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Assessment of physicochemical and water borne pathogens of water plants in Kafr El-Sheikh Governorate, Egypt.

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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. Some physical parameters such as temperature, turbidity, dissolved oxygen and pH were monitored. In addition, the bacteriological analyses involved, Fecal Coliforms (FC), and Fecal *Streptococci* (FS) were counted in inlet and outlet of the plants where *E.coli* and *Shigella* spp. were detected. The results of physicochemical parameters showed that the temperature values varied from 13.8°C to 31.5°C, turbidity from 0.22 NTU to 30 NTU, pH from 7.0 to 8.7 and dissolved oxygen (DO) from 3.2 mg/l to 8.8 mg/l. The fecal coliform less than 1 CFU/100 ml in outlet of all plants except outlet of Metobas plant at 02/2012 and 09/2012 as 1 CFU/100ml and 2 CFU/100ml respectively, where the fecal coliform at interance of all plants from 20CFU/100 ml to 1600 CFU/100 ml , also *Streptococcus* bacteria less than 1 CFU/100 ml in all outlet of plants where from less than 1 CFU/100 ml to 600 CFU/100/ml in interance of all plants where *Shigella* spp. and *E.coli* were detected in outlet of Metobas plant, characterization of isolates was carried out by Gram staining reaction, bacteriological selective media and biochemical tests.

Keywords: Drinking water, Fecal coliform, *E. coli*, *Streptococcus*, *Shigella*.

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 pre 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).

As a result, around 6–8 million people die each year due to water related diseases and disasters (UN, 2013). Therefore, water quality control is a top-priority policy agenda in many parts of the world (WHO, 2011). In the world today, the water use in household supplies is commonly defined as domestic water. This water is processed to be safely consumed as drinking water and other purposes. Water quality and suitability for use are determined by its taste, odor, colour, and concentration of organic and inorganic matters (Dissmeyer, 2000). Contaminants in the water can affect the water quality and consequently the human health. The potential sources of water contamination are geological conditions, industrial and agricultural activities, and water treatment plants. These contaminants are further categorized as microorganisms, inorganics, organics, radionuclides, and disinfectants (Nollet, 2000).

In water, *Shigella* can survive for at least six months at room temperature, and this high survival favors transmission through water. The total number of *Shigella* episodes that occur each year throughout the world is estimated to be 164.7 million, including 163.2 million cases in developing countries, 1.1 million of which result in death. Children under 5 years account for 61% of all deaths attributable to shigellosis (Germani and Sansonetti, 2003; Emch and Ali, 2008).

Fecal pollution of water resources is a problem of increasing worldwide concern (Fleischer *et al*.,1996; Sauert *et al*.,2000). Human population growth, inadequate sewage systems, and management of animal waste are some of the issues associated with maintenance of supplies of clean water (EPA, 1998). Underlying this concern, there are numerous reports of waterborne outbreaks of disease involving fecal organisms such as *Escherichia coli* (which is an indicator of fecal contamination), *Campylobacter jejuni*,*Salmonella*, *Vibrio cholerae and Shigellae* (Jones and Roworth , 1996; Licence *et al*., 2001). Identification of the source of the bacterial contamination is an essential first step in seeking to control fecal contamination of water. In particular, it is important to determine whether the source of fecal contamination is of human, livestock, or wildlife origin.

The aim of the present study is the assessment of drinking water both physicochemically and microbiologically in Kafr-El-Sheikh Governorate to meet the standard criteria and permissible level for drinking water defined by WHO.

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 *et al*., 2005 a). 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).

Samples for physical analysis were collected in prewashed clean polyethylene bottles. Temperature, pH and conductivity of the samples were measured in situ. Samples were subsequently stored at 4 °C, for as short time as possible, before analysis to minimize physicochemical changes (Anonymous, 1996).

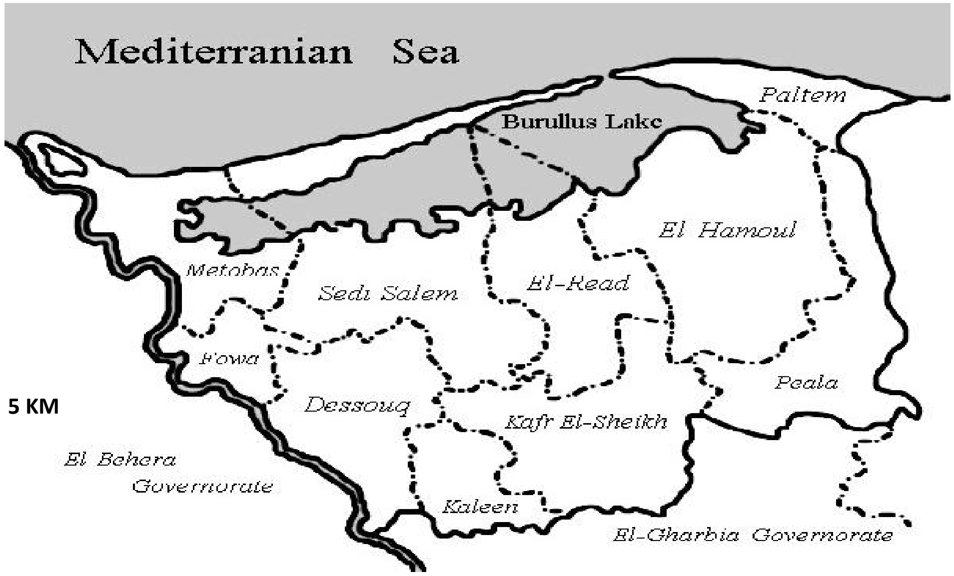

Figure 1: Sampling Sites of Kafr El-Sheikh Governorate.

Table 1: Water Plants Locations in Kafr El-Sheikh Governorate.

S.N N	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	

2.3. Bacterial count using Membrane Filtration Technique:

using a membrane filtration technique, briefly, water sample (100 ml) was filtered through a gridded sterile cellulose-nitrate membrane filter (0.45 µm pore size, 47 mm diameter, Sartorius type filters) under partial vacuum (Millipore, Befrid, UK).

The membrane filters were immediately removed with sterile forceps and placed on the following media with rolling motion to avoid entrapment of air: according to Eaton *et al*., (2005 b) Fecal coliforms were cultured on M-FC agar (Difco) and incubation at 44.5 Ċ. for 24 hr ,fecal streptococci were incubated for 48 hr at 35C on M-Enterococcus agar (difco). Results were recorded as colony forming unit (CFU/100ml) (APHA, 2005). Selective media were used for isolation of pathogenic microorganisms (*E.coli* and *Shigella* spp). *E.coli* were selective using lactose broth, MacConkey agar (Trepeta and Edberg, 1984) and Eiosine Methelene agar (Oxoid, 1982) where Selenite broth, *Salmonella Shigella* agar, Xylose Lysine Deoxycholate agar (Taylor and Harri1, 1965) and Hektone Enteric agar (Oxoid, 1982) for *Shigella* spp

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2.4. Identification of bacterial isolates:

Identification have been conducted according to Bergey's Manual of Systematic Bacteriology (Brenner *et al*., 2005) and confirmed by API 20E and API 20 Strep. (Bio Mereux, France) according to Juang and Morgan, (2001). Biochemical tests included Triple Sugar Iron (TSI), Lysin Iron agar, Motility, Indole, Ornithine Medium, Tryptophan media and citrate utilization media Catalase, Oxidase and Co- agulase tests (Cheesbrough, 2006)

2.5. Physical Parameters:

2.5.1. Temperature, turbidity and pH were measure in *situ* according to APHA, 1998. Temperature of water was measured using a calibrated thermometer while turbidity is measured as "Nephelometric turbidity units" (NTU) by using turbidity meter (PCH019054, Germany) and the pH values were determined by the use of Bench-Top pH Meter, Jenway, Model 3510, UK). The pH meter was calibrated, with three standard solutions (pH 4.0, 7.0, and 10.0), before taking the measurements).

2.5.2. Electrical Conductivity (EC) and Total Dissolved Solids (TDS):

EC was measured at 25°C as standard temperature by using CON 6000 Bench Electrical Conductivity Meter (model No. EPA-30IDAN-9, Eutech Instruments, Singapore), and expressed as µmhos/cm. Total dissolved solids (TDS) of the collected water samples were expressed as mg/L.

2.5.3. Dissolved Oxygen (DO):

The oxygen content of the water samples was measured by SB70D DO Bench- top Meter S/NDO 0800, U.S.A. and expressed as mg/L.

Results and Discussion

The examined microbiological an physicochemical parameters showed considerable variations in different samples.

3.1. Fecal coliform and Streptococcus:

Microbiological quality of the water from ten plants in Kafr El-Sheikh Governorate has been determined in the different sites especially Fecal coliform (FC) as shown in Table (2). In outlet of Metobas plant 1CFU/100 ml FC and 2 CFU/100 ml on 02/2012 and 09/2012 respectively were recorded. This disagree according to Egyptian specification and (WHO, 2011).

Faecal streptococci are associated with fecal material from human and other warm-blooded animals and their presence in water indicates the potential incidence of enteric pathogens that could cause illness in exposed individuals (Dufour, 1984). Any bacterial cell of fecal indicator were found in drinking water, considered to be contaminated with feces, therefore unsuitable for drinking purposes according to WHO guide line for drinking water (WHO, 2003).

In our study *Streptococcus* are acceptable for human consumption as shown in Table (3). This agree according to Egyptian specification (WHO, 2011) and is not in agreement with **Hassanein *et al*., (2013)** who detected Faecal streptococci that are indicators for water contamination.

Farkas *et al*., (2013) proved that approximately 95% of bacterial cells were attached to the pipe walls forming biofilms and less than 5% were found in the water phase. These biofilms were a source of planktonic bacteria, which remain present in the water when delivered through a consumer's tap (Simöes & Simöes, 2013).

These results agreed with **Dania, (2007)** who reported that problems present in drinking water at Metobas and not in agreement with **Fawzy *et al*. (2013)** who reported that faecal coliform was not detected in Metobas.

The presence of faecal bacterial indicator in the River Nile water is owing to the River body receiving big quantities of domestic, industrial and agricultural wastes (Ali *et al*., 2000).

Fecal coliforms (FC) was detected in Nile water at Greater Cairo in 100% of the tested samples reaching 10^3 CFU/100 ml (Shash *et al*.,2010). Moreover, **Niemi and Niemi, (1991)** reported that domestic and industrial wastewater, agriculture waste environment are sources of fecal bacterial to rivers.

Hassanein *et al*., (2013) detected pathogenic microorganisms as fecal coliform that are indicators for water contamination.

3.2. *Escherichia coli* and *Shigella* spp.:

Shigella spp. and *E. coli* were detected in outlet of Metobas plant on 02/2012 and 09/2012 respectively, the presence of *E.coli* in out let of Metobas plant evidence of fecal contamination of drinking water which was not properly treated and screened before water was pumped for consumption.

Escherichia coli causes intestinal tract infections, uncomplicated urinary tract infections and neonatal meningitis. The range of microorganisms detected in this study is a cause for concern because of the wide spectrum of diseases which they cause (Olowe *et al*. 2005; Abo-State *et al*., 2014). They pose continuous health risk to the University community who patronize these pure water vendors or drink the tap water directly without boiling or further treatment fecal coliforms and *E. coli* originate exclusively from human and animal fecal waste (Rompré *et al*., 2002).

Every water sample that has coliform must be analyzed for either fecal coliform or *E. coli* Significant correlation of total coliform with the number of pathogenic additional bacterial indicators is not in agreement with EPA and WHO standard for recreational use (stated that pathogenic organism must not be present in water) because they are of public health significance, having been associated with gastrointestinal infections (Donald *et al*., 2006; Hinton and Holser, 2009). Many authors have reported waterborne disease outbreaks in water meeting the coliform regulations (Gofti *et al*., 1999). The detection of pathogenic enteric bacteria also reveals the alarming situation for water borne epidemics in delta area. The general trend of tap water of proposed mixed origin to contain the highest number of the isolated bacteria concluded that treatment against microbes in water plants was not highly effective. In addition, microbes can enter water utility distribution systems and biofilm formation may account for the persistence of microbes in the distribution systems (Marciano-Cabral *et al*., 2010). The walls of the pipes in the distribution system provide ideal surfaces for microbial colonization (Flemming, 2011).

Patridis *et al*., (2002) reported that the presence of *Escherichia coli* which is the most common indicator of faecal pollution in a water sample is an indication of the presence of other enteric pathogens.

The presence of fecal, *Streptococcus* bacteria, pathogenic microorganisms like *E.coli* and *Shigella* spp. related to contamination of water resources with faecal material, industrial sewage, domestic, agricultural waste, On the other hand 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).

Abo-Amer *et al*., (2008) reported that some drink water stations were polluted with pathogenic strains also **Hassanein *et al*., (2013)** detected pathogenic microorganisms as *Shigella* spp. and *E. coli* that are indicators for water contamination.

3.3. Turbidity:

The turbidity in water refers to the loss of transparency caused by the presence of clay, organic matters, microscopic organisms and other particulate matters (Angela *et al*.,2015). The turbidity was found in the range from 0.22 NTU at Paltem outlet plant in 11/2011 and 07/2012 to 30 NTU at Sedi-Salem and El-Hamoul interance as shown in Table (4).

The turbidity of all water samples in outlet of plants used in this study is in agreement with WHO (2007) guidelines. Water turbidity is very important because high turbidity is often associated with higher level of disease causing microorganism, such as bacteria and other parasites (Shittu *et al*., 2008).

3.4. Temperature:

The temperature was found in the range from 13.8°C at Ebshane interance in 01/2012 to 31.5°C at El-Hamoul outlet in 09/2012 as shown in Table (5).
Recorded water temperature showed obvious seasonal variation with minimum in winter and maximum in summer.

The variation in the water temperature may be due to different timing of collection and influence of season (Diersing, 2009; Jayaraman *et al*., 2003).Water temperature varies with changing climatic condition.Stated that temperature is important in controlling both the quality and quantity of plankton flora.

Water temperature is one of the most important environmental parameters that play a prominent role in regulating nearly all physicochemical characteristics of water as well as biological productivity (Wetzel, 1983).

Temperature changes depend mainly on the climatic conditions, sampling times and the number of sunshine hours (Ezzat et al, 2012).

3.5. Hydrogen Ion Concentration (pH):

pH is affected not only by the reaction of carbon dioxide but also by organic and inorganic solutes present in water, There is no health based guideline for pH.

The pH indicates the intensity of acidic or basic character of a solution. Water with a pH below 7 is acidic and is soft and corrosive. Such water can leach metals from pipes and fixtures (Chandra et al., 2012). Water with pH greater than 7 is alkaline. The WHO (2007) guidelines of pH is 6.5 – 8.5, water with a pH below 6.5 allows dissolution of metals especially the heavy metals beyond the permissible limit, which affects the mucous membrane of cells of human (Nishtha et al., 2012).

the pH was found in the range from 6.5–8.5 is suggested by WHO, the pH was found in the range from 7.0 at Dessouq outlet in 04/2012 to 8.7 at Dessouq interance in 01/2012 as shown in Table (6).

Any alteration in water pH is accompanied by the change in other physicochemical parameters (Shrivastava *et al*.,2013). High and the low pH indicate that the equilibrium of carbon dioxide, carbonate and bicarbonate equilibrium is affected (Chandra *et al*., 2013).

High value of pH may results due to waste discharge, microbial decomposition of organic matter in the water body (Raja, 2008; Patil *et al*., 2012). The high pH in this case may be attributed to sewage discharge by surrounding human population.

PH values were important for plankton growth (Chisty, 2002).

3. 6. Dissolved Oxygen (DO):

DO is a very important parameter of water quality and an index of physical and biological process going on in water which favors solubility of oxygen among the study sites as the DO range from 4 mg/l to 8.8 mg/l, It may be present in water due to direct diffusion from air and photosynthetic activity of autotrophs. Concentration of DO is one of the most important parameters to indicate water purity and to determine the distribution and abundance of various algal groups (Niba and Chrysanthus., 2013; Patil *et al*., 2012; Shyamala *et al*., 2009).

In our study the DO range from 3.2 mg/l in fowa interance at 12/2011 to 8.8 mg/l in Kafr El-Sheikh outlet at 02/2012 as shown in Table (7).

Previous studies reported by **Benerjee, (1967)** reported that the DO concentration of about 5mg/l throughout the year was found to be productive for Fish culture. As DO levels in water drop below 5.0 mg/L, many life forms are put under pressure (Bowman et al., 2008).

Our study in agreement with **Anon, (2007)** who reported that the DO concentration was found to be higher in the cold season which recorded 8.8 mg/l in Kafr El-Sheikh outlet at 02/2012 comparing with the hot season.

In our study the low result is 3.2 mg/l in fowa interance at 12/2011, indicated location were polluted.

The Water DO is an indicator of water quality. DO concentration of unpolluted water is normally about 8-10 ppm at 25±2°C. DO is very important factor for the aquatic organisms, because they affect their biological process. For the oxidation of the organic matters and the sediments, the complex organic substances are converted to simple dissolved inorganic salts which could be utilized by the micro and macrophyte (Okbah and Tayel, 1999). DO concentration was found to be higher in the cold season comparing with the hot season (Anon, 2007). WHO suggested that the standard of DO is not less than 5 mg O_2/l.

DO values during hot and cold season showned negative correlation with NO3-, NH3, total bacterial count, total coliform, Faecal coliform, Faecal streptococci, Salmonella spp., Shigella spp. and pseudomonas aeruginosa (Hassanein *et al*., 2013).

Table (2): Fecal coliform Count (CFU/100ml)

Months / Plants	10/2011	11/2011	12/2011	01/2012	02/2012	03/2012	04/2012	05/2012	06/2012	07/2012	08/2012	09/2012
Kafr El-Sheikh interance	410	110	480	500	220	400	50	540	480	500	520	440
Kafr El-Sheikh outlet	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>
Ebshan interance	420	740	680	600	215	210	10	520	690	240	640	550
Ebshan outlet	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>
Fowa interance	100	700	70	240	210	35	75	240	160	700	260	220
Fowa outlet	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>
Metobas interance	100	220	140	300	210	300	20	560	460	340	670	580
Metobas outlet	1>	1>	1>	1>	**1**	1>	1>	1>	1>	1>	1>	**2**
Kaleen interance	105	690	280	660	100	80	2	130	720	600	440	440
Kaleen outlet	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>
Dessouq interance	310	260	400	50	420	400	100	400	720	440	1100	720
Dessouq outlet	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>
El-Read interance	450	1600	310	810	160	350	20	620	200	340	1550	1100
El-Read outlet	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>
El-Hamoul interance	510	700	600	800	310	210	80	500	710	700	800	710
El-Hamoul outlet	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>
Paltem interance	300	660	400	370	350	220	50	160	700	250	500	560
Paltem outlet	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>
Sedi-Salem interance	350	920	100	440	450	185	90	480	490	250	290	220
Sedi-Salem outlet	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>

Table (3): Streptococcus Count (CFU/100ml)

Months / plants	10/2011	11/2011	12/2011	01/2012	02/2012	03/2012	04/2012	05/2012	06/2012	07/2012	08/2012	09/2012
Kafr El-Sheikh interance	10	10	44	14	5	95	80	250	1>	220	110	120
Kafr El-Sheikh outlet	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>
Ebshan interance	50	30	1>	12	1>	25	25	15	1>	150	250	150
Ebshan outlet	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>
Fowa interance	5	10	1>	2	40	15	30	10	30	600	110	130
Fowa outlet	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>
Metobas interance	1>	10	1>	10	30	12	50	35	9	100	210	200
Metobas outlet	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>
Kaleen interance	60	1>	135	30	3	9	12	30	8	100	90	150
Kaleen outlet	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>
Dessouq interance	20	5	5	3	7	1>	60	4	20	150	500	290
Dessouq outlet	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>
El-Read interance	10	190	100	19	5	80	20	60	30	440	750	310
El-Read outlet	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>
El-Hamoul interance	10	15	10	1>	55	20	60	30	1>	40	410	330
El-Hamoul outlet	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>
Paltem interance	2	1>	1>	5	7	20	25	30	1>	15	100	180
Paltem outlet	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>
Sedi-Salem interance	1>	1>	40	10	20	60	70	70	1>	120	120	110
Sedi-Salem outlet	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>

Table (4): Turbidity measure (NTU)

Months / Plants	10/2011	11/2011	12/2011	01/2012	02/2012	03/2012	04/2012	05/2012	06/2012	07/2012	08/2012	09/2012
Kafr El-Sheikh interance	17.8	14.0	14.0	12.2	15.3	12.4	10.3	17.8	16.8	17.8	12.8	18.9
Kafr El-Sheikh outlet	0.25	0.35	0.42	0.32	0.43	0.65	0.35	0.34	0.56	0.67	0.48	0.56
Ebshan interance	17.8	9.80	9.00	10.0	9.80	13.0	12.5	19.8	16.7	18.7	18.4	16.4
Ebshan outlet	0.36	0.40	0.55	0.45	0.55	0.46	0.54	0.56	0.45	0.43	0.34	0.56
Fowa interance	7.80	9.80	8.00	8.00	6.70	6.80	7.60	12.8	11.7	11.7	14.8	19.8
Fowa outlet	0.48	0.68	0.50	0.80	0.45	0.98	0.56	0.48	0.68	0.62	0.62	0.56
Metobas interance	6.08	5.80	6.40	7.80	7.50	4.60	5.60	14.8	17.8	16.8	19.8	18.7
Metobas outlet	0.30	0.27	0.25	0.82	0.40	0.48	0.38	0.54	0.48	0.68	0.38	0.89
Kaleen interance	7.90	8.40	16.4	5.40	6.97	4.80	10.9	13.8	18.4	20.8	12.4	16.8
Kaleen outlet	0.30	0.40	0.62	0.56	0.65	0.76	0.67	0.65	0.32	0.86	0.68	0.78
Dessouq interance	6.19	6.40	6.30	4.30	6.50	6.20	10.4	9.80	9.80	8.70	8.70	16.8
Dessouq outlet	0.41	0.46	0.48	0.48	0.52	0.89	0.89	0.54	0.48	0.47	0.45	0.92
El-Read interance	17.9	18.3	15.2	7.12	15.5	6.60	13.4	18.4	20.4	18.7	20.8	22.8
El-Read outlet	0.43	0.46	0.59	0.42	0.59	0.92	0.62	0.36	0.67	1.00	0.37	0.48
El-Hamoul interance	30.0	18.0	12.4	12.2	12.5	11.2	20.0	22.8	28.3	24.8	26.4	22.8
El-Hamoul outlet	0.23	0.24	0.25	0.48	0.26	0.62	0.27	0.24	0.22	0.43	0.84	0.23
Paltem interance	11.0	10.3	8.40	5.70	7.90	5.20	12.6	16.7	18.9	16.8	18.9	17.7
Paltem outlet	0.25	0.22	0.11	0.12	0.22	0.34	0.25	0.28	0.24	0.43	0.38	0.24
Sedi-Salem interance	30.0	28.0	5.60	12.8	6.50	9.60	13.8	16.8	19.7	18.7	18.7	19.7
Sedi-Salem outlet	0.56	0.48	0.38	0.86	0.62	0.80	0.86	0.86	0.85	0.86	0.86	0.98

Table (5): Water Temperature (Cº)

Plants \ 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
Kafr El-Sheikh interance	24.2	20.0	20.0	14.5	14.5	20.2	24.2	25.2	26.2	28.8	29.4	28.6
Kafr El-Sheikh outlet	25.0	18.5	17.3	14.7	14.2	20.3	24.8	28.8	26.6	29.3	29.8	29.8
Ebshan interance	24.1	19.6	16.5	13.8	15.5	18.2	22.6	24.8	26.4	28.8	29.4	28.7
Ebshan outlet	25.0	19.8	16.7	14.2	15.6	18.4	23.2	24.4	26.6	29.4	30.6	29.2
Fowa interance	23.2	22.2	16.0	16.2	14.5	18.8	21.8	24.8	26.4	28.8	29.4	28.8
Fowa outlet	24.5	22.0	16.5	16.6	14.7	19.2	22.2	25.3	26.8	29.3	30.8	29.4
Metobas interance	24.2	19.3	18.5	14.5	14.5	18.2	20.8	25.2	26.4	30.2	29.7	29.4
Metobas outlet	24.8	19.0	19.0	14.7	14.8	18.6	21.2	25.8	27.4	30.8	31.2	31.2
Kaleen interance	23.1	17.5	15.5	14.2	14.0	18.0	23.6	26.4	26.4	29.4	28.8	28.0
Kaleen outlet	23.4	17.8	16.1	14.6	14.2	18.4	22.2	26.8	26.9	29.8	29.2	28.4
Dessouq interance	23.0	21.2	18.5	16.1	14.8	18.2	22.4	26.8	27.4	29.6	29.8	28.4
Dessouq outlet	24.0	20.8	19.0	15.7	15.0	18.4	22.6	27.1	27.8	29.8	30.4	28.6
El-Read interance	22.9	19.8	17.2	15.0	17.2	18.0	22.8	25.2	26.4	28.8	30.4	28.8
El-Read outlet	23.0	20.0	17.0	15.2	17.4	18.2	23.4	25.4	26.9	29.4	30.8	29.2
El-Hamoul interance	24.0	21.6	17.5	14.8	14.5	18.2	21.6	25.8	26.4	28.8	29.7	29.8
El-Hamoul outlet	24.6	22.5	18.2	15.2	14.7	18.6	22.2	26.6	26.9	29.4	31.2	31.5
Paltem interance	22.3	22.0	16.6	14.0	14.3	18.2	22.8	24.8	26.7	28.4	29.8	27.8
Paltem outlet	22.5	22.6	16.3	14.5	14.6	18.8	23.0	25.5	27.4	28.8	30.4	28.6
Sedi-Salem interance	24.2	22.1	16.6	14.2	14.5	18.6	22.2	26.8	27.7	28.4	28.4	27.8
Sedi-Salem outlet	24.5	22.6	17.2	14.8	14.8	18.8	22.6	27.2	27.9	29.8	29.8	28.2

Table (6): Values of pH of water

Month / plants	10/2011	11/2011	12/2011	01/2012	02/2012	03/2012	04/2012	05/2012	06/2012	07/2012	08/2012	09/2012
Kafr El-Sheikh interance	7.7	7.3	7.3	7.7	7.7	7.9	7.8	7.9	7.7	7.8	7.9	7.9
Kafr El-Sheikh outlet	7.2	7.1	7.1	7.2	7.2	7.4	7.2	7.2	7.3	7.2	7.2	7.2
Ebshan interance	7.8	7.8	7.8	7.8	7.8	7.8	7.7	7.8	7.8	7.9	7.9	7.9
Ebshan outlet	7.3	7.5	7.4	7.3	7.4	7.3	7.2	7.2	7.2	7.2	7.2	7.2
Fowa interance	7.8	7.6	7.7	7.7	7.7	7.8	7.8	7.9	7.8	7.9	7.9	7.8
Fowa outlet	7.1	7.2	7.1	7.2	7.1	7.3	7.2	7.2	7.2	7.2	7.1	7.2
Metobas interance	7.9	7.8	7.9	8.1	7.2	8.1	7.8	7.9	7.9	7.8	7.8	7.9
Metobas outlet	7.2	7.1	7.2	7.7	7.1	7.9	7.2	7.1	7.2	7.2	7.2	7.2
Kaleen interance	7.7	7.7	7.8	7.6	7.3	7.9	7.0	7.7	7.8	7.7	7.4	7.9
Kaleen outlet	7.3	7.3	7.4	7.4	7.1	7.5	7.9	7.1	7.2	7.1	7.1	7.1
Dessouq interance	7.7	7.9	7.9	8.7	7.6	7.9	7.9	7.9	7.9	7.8	7.8	8.2
Dessouq outlet	7.2	7.1	7.2	8.2	7.1	7.5	7.0	7.2	7.2	7.1	7.1	7.2
El-Read interance	7.7	7.7	7.8	7.9	7.8	7.7	7.9	7.9	7.9	7.9	7.9	7.9
El-Read outlet	7.1	7.2	7.3	7.6	7.3	7.3	7.4	7.3	7.2	7.3	7.3	7.3
El-Hamoul interance	7.6	7.8	7.8	7.8	7.4	7.9	7.7	7.9	7.9	7.9	7.9	7.8
El-Hamoul outlet	7.2	7.2	7.2	7.5	7.7	7.3	7.2	7.2	7.2	7.2	7.2	7.2
Paltem interance	7.8	7.8	7.9	7.8	7.8	7.7	7.7	7.9	8.4	7.8	7.9	7.8
Paltem outlet	7.3	7.2	7.3	7.2	7.3	7.3	7.3	7.3	7.4	7.2	7.3	7.3
Sedi-Salem interance	7.6	7.8	7.9	8.1	7.8	7.9	7.8	7.9	7.9	7.9	7.9	8.2
Sedi-Salem outlet	7.2	7.3	7.2	7.6	7.4	7.4	7.3	7.3	7.3	7.2	7.2	7.2

Table (7) Dissolve Oxygen (mg/l)

Months / Plants	10/2011	11/2011	12/2011	01/2012	02/2012	03/2012	04/2012	05/2012	06/2012	07/2012	08/2012	09/2012
Kafr El-Sheikh interance	6.8	6.8	6.8	6.9	6.1	6.8	6.2	6.2	6.2	6.2	6.2	6.4
Kafr El-Sheikh outlet	7.0	7.2	7.2	7.1	8.8	7.2	7.4	7.4	7.2	7.6	7.6	7.8
Ebshan interance	7.0	6.7	6.5	7.0	6.6	7.0	6.2	5.9	6.9	5.6	6.7	6.4
Ebshan outlet	7.1	7.2	7.6	7.1	6.9	7.1	7.2	7.2	7.3	6.7	7.3	7.6
Fowa interance	4.4	4.2	3.2	3.8	4.6	6.9	4.5	5.2	5.2	4.8	4.8	5.3
Fowa outlet	5.8	4.8	4.2	4.8	4.6	5.4	5.2	6.8	6.4	6.2	5.8	6.9
Metobas interance	5.6	6.4	5.2	5.8	5.8	6.8	4.6	5.8	5.4	5.2	6.2	5.4
Metobas outlet	6.1	6.8	5.8	6.2	6.8	5.8	5.8	7.1	6.2	6.8	7.3	6.6
Kaleen interance	6.7	7.1	6.8	6.9	6.8	6.8	7.0	5.4	5.4	6.4	6.7	6.6
Kaleen outlet	6.9	5.6	7.0	4	7.0	7.0	7.1	6.8	6.5	7.2	7.2	7.2
Dessouq interance	5.6	6.1	5.2	5.4	4.3	5.8	6.2	5.8	5.4	5.4	6.4	5.6
Dessouq outlet	6.2	6.6	6.2	6.8	4.6	6.2	7.1	6.8	6.2	6.4	7.8	6.8
El-Read interance	6.4	6.4	6.8	6.2	6.8	6.8	5.8	5.8	6.2	6.2	6.7	6.8
El-Read outlet	7.1	7.1	6.2	6.8	7.1	7.1	7.1	7.1	7.4	7.3	7.6	7.3
El-Hamoul interance	7.0	6.9	7.1	7.0	6.9	6.9	6.8	7.0	6.5	6.6	6.9	6.8
El-Hamoul outlet	7.1	7.3	7.2	7.2	7.2	7.1	7.0	7.6	7.9	7.8	7.7	7.5
Paltem interance	8.6	8.4	6.8	6.2	6.5	6.6	6.7	6.3	6.4	6.4	6.2	7.2
Paltem outlet	8.8	8.3	7.3	7.3	6.8	7.1	7.7	6.7	7.3	7.6	7.6	7.7
Sedi-Salem interance	5.8	5.4	6.2	5.4	6.8	6.6	5.8	6.2	5.8	6.6	6.6	5.8
Sedi-Salem outlet	6.2	6.1	6.6	6.6	7.1	6.8	6.8	7.2	6.7	7.3	7.3	7.2

Conclusion

In general results revealed that water treatment of the plants in Kafr El-Sheikh Governorate are efficient. Water in outlet of all plants during 12 months were accepted for drinking and met the standars of Egyptian and WHO permissible limits except at Metobas outlet, which revealed that there was a problem in this plants and its treatment was not sufficient (Contamination with fecal bacteria).

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