	100	765	
Kaleen interance	700	315	55	1070	84.11
Kaleen outlet	110	60	0	170	
Desouk interance	2060	1145	250	3455	69.60926
Desouk outlet	110	840	100	1050	
El-Read interance	890	580	45	1515	76.23762
El-Read outlet	190	140	30	360	
El-Hamoul interance	1765	95	60	1920	91.40625
El-Hamoul outlet	105	50	10	165	
Paltem interance	840	530	125	1495	81.60535
Paltem outlet	135	95	45	275	
Sedi Salem interance	835	550	200	1585	76.02524
Sedi Salem outlet	210	120	50	380	

Table (7): Algae count and evaluation of water treatment efficiency from 01/03/2012 to 30/03/2012

Plants	Diatoms	Green algae	Blue Green algae	Total	Ratio of removal
Kafr El-Sheikh	300	860	60	1220	74.59016
Kafr El-Sheikh outlet	60	225	25	310	
Ebshan interance	995	985	225	2205	83.67347
Ebshan outlet	195	100	65	360	
Fowa interance	3460	3880	400	7740	91.08527
Fowa outlet	385	295	10	690	
Metobas interance	620	730	120	1470	59.52381
Metobas outlet	205	350	40	595	
Kaleen interance	470	625	150	1245	66.26506
Kaleen outlet	40	355	25	420	
Desouk interance	1825	60	50	1935	90.69767
Desouk outlet	120	30	30	180	
El-Read interance	800	760	150	1710	90.35088
El-Read outlet	90	65	10	165	
El-Hamoul interance	950	940	210	2100	84.28571
El-Hamoul outlet	190	90	50	330	
Paltem interance	880	130	100	1110	72.97297
Paltem outlet	180	90	30	300	
Sedi Salem interance	245	360	45	650	76.15385
Sedi Salem outlet	95	50	10	155	

Table (8): Algae count and evaluation of water treatment efficiency from 01/04/2012 to 28/04/2012

Plants	Diatoms	Green algae	Blue Green algae	Total	Ratio of removal
Kafr El-Sheikh interance	300	860	60	1220	74.59016
Kafr El-Sheikh outlet	60	225	25	310	
Ebshan interance	960	670	200	1830	72.6776
Ebshan outlet	395	70	35	500	
Fowa interance	1750	650	170	2570	73.73541
Fowa outlet	345	200	130	675	
Metobas interance	1605	235	115	1955	72.89003
Metobas outlet	315	180	35	530	
Kaleen interance	1290	870	620	2780	79.4964
Kaleen outlet	310	165	95	570	
Desouk interance	3000	1210	430	4640	81.25
Desouk outlet	415	265	190	870	
El-Read interance	2350	1600	530	4480	79.57589
El-Read outlet	265	500	150	915	
El-Hamoul interance	1737	635	510	2882	75.53782
El-Hamoul outlet	290	250	165	705	
Paltem interance	960	670	200	1830	72.6776
Paltem outlet	395	70	35	500	
Sedi Salem interance	950	445	85	1480	71.28378
Sedi Salem outlet	135	240	50	425	

Table (9): Algae count and evaluation of water treatment efficiency from 01/05/2012 to 30/05/2012

Plants	Diatoms	Green algae	Blue Green algae	Total	Ratio of removal
Kafr El-Sheikh interance	850	370	200	1420	77.8169
Kafr El-Sheikh outlet	130	155	30	315	
Ebshan interance	2150	740	430	3320	74.54819
Ebshan outlet	420	210	215	845	
Fowa interance	1500	150	110	1760	82.38636
Fowa outlet	200	80	30	310	
Metobas interance	975	140	105	1220	81.96721
Metobas outlet	130	70	20	220	
Kaleen interance	1740	730	440	2910	83.67698
Kaleen outlet	235	125	115	475	
Desouk interance	1900	175	120	2195	86.78815
Desouk outlet	170	60	60	290	
El-Read interance	995	290	250	1535	80.78176
El-Read outlet	225	40	30	295	
El-Hamoul interance	2300	820	650	3770	92.57294
El-Hamoul outlet	130	125	25	280	
Paltem interance	2000	700	140	2840	91.5493
Paltem outlet	110	100	30	240	
Sedi Salem interance	1600	520	220	2340	87.60684
Sedi Salem outlet	150	100	40	290	

Table (10): Algae count and evaluation of water treatment efficiency from 01/06/2012 to 28/06/2012

Plants	Diatoms	Green algae	Blue Green algae	Total	Ratio of removal
Kafr El-Sheikh interance	1200	140	105	1445	86.15917
Kafr El-Sheikh outlet	130	70	0	200	
Ebshan interance	900	250	60	1210	82.64463
Ebshan outlet	115	45	50	210	
Fowa interance	1250	900	150	2300	86.08696
Fowa outlet	170	80	70	320	
Metobas interance	4000	3300	900	8200	77.07317
Metobas outlet	930	600	350	1880	
Kaleen interance	1790	880	500	3170	84.70032
Kaleen outlet	260	120	105	485	
Desouk interance	1750	190	150	2090	86.60287
Desouk outlet	150	70	60	280	
El-Read interance	1100	540	75	1715	90.37901
El-Read outlet	60	90	15	165	
El-Hamoul interance	900	250	60	1210	82.64463
El-Hamoul outlet	115	45	50	210	
Paltem interance	4010	220	90	4320	94.21296
Paltem outlet	190	15	45	250	
Sedi Salem interance	1300	530	230	2060	90.7767
Sedi Salem outlet	140	45	5	190	

Table (11): Algae count and evaluation of water treatment efficiency from 01/07/2012 to 30/07/2012

Plants	Diatoms	Green algae	Blue Green algae	Total	Ratio of removal
Kafr El-Sheikh interance	2800	400	490	3690	98.10298
Kafr El-Sheikh outlet	20	45	5	70	
Ebshan interance	1240	290	120	1650	91.81818
Ebshan outlet	75	55	5	135	
Fowa interance	2780	900	270	3950	87.34177
Fowa outlet	330	65	105	500	
Metobas interance	3150	540	700	4390	86.67426
Metobas outlet	345	95	145	585	
Kaleen interance	1040	250	40	1330	92.4812
Kaleen outlet	50	45	5	100	
Desouk interance	3050	1280	480	4810	97.60915
Desouk outlet	45	40	30	115	
El-Read interance	2100	140	180	2420	80.16529
El-Read outlet	370	40	70	480	
El-Hamoul interance	1310	140	180	1630	90.18405
El-Hamoul outlet	135	5	20	160	
Paltem interance	1280	170	130	1580	93.03797
Paltem outlet	100	5	5	110	
Sedi Salem interance	1250	550	220	2020	86.63366
Sedi Salem outlet	190	60	20	270	

Table (12): Algae count and evaluation of water treatment efficiency from 01/08/2012 to 28/08/2012

Plants	Diatoms	Green algae	Blue Green algae	Total	Ratio of removal
Kafr El-Sheikh interance	1740	470	320	2530	70.75099
Kafr El-Sheikh outlet	510	180	50	740	
Ebshan interance	1200	720	310	2230	75.33632
Ebshan outlet	300	150	100	550	
Fowa interance	1160	920	270	2350	81.06383
Fowa outlet	260	75	110	445	
Metobas interance	1520	310	210	2040	76.47059
Metobas outlet	280	170	30	480	
Kaleen interance	1280	280	130	1690	86.98225
Kaleen outlet	75	140	5	220	
Desouk interance	1670	360	290	2320	76.50862
Desouk outlet	320	190	35	545	
El-Read interance	1820	450	200	2470	77.73279
El-Read outlet	390	60	100	550	
El-Hamoul interance	2130	420	70	2620	82.82443
El-Hamoul outlet	270	130	50	450	
Paltem interance	1320	580	190	2090	83.25359
Paltem outlet	180	100	70	350	
Sedi Salem interance	1250	640	420	2310	80.95238
Sedi Salem outlet	260	130	50	440	

Table (13): Algae count and evaluation of water treatment efficiency from 01/09/2012 to 30/09/2012

Plants	Diatoms	Green algae	Blue Green algae	Total	Ratio of removal
Kafr El-Sheikh interance	1680	490	310	2480	74.59677
Kafr El-Sheikh outlet	420	150	60	630	
Ebshan interance	1100	630	410	2140	73.83178
Ebshan outlet	290	170	100	560	
Fowa interance	1210	980	290	2480	84.87903
Fowa outlet	210	85	80	375	
Metobas interance	1600	310	270	2180	79.81651
Metobas outlet	270	130	40	440	
Kaleen interance	1190	290	150	1630	88.34356
Kaleen outlet	110	60	20	190	
Desouk interance	1730	410	190	2330	77.6824
Desouk outlet	300	190	30	520	
El-Read interance	1750	410	180	2340	80.34188
El-Read outlet	310	70	80	460	
El-Hamoul interance	1110	630	380	2120	79.71698
El-Hamoul outlet	250	120	60	430	
Paltem interance	1990	480	100	2570	80.93385
Paltem outlet	270	170	50	490	
Sedi Salem interance	1610	700	210	2520	77.38095
Sedi Salem outlet	290	180	100	570	

Table (14) Algae identification at interance and outlet of Kafr El-Sheikh plants

Algae / Months	10/2011	11/2011	12/2011	01/2012	02/2012	03/2012	04/2012	05/2012	06/2012	07/2012	08/2012	09/2012
Diatoms												
Stephanodiscus	I.O	O	I	I.O	I	I	I.O	I.O	I.O	I.O	I.O	I.O
Cyclotella	I.O	I.O	I.O	I.O	I.O	I	I.O	I.O	I.O	I.O	I.O	I
Nitzschia	I	I	I	I.O	I	I	I	I.O	I.O	I	I.O	A
Melosira	I	I.O	I	I.O	I.O	I.O	I	I	I	I	I	I.O
Diatoma	I.O	I.O	I.O	I.O	A	I	I.O	I	I.O	I	I.O	I.O
Navicula	I	I	I	O	I	A	I.O	I	A	I	I	I
Fragilaria	I	I	A	A	A	A	A	A	A	A	A	I.O
Surirella	A	A	I	A	I	I	I	A	A	A	A	A
Asteri.onella	A	I	I	A	A	A	A	I	I	A	A	A
Gyrosigma	A	A	A	I	I.O	O	I	A	A	A	A	A
Cocconeis	A	A	A	A	I	I	A	I	I	A	A	A
Synedra	I	I	I	I.O	I	A	I	I	I	A	I.O	I
Green algae												
Scenedesmus	I.O	I.O	I.O	I.O	I.O	I.O	I.O	I.O	I.O	I.O	I.O	I.O
Pediastrum	I	A	A	O	I	I	I	A	A	I	I.O	I
Selenastrum	I	A	I	I.O	I.O	I.O	I.O	I	I.O	I	I	I
Ankistrodesmus	I	I.O	I.O	I	A	A	I	I	I	A	I	I
Treubaria	I	A	A	A	A	A	A	A	A	A	A	A
Botrydiopsis	A	A	A	I.O	A	A	A	A	A	A	A	A
Actinastrum	I	A	I	I	I	I	O	A	A	A	A	I
Tetraedron	A	O	A	I.O	A	I	I	I	I.O	I	A	A
Crucigenia	A	A	A	A	A	A	I	O	A	A	I	I.O
Coelastrum	A	I	I	A	A	A	A	I	A	A	I.O	I.O
Oocyst	A	A	A	O	I	I	O	A	A	A	A	A
Anthophysis	A	A	A	I	A	A	A	A	A	A	A	A
Staurastrum	A	A	A	A	A	A	A	I	A	I	I.O	A
Ulothrix	A	A	A	A	A	A	A	A	A	A	A	I
Golenkinia	A	A	A	I	A	A	A	A	A	A	A	A
Botryococcus	A	A	A	A	I	A	I.O	A	I	A	I.O	A
Blue green algae												
Gomphosphaeria	I	A	A	I.O	A	A	A	I.O	A	I	I	I
Chroococcus	I.O	I.O	I.O	I.O	I	I	A	I.O	O	I	I.O	I.O
Microcystis	I	I	I	I	I.O	I.O	O	I	I.O	I	I.O	A
Merismopedia	I	A	I	A	A	A	I.O	A	I	I.O	A	A
Oscillatoria	A	I	A	A	A	A	I.O	A	I	A	A	A
Anabeana	A	A	A	I	I	A	I	A	A	A	A	A

(I)=present at interance
(O)=present at outlet
(I.O)= present at interance and outlet
(A)=absent

Table (15) Algae identification at interance and outlet of Ebshan plants

Algae / Months	10/2011	11/2011	12/2011	01/2012	02/2012	03/2012	04/2012	05/2012	06/2012	07/2012	08/2012	09/2012
Diatoms												
Stephanodiscus	I	O	I.O	I	I.O	I	I.O	I.O	I	I.O	I.O	I.O
Cyclotella	A	I.O	I.O	I.O	I.O	I	I.O	I.O	I	I.O	I	I
Nitzschia	I	A	A	I	I	I.O	A	I	I.O	I	I	I.O
Melosira	I.O	I	A	I	I	I.O	I	I	I	I	I	I
Diatoma	I.O	I.O	I	I	I	I.O	I.O	I	I.O	I.O	I	I.O
Navicula	I	I	I.O	I.O	I	I	A	I.O	A	A	A	I
Fragilaria	A	I	A	A	A	A	I.O	O	A	I	I	A
Surirella	I	I	A	A	I	I	A	A	A	A	A	A
Asteri.onella	A	A	A	A	A	A	A	I	A	A	A	A
Gyrosigma	A	A	I	I	A	A	A	A	A	A	A	A
Cocconeis	A	A	A	A	I	I.O	I	A	I	I	I	I.O
Synedra	I.O	I	I.O	I.O	I.O	I	I	I.O	I	I	I	I.O
Green algae												
Scenedesmus	I	I.O	I.O	I.O	I.O	I	I	I.O	I	I.O	I.O	I
Pediastrum	I.O	I	A	A	O	I.O	A	I	I.O	I	I.O	A
Selenastrum	I	A	A	A	I	I	I.O	I.O	I.O	I.O	I.O	A
Ankistrodesmus	A	I	A	A	A	I.O	I	I	I	A	A	I
Treubaria	I	A	A	A	A	A	A	A	A	A	A	A
Botrydiopsis	A	A	I	I	I	A	A	A	A	A	A	A
Actinastrum	I.O	I	I	I	I	I	I.O	A	A	A	A	A
Tetraedron	A	O	A	A	I.O	I	I.O	I.O	A	I.O	A	I.O
Coelastrum	A	A	I	A	A	A	I	I.O	A	I	I	A
Kirchinella	I	I	A	A	A	A	A	A	A	I	A	A
Oocyst	A	A	I.O	I.O	I	I.O	I.O	A	I.O	I	I	I.O
Staurastrum	A	A	A	A	A	A	A	I	A	A	I	A
Volvex	A	A	I	I	A	A	A	A	A	A	A	A
Ulothrix	A	A	A	A	A	A	A	A	A	A	I	I
cosmarium	A	I	A	A	A	A	A	A	A	A	A	A
Botryococcus	A	I	A	A	A	A	I	A	A	I.O	O	A
Blue green algae												
Gomphosphaeria	I.O	O	I	I	A	I	I	I	I	A	I	A
Chroococcus	I.O	I.O	I.O	I	I	I.O	I.O	I.O	I	O	O	I
Microcystis	I	I	I.O	I.O	I.O	A	I.O	O	I.O	I	I	I.O
Merismopedia	I	I.O	I	A	A	I.O	I	A	A	I	I.O	I
Oscillatoria	I	I	A	A	A	A	A	A	A	I	A	A

(I)=present at interance
(O)=present at outlet
(I.O)= present at interance and outlet
(A)=absent

Table (16) Algae identification at interance and outlet of Fowa plants

Algae / Months	10/2011	11/2011	12/2011	01/2012	02/2012	03/2012	04/2012	05/2012	06/2012	07/2012	08/2012	09/2012
Diatoms												
Stephanodiscus	I.O	I.O	I.O	I.O	I.O	I.O	I.O	I	I.O	I.O	I.O	I
Cyclotella	I.O	I.O	I.O	I.O	I.O	I.O	I.O	I.O	I.O	I.O	I.O	I
Nitzschia	I.O	I	A	A	I.O	I	I.O	I.O	I	I	I	I
Melosira	I.O	I.O	I.O	I	I	I	I	I.O	I.O	I.O	I	I.O
Diatoma	I	I.O	I.O	I.O	I.O	I.O	A	I.O	I.O	I	I	I
Navicula	I	A	A	A	A	I.O	A	I	A	A	I.O	I.O
Fragilaria	A	A	A	I	A	A	A	A	A	A	A	I
Surirella	I.O	I	I	A	I	I	I.O	I	I	I	A	I
Synedra	I	I.O	I	I	I	I.O	I	I.O	A	A	A	I.O
Green algae												
Scenedesmus	I.O	I.O	I.O	I.O	I.O	I	I	I	I.O	I.O	I.O	I
Pediastrum	I.O	I.O	I.O	O	A	O	I.O	I.O	I	I	I	I.O
Selenastrum	I.O	I.O	I.O	A	I.O	I.O	A	I	I	I.O	I	I
Ankistrodesmus	A	O	I.O	A	I	I	A	A	I	I	I.O	A
Botrydiopsis	I.O	I.O	A	A	A	A	I	I	A	I	A	A
Actinastrum	I	I	I	A	A	A	I.O	A	A	A	A	A
Tetraedron	I.O	I.O	I	I	I.O	I.O	A	I.O	A	I	I.O	A
Crucigenia	I.O	A	A	A	A	I	I.O	I.O	O	O	I	A
Coelastrum	I	A	I	I	I.O	A	I	I	A	I	A	A
Micractinium	I	A	A	A	A	I	A	A	A	A	A	A
Kirchinella	A	A	A	I	A	O	I.O	A	A	A	I.O	I.O
Nephrocytium	A	I	A	A	A	A	A	A	A	A	A	A
Oocyst	A	A	A	I	A	A	I	O	O	A	A	I.O
Anthophysis	A	I	A	A	A	A	A	A	A	A	A	A
Staurastrum	A	O	A	A	A	A	A	A	I	A	A	A
Ulothrix	A	A	A	A	A	A	A	A	A	A	I	A
Botryococcus	A	A	A	A	A	I	A	A	I	A	A	I
Blue green algae												
Gomphosphaeria	I.O	I	I	I	I	I	I.O	I	I	I	A	I
Chroococcus	I.O	I.O	I.O	I	I.O	I	I.O	I	I	I.O	I.O	I.O
Microcystis	I	I	I.O	I.O	A	I	I.O	I	I	I	I	I
Merismopedia	I.O	I.O	A	A	I	O	A	I.O	I.O	I	A	A
Oscillatoria	A	A	A	A	A	A	A	A	I	A	A	A
Phacus	A	I	A	A	A	A	A	A	A	A	A	A

(I)=present at interance
(O)=present at outlet
(I.O)= present at interance and outlet
(A)=absent

Table (17) Algae identification at interance and outlet of Metobas plants

Algae	Months	10/2011	11/2011	12/2011	01/2012	02/2012	03/2012	04/2012	05/2012	06/2012	07/2012	08/2012	09/2012
Diatoms													
Stephanodiscus		I.O	O	I	I	I	I.O	I	I	I.O	I	I.O	I.O
Cyclotella		I.O	I.O	I.O	I.O	I.O	I.O	I	I	I.O	I	I	I
Nitzschia		A	I	I	A	O	I	I.O	I.O	I.O	I.O	I.O	A
Melosira		I	I	I	A	A	I	I	I.O	I	I.O	I	I
Diatoma		I	I.O	I.O	I.O	I.O	I	I.O	O	I.O	I.O	I.O	I
Navicula		A	A	I	I.O	I	A	A	A	A	I	I	I
Fragilaria		A	A	A	I.O	A	A	O	A	I	I	I	I
Surirella		I.O	I	I	A	O	A	A	I	A	A	A	A
Asterionella		A	A	A	A	A	A	I	A	I.O	A	A	A
Gyrosigma		A	A	I	A	A	A	I	A	A	A	A	A
Amphora		A	A	A	I.O	A	A	A	A	A	A	A	A
Synedra		I.O	I	I	I	A	I	O	O	I.O	A	I.O	I
Green algae													
Scenedesmus		A	I	I.O	I.O	I.O	I	I.O	I	I.O	I.O	I	I.O
Pediastrum		I.O	I.O	I	I	A	A	I	I.O	I.O	I	I.O	I
Selenastrum		A	I.O	I.O	A	I	I.O	A	I.O	I	I.O	I	A
Ankistrodesmus		A	A	I	I	O	I	I	I	A	A	A	A
Botrydiopsis		A	I	A	A	A	A	A	A	A	I	A	A
Actinastrum		A	I	I	A	A	A	I	I	A	A	A	A
Tetraedron		I	I.O	I.O	I.O	I.O	I.O	O	I.O	I	I	I.O	A
Crucigenia		O	I.O	A	A	A	I	A	A	I	O	A	I.O
Coelastrum		I	A	A	A	A	A	O	A	I	I	A	A
Micractinium		A	I	A	A	A	I	A	I	A	A	A	A
Kirchinella		A	A	I.O	A	A	O	I	A	I	A	I.O	I
Nephrocytium		I	A	A	A	A	A	A	A	A	A	A	I
Peridinium		I	A	A	A	A	A	A	A	A	A	A	A
Oocyst		A	A	A	I	A	A	O	A	I	A	A	A
Anthophysis		A	A	A	A	I.O	A	A	A	A	A	A	A
Staurastrum		A	A	A	A	A	A	A	A	A	A	I	A
Volvex		A	A	A	I.O	A	A	A	A	A	A	A	A
Ulothrix		A	A	A	A	A	A	A	A	I	A	A	I
Botryococcus		A	A	A	A	A	I	A	A	I	A	A	A
Blue green algae													
Gomphosphaeria		A	I.O	I	I	A	I	O	I	I	I	A	A
Chroococcus		I.O	I.O	I.O	I.O	I.O	I.O	I.O	I.O	I.O	I.O	I.O	O
Microcystis		I	I	I.O	I	I	A	I	I	I.O	I	I	I.O
Merismopedia		I	I	A	A	A	A	A	A	I.O	I	A	A
Oscillatoria		A	A	A	A	A	A	A	A	A	A	A	I

(I)=present at interance
(O)=present at outlet
(I.O)= present at interance and outlet
(A)=absent

Table (18) Algae identification at interance and outlet of Kaleen plants

Algae / Months	10/2011	11/2011	12/2011	01/2012	02/2012	03/2012	04/2012	05/2012	06/2012	07/2012	08/2012	09/2012
Diatoms												
Stephanodiscus	I.O	I.O	I.O	I	I	I.O	I	I.O	I	I.O	I.O	I.O
Cyclotella	I	I	I.O	I.O	I.O	I.O	I.O	I	I	I.O	I.O	I.O
Nitzschia	I	I.O	O	I	I	I	O	I	I	A	I	I.O
Melosira	I.O	I	I	A	I	I	I.O	A	I.O	I	I	I
Diatoma	I	I.O	A	I	I	I.O	I.O	I	I	I.O	I.O	I.O
Navicula	I	I	I	A	A	A	A	A	I.O	I	I	I
Fragilaria	A	I	A	A	I	A	A	A	A	A	A	I
Surirella	I.O	A	O	A	A	I	A	I	A	I	I.O	A
Gyrosigma	I	I	A	I	A	A	A	A	A	A	I	I
Amphora	A	A	A	O	A	O	A	A	A	A	A	A
Cocconeis	A	A	A	I	A	I	I	A	I.O	A	A	A
Synedra	I	I	I	I	O	I	I	I	I.O	I.O	A	I
Green algae												
Scenedesmus	I.O	I.O	I.O	I.O	I.O	I.O	I.O	I.O	I	I.O	I.O	I
Pediastrum	I	I	I	I	I	I	I	I	I	I	I	I.O
Selenastrum	I.O	A	I	I	I	I	I.O	I	I.O	I	I.O	A
Ankistrodesmus	A	A	O	A	A	A	I	I	A	I	I	A
Botrydi.opsis	A	A	A	A	I	A	A	A	A	A	A	A
Actinastrum	I.O	I	I	I	I	A	A	I	A	A	A	A
Tetraedron	O	I.O	I.O	I	I.O	I	I	O	I.O	I.O	I.O	I
Coelastrum	I	I.O	A	I	I	A	A	A	A	A	A	A
Micractinium	A	A	A	A	A	I	A	I	A	A	A	A
Kirchinella	A	A	I	A	A	A	A	I.O	A	A	A	A
Oocyst	A	A	A	A	I.O	I.O	I.O	A	I.O	A	A	A
Botryococcus	I	A	A	A	A	A	A	O	A	I	A	A
Blue green algae												
Gomphosphaeria	I	O	I	I	A	A	I	I	I	A	I	A
Chroococcus	I.O	I.O	O	I	A	I	I	I.O	I.O	A	A	O
Microcystis	I	I	I	I	A	I.O	I.O	I.O	I.O	I.O	I. O	I
Merismopedia	I.O	I	I	A	A	A	A	A	A	I	A	A
Oscillatoria	I	I	A	A	A	A	A	A	A	A	A	A

(I)=present at interance
(O)=present at outlet
(I.O)= present at interance and outlet
(A)=absent

Table (19) Algae identification at interance and outlet of Dessouk plants

Algae / Months	10/2011	11/2011	12/2011	01/2012	02/2012	03/2012	04/2012	05/2012	06/2012	07/2012	08/2012	09/2012
Diatoms												
Stephanodiscus	I	I	O	I.O	I.O	I.O	I	I	I	I.O	I.O	I
Cyclotella	I.O	I.O	I.O	I.O	I.O	I.O	I	I.O	I.O	I.O	I.O	I
Nitzschia	I	I	I.O	A	I.O	I	I.O	I.O	I.O	I	A	A
Melosira	I.O	I	I	A	I	I	I.O	A	I.O	I	I	I
Diatoma	I.O	I	I.O	I	I.O	I.O	I.O	A	I	I	I.O	I.O
Navicula	I	I	I.O	I	I	A	A	A	A	I	A	I
Fragilaria	I	A	I	A	A	A	A	I	I	A	I	I
Surirella	I	I	I	I	A	I.O	I	I	A	A	A	A
Asterionella	I	A	A	A	A	A	A	A	A	A	A	A
Gyrosigma	A	A	A	A	A	A	A	A	I.O	A	A	A
Cocconeis	A	I	A	I	I	I	A	A	A	A	A	A
Amphora	A	A	A	A	A	A	A	A	A	A	I	A
Synedra	O	I	I	I	I.O	A	I.O	I.O	I.O	I.O	I.O	I.O
Green algae												
Scenedesmus	I.O	I	I.O	I.O	I.O	I.O	I.O	I.O	I	I.O	I.O	I.O
Pediastrum	I	I	I.O	A	O	I	I	I	I	I.O	I.O	I
Selenastrum	I.O	I.O	I.O	I	I.O	I.O	I.O	I.O	I.O	I	I.O	A
Ankistrodesmus	A	I	I.O	I	I.O	I	A	A	I	I	A	A
Botrydiopsis	I	A	O	I	A	A	I	A	A	A	A	A
Actinastrum	I.O	I	I	A	I	I	A	A	A	A	A	I.O
Tetraedron	I	A	I.O	I	I	I.O	I	I.O	I.O	A	A	A
Coelastrum	I	I	I	A	A	A	A	I	A	A	A	I
Micractinium	A	I	A	A	A	A	I	A	A	A	A	A
Kirchinella	A	A	A	I.O	A	A	A	I	A	I	O	I
Nephrocytium	A	I	A	A	A	A	A	A	A	A	A	A
Oocyst	O	I	O	I	A	A	A	A	A	I.O	I.O	A
Anthophysis	A	A	A	A	A	A	I	A	A	A	A	A
Heterococcus	A	A	A	A	I	O	A	A	A	A	A	A
Dictyosphaerium	A	A	A	A	A	A	I	A	A	A	A	A
Ulothrix	A	A	A	A	A	A	A	A	A	A	I	A
Botryococcus	A	A	A	I	A	A	A	I	I.O	A	A	A
Blue green algae												
Gomphosphaeria	A	A	A	I	A	A	I	I.O	I	I	A	A
Chroococcus	I	I.O	A	I	I.O	I.O	I	I.O	I	I	I.O	A
Microcystis	A	I	I.O	I	I	I.O	I.O	I	I.O	A	I	I.O
Merismopedia	O	I	I.O	A	A	A	A	I	A	I.O	A	I
Oscillatoria	I	A	A	A	A	I	A	A	A	A	A	A
Dactylococopsis	I	A	A	A	A	A	A	A	A	A	A	A
Phacus	O	A	A	A	A	A	A	A	A	A	A	A
Euglena	A	A	A	A	A	A	I.O	A	A	A	A	A
Anabeana	A	A	O	A	A	A	A	A	A	A	A	A

(I)=present at interance
(O)=present at outlet
(I.O)= present at interance and outlet
(A)=absent

Table (20) Algae identification at interance and outlet of El-Read plants

Algae / Months	10/2011	11/2011	12/2011	01/2012	02/2012	03/2012	04/2012	05/2012	06/2012	07/2012	08/2012	09/2012
Diatoms												
Stephanodiscus	I.O	I.O	A	I.O	I.O	I	I	I	I.O	I.O	I.O	I.O
Cyclotella	I	I	I.O	I.O	I.O	I.O	I.O	I	I.O	I.O	I.O	I
Nitzschia	I.O	I.O	I	I	O	I.O	I	I.O	I	I	I	A
Melosira	I.O	I	I	A	I.O	I.O	I.O	I	I	I	I	I
Diatoma	I.O	I.O	I	I.O	I.O	I	I.O	I.O	I.O	A	I.O	I.O
Navicula	I	I	I.O	I.O	I	O	A	I	A	A	I	I
Fragilaria	A	I	A	A	A	A	A	I.O	A	A	I.O	I
Surirella	A	A	I	I	I	I	A	A	A	A	A	A
Asterionella	A	A	A	A	A	A	A	I	A	A	A	A
Gyrosigma	A	A	A	A	I	A	I	A	I	A	A	A
Cocconeis	A	A	A	A	A	I	I	A	A	A	A	A
Synedra	I.O	I	O	I	O	O	I.O	I.O	I	I	I.O	I.O
Green algae												
Scenedesmus	I.O	I.O	I.O	I.O	I.O	A	I	I.O	I.O	I	I.O	I.O
Pediastrum	I	I	I	A	I	I.O	A	I.O	I	I	A	I.O
Selenastrum	O	I.O	I.O	I.O	O	A	A	I.O	I.O	I.O	I	I.O
Ankistrodesmus	A	A	I.O	I	I.O	I.O	I	I	I	A	A	A
Actinastrum	I.O	A	A	I	I	I	I	A	I	A	A	A
Tetraedron	I.O	I.O	I	I	I.O	I.O	I	I.O	A	A	I.O	A
Crucigenia	A	A	I.O	A	A	A	A	A	O	A	A	A
Coelastrum	A	I	I.O	A	I	A	A	I	A	A	A	A
Micractinium	A	A	A	A	A	A	I	A	A	A	A	A
Kirchinella	A	A	I	A	I	I	A	A	A	A	A	I
Oocyst	A	A	I	I.O	I	I	A	A	A	A	I.O	A
Staurastrum	A	A	A	A	A	A	A	I	I	I	I.O	I
Heterococcus	A	A	A	A	A	A	I	A	A	A	A	A
Dictyosphaerium	A	A	A	A	A	A	A	A	A	A	A	I
Ulothrix	A	A	A	A	A	A	A	A	A	I	A	A
Cosmarium	A	A	A	A	A	A	A	A	A	A	A	I
Botryococcus	A	A	A	I	A	A	A	A	O	A	I	A
Blue green algae												
Gomphosphaeria	A	O	I	I	I	I	I	I	I	I	A	I.O
Chroococcus	A	O	A	I.O	I.O	I	I.O	I.O	I.O	I.O	I	I
Microcystis	I	I	I	I	I.O	I.O	I.O	I.O	I.O	I	I.O	A
Merismopedia	A	I	I	A	A	A	I	A	A	I	I.O	A
phacus	I	A	A	A	A	A	A	A	A	A	A	A
Euglena	I	A	A	A	A	A	A	A	A	A	A	A
Spirogeria	A	A	A	A	I	A	A	A	A	A	A	A

(I)=present at interance
(O)=present at outlet
(I.O)= present at interance and outlet
(A)=absent

Table (21) Algae identification at interance and outlet of El-Hamoul plants

Algae / Months	10/2011	11/2011	12/2011	01/2012	02/2012	03/2012	04/2012	05/2012	06/2012	07/2012	08/2012	09/2012
Diatoms												
Stephanodiscus	I	I.O	I	I.O	I.O	I	I	I	I.O	I	I.O	I
Cyclotella	A	I	A	I.O	I.O	I	I	I.O	I	I	I	I
Nitzschia	I.O	O	I	I	O	I.O	I	I.O	I	I	A	I.O
Melosira	A	I	A	A	A	I	I	I	I	A	I	I
Diatoma	I.O	I.O	I	I.O	I.O	I.O	I.O	I	I.O	I.O	I	I.O
Navicula	I	I	I.O	I	I	I	I	A	I	A	A	I.O
Fragilaria	A	I	I	A	A	A	A	I	I	A	I	I
Surirella	A	A	A	A	I	I.O	A	A	A	A	A	A
Asterionella	A	A	A	A	I	A	I	A	A	A	A	A
Gyrosigma	A	A	A	A	A	A	A	A	A	A	A	I
Cocconeis	A	A	A	A	A	I	I.O	A	A	A	A	A
Synedra	I	I	I.O	I	I	O	O	I.O	A	I.O	I	I.O
Green algae												
Scenedesmus	I.O	I.O	I	I.O	I.O	A	I	I	I.O	I	I.O	I
Pediastrum	I	A	A	A	I	I	I	I.O	I	I	I	I.O
Selenastrum	A	A	I.O	I.O	I.O	I.O	I.O	I.O	I.O	I.O	I.O	I
Ankistrodesmus	A	A	A	A	A	I.O	I	A	A	I	A	A
Actinastrum	A	A	A	A	I	A	I	A	A	A	A	I
Tetraedron	I.O	I	I.O	I	O	I.O	I.O	A	I	A	A	A
Coelastrum	A	I	I	A	A	A	A	I	A	A	A	A
Kirchinella	A	A	A	A	A	I	A	A	A	I	A	A
Oocyst	A	A	A	I	I	A	I	A	A	A	I	I.O
Staurastrum	A	A	A	A	A	A	A	A	I	A	I	A
Ulothrix	A	A	A	A	A	A	A	A	A	A	I	A
Botryococcus	A	A	A	I	A	A	A	I.O	I	I.O	A	I.O
Blue green algae												
Gomphosphaeria	A	A	A	I.O	I	A	I	I.O	I	I	I	I
Chroococcus	I.O	I.O	I.O	I.O	I.O	I.O	I.O	I.O	I.O	I	A	I.O
Microcystis	I	I	I	I	I	I	I	I	I	I.O	I.O	I
Merismopedia	A	A	I	A	A	A	I	A	A	A	I	A

(I)=present at interance
(O)=present at outlet
(I.O)= present at interance and outlet
(A)=absent

Table (22) Algae identification at interance and outlet of Paltem plants

Months / Algae	10/2011	11/2011	12/2011	01/2012	02/2012	03/2012	04/2012	05/2012	06/2012	07/2012	08/2012	09/2012
Diatoms												
Stephanodiscus	I.O	I	I	I.O	I.O	I.O	I	I.O	I.O	I	I.O	I.O
Cyclotella	I.O	I.O	I.O	I.O	I.O	I.O	I	I.O	I	I	I	I
Nitzschia	I.O	A	A	A	A	I.O	I.O	I	I	I.O	I	I
Melosira	I	I	I	A	I	I	I	I	I	I.O	I	I
Diatoma	I.O	I.O	I.O	I.O	I.O	I	I	A	I	I	I	I
Navicula	I	I.O	I.O	I	I	I.O	I.O	I.O	I	I	I	A
Fragilaria	I	A	A	A	I	A	A	A	A	A	A	A
Surirella	O	A	A	I	A	I	A	A	A	I	A	I
Asterionella	A	A	A	A	A	A	I	I	A	A	A	A
Gyrosigma	I	I	I	A	A	A	I	A	A	A	A	A
Cocconeis	I	I	A	A	A	A	O	A	A	A	A	A
Amphora	A	A	A	A	I	A	A	A	A	A	A	A
Synedra	I	I	I.O	I	I	I	O	I.O	I	I.O	I.O	O
Green algae												
Scenedesmus	I.O	I.O	I.O	I.O	I.O	I.O	I.O	I	I.O	I	I	I.O
Pediastrum	I	I	I.O	A	I	I	A	I.O	I	I.O	A	I
Selenastrum	O	A	I	I	I	I.O	A	I.O	I	I.O	I.O	I.O
Ankistrodesmus	A	A	I	I.O	A	I	I.O	A	A	I	I	A
Treubaria	I	I	A	A	A	A	A	A	A	A	I	A
Botrydiopsis	A	A	A	I	A	A	A	A	A	A	I	A
Actinastrum	A	I	I	A	A	A	I	I.O	A	A	I	O
Tetraedron	A	A	A	I.O	A	I	A	I.O	A	A	A	A
Crucigenia	O	A	A	A	A	A	A	A	A	A	A	I.O
Coelastrum	I	A	A	A	A	A	I.O	A	A	A	A	I
Kirchinella	A	A	A	I.O	I	A	I	A	A	A	A	A
Oocyst	A	A	A	A	I	I	O	A	A	A	A	A
Anthophysis	A	A	A	A	A	I	A	A	A	A	A	A
Staurastrum	A	A	A	A	A	A	I	A	I	A	A	A
Botryococcus	A	I	I	A	A	I	A	A	O	I	I.O	A
Blue green algae												
Gomphosphaeria	O	I	I	I	I	I	I	I	I	I	A	I.O
Chroococcus	I.O	I.O	I.O	I.O	I.O	I.O	I.O	I.O	I	I.O	I.O	I.O
Microcystis	I	I	A	I.O	I.O	I	I.O	I	I	I	I	I
Merismopedia	A	A	A	A	A	I	A	A	I.O	A	A	A

(I)=present at interance
(O)=present at outlet
(I.O)= present at interance and outlet
(A)=absent

Table (23) Algae identification at interance and outlet of Sedi Salem plants

Algae / Months	10/2011	11/2011	12/2011	01/2012	02/2012	03/2012	04/2012	05/2012	06/2012	07/2012	08/2012	09/2012
Diatoms												
Stephanodiscus	I	I	A	O	I	I	I.O	I	I	I.O	I.O	I.O
Cyclotella	I.O	I.O	I.O	I.O	A	I	I.O	I.O	I.O	I	I	I.O
Nitzschia	I.O	A	A	A	A	I	I	A	I	I	A	I
Melosira	I	I.O	I	I	I	I	I.O	I	I	I	I	I
Diatoma	I.O	O	I	O	O	I.O	I	A	I	I	I.O	I
Navicula	I	A	I.O	I.O	I.O	I.O	O	I.O	A	I	I	I.O
Fragilaria	A	A	A	I	I	A	A	A	A	A	A	I
Surirella	I.O	I	I	I	A	A	I	I	A	A	A	A
AsterI.Onella	A	A	A	A	A	A	A	A	A	I.O	A	A
Gyrosigma	A	A	I	I	I	A	A	A	A	A	A	I
Cocconeis	A	A	A	A	A	I.O	A	A	A	A	A	A
Synedra	A	I	I.O	I	I.O	I.O	I	I.O	I	I.O	I.O	I
Green algae												
Scenedesmus	A	I	I.O	I.O	I.O	I.O	I	I.O	I.O	I	I	I
Pediastrum	I.O	I	I	I	I	I	I.O	I.O	I	I	A	A
Selenastrum	A	I.O	I	I.O	I.O	I.O	I	I.O	I.O	I.O	I.O	I
Ankistrodesmus	A	I.O	I	I	I	O	O	A	I	A	A	A
Botrydiopsis	I.O	A	A	A	A	A	A	A	I	A	I	A
Actinastrum	A	A	I	A	A	A	A	I	A	A	A	A
Tetraedron	I	A	I.O	I	A	I.O	I.O	A	I	A	A	A
Crucigenia	I.O	A	A	A	A	A	A	A	A	A	A	A
Coelastrum	I	I	A	A	A	A	I	A	A	A	A	I.O
Micractinium	I	A	A	A	A	I	I	A	A	A	A	A
Kirchinella	A	A	I	A	A	I	A	A	I	A	A	I.O
Oocyst	A	A	A	I	I	I.O	I.O	A	A	A	A	I.O
Ulothrix	A	A	A	A	A	A	A	A	A	I	A	A
Botryococcus	A	A	A	I	I	I	I	A	A	I.O	I.O	I.O
Blue green algae												
Gomphosphaeria	I	A	A	I.O	I	A	I	I	I	I	A	A
Chroococcus	I.O	A	A	O	I.O	A	I.O	I	I	I.O	I.O	I.O
Microcystis	I.O	I.O	A	I	I	I	I.O	I.O	I	I.O	I.O	I
Merismopedia	I	A	A	I	A	A	A	A	I.O	A	I	A
Oscillatoria	A	A	A	I	A	I.O	I	A	A	A	A	A
Anabeana	I	A	A	A	A	A	A	A	A	A	A	A

(I)=present at interance
(O)=present at outlet
(I.O)= present at interance and outlet
(A)=absent

Two different hypotheses on the origin of algae in drinking water can be considered. Firstly, it can be assumed that water treatments are not 100% effective in removing algae**.** Abed El Rahman, (2009) said that clarifiers algae fluctuates between 85% and 99% in an average 92 %. But in our study removal ratio between 98.99 % to 54.68 %, For this reason some of them are capable of penetrating in the drinking water systems. Since algae can travel all the way from origin to the end point, the levels detected in tap water are exclusively from algae not removed by treatment.

Secondly, some of these algae could proliferate or have the ability to grow in the system in the dark, using the ability of some Genera to develop heterotrophic metabolisms. These microscopic algae, having a relatively active role and could become members of the normal flora of drinking water systems (Neilson and Lewis, 1974). In most pipe surfaces, the development of bio-films containing algae and bacteria has been proven. In this case, it is logical to consider the possibility of algae re growth, probably into the bio-films (Allen *et al*., 1980) So their presence is not affected by the seasonal changes occurring in the surface waters used for supply (Francesc *et al*., 2003).

3.3. Efficiency of algae treatment:

High ratio of algae remove is 98.99% in month 01/2012 at Kaleen water plant with total algae inter and outlet respectively (1490 CFU/ml, 15 CFU/ml) represented respectively in genera descripted in Table (18) (*Synedra, Stephanodiscus, Cyclotella, Nitzchia, Cocconeis, Diatoma and Gyrosigma* as diatoms, *Scenedesmus, Tetraedron, Actinastrum, Pediastrum, Selenastrum* and *Coelastrum* as green algae *Microcystis, Chroococcus* and *Gomphosphaeria* as blue green algae) which represented (1490) genera at Kaleen plant interance while the (15) genera at outlet after treatment are (*Cyclotella* and *Amphora* as diatoms, *Scenedesmus* as green algae and blue green algae are compoletly removed).

In contrast the low ratio of algae remove is 54.68% in month 02/2012 at Metobas water plant with total algae in interance and outlet respectively (1688 CFU/ml, 765CFU/ml) and represented respectively in genera descript in Table (17) (*Stephanodiscus, Cyclotella, Diatoma and Navicula* as diatoms, *Scenedesmus, Anthophysis, Tetraedron* and *Selenastrum* as green algae, *Chroococcus* and *Microcystis* as blue green algae) which represented (1688) genera, while (*Surirella, Cyclotella, Diatoma* and *Nitzchia* as diatoms, *Scenedesmus, Anthophysis, Tetraedron, Selenastrum, and Ankistrodusmus* as green algae, Chroococcus as blue green algae*)* represented (765) genera.

In this study, the presence of algae in outlets of drinking water samples may be attributed to failure of sand filters. While their presence in the distribution system may be attributed to aging of some networks and pipes, leakage to sewer systems. Also no existence of cleaning valves at the end of pipes that results in the increase of precipitation and the increase in the probability of pollution; in addition to the operation and maintenance is done by unqualified trainees (Donia, 2007). This study agrees with Amer, (2012) where attributed presence of pathogenic organisms in outlets of drinking water samples to failure of sand filter stage and in the distribution system to cross connections between drinking water and sewer lines, backflows, breakthroughs in drinking water, wastewater treatment plant operations, leaking pipes, valves, joints and seals as well as contamination of the tap by the final users.

During this study; it was noticed that *Microcystis* cells and other genera from blue green algae disappeared completely from the outlet and inlet of drinking water treatment plants in some plants at different months. This result can be explained due to the sedimentation and filtration processes (El-Manawy and Amin, 2004).

The addition of oxidants such as chlorine, ozone or permanganate to untreated water prior to coagulation has been shown to increase the removal of algae. These oxidants alter the surface charge of algae, thus improving their removal during coagulation (Chen and Yeh, 2005).

River Nile is considered the main water source of drinking water in Egypt and prevention of contamination, especially in rural areas will enhance the efficiency of drinking water treatment facilities for Cyanobacterial harmful algae removal.

Conclusion

It can be concluded that water treatment plants are not 100% effective in removing of Diatoms, Green algae and Blue Green algae. For this reason some of them are capable of penetrating in the drinking water systems. They can travel all the way from origin to the end point and the levels detected in tap water are exclusively from Cyanobacterial harmful algae not removed by treatment. The presence of algae species in drinking water treatment plants during this study may be due to its small size and structure of cysts that make it may be resistant to chlorine disinfection. The implementation of new technologies as such Activated carbon filtration as an additional unit process to meet current and proposed regulations, in case of Cyanobacterial harmful algal blooms are of great necessary to produce biologically safe drinking water. The drinking water treatment plants must modify their treatment method according to the numbers and types of algae present.

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