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Assessment of *Bacillus cereus*, *Staphylococcus* spp. and Coliform Bacteria in Water Plants of Kafer 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 Electrical Conductivity (EC), Total Dissolved Solids (TDS) and Total Suspended Solid (TSS) were monitored. In addition, the bacteriological analyses involved, total aerobic count, total coliforms, were counted in inlet and outlet of the plants while *Bacillus cerues* and *Staphylococcus* spp. were assessed only in outlet of plants. The results of physicochemical parameters showed that the Electrical Conductivity (EC) from 318 µs/l to 831µs/l, Total Dissolved Solids (TDS) from 215 mg/l to 582 mg/l, and total suspended solid from zero mg/l to 10 mg/l. Where the total aerobic bacterial count (TBC) from 60% of the plants agree according to WHO (2007) and 40% from the plants record the total aerobic count out of Egyption specification recorded as (80 CFU/ml on 11/2011 in outlet of El-Read plant, 70 CFU/ml on 02/2012 in Metobas outlet, 80 CFU/ml on 05/2012 in Ebshan outlet, 100 CFU/ml on 06/2012 in Fowa outlet and 60 CFU/ml on 09/2012 in outlet of Metobas plant. Also coliform bacteria from 70% of the plants agree according to WHO (2007) and 30% from the plants record the total coliform out of Egyption specification recorded as (5 CFU/ 100 ml on 05/2012 in outlet of Ebshan plant, 4CFU/ 100 ml on 05/2012 in outlet of kaleen plant and 3CFU/100/ml on 09/2012 in Metobas outlet) where *Bacillus cerues* isolated on 05/2012 in outlet of Paltem plant and *Staphylococcus* spp. was detected in outlet of Fowa and Sedi Salem plant on 07/2012 and 08/2012 respectively, characterization of isolates was carried out by Gram staining reaction, bacteriological selective media and biochemical tests.

Keywords: Physicochemical parameters, Total aerobic count, Total coliform, *Bacillus cereus, Staphylococcus* spp.

1. Introduction

Contaminated water can be the source of large disease outbreaks caused by many human pathogens (Brunkard *et al*., 2011). Chemical and microbiological contaminants can occur in surface waters through runoff from agricultural and zoo technical areas, sewage, industrial discharge and wastewaters coming from urban areas (Dwight *et al*., 2004; Semenza *et al*., 2012). Surface waters can also be contaminated through faeces from infected domestic, wild animals and people and can also be greatly affected by extreme weather events, such as heavy precipitation (Funari *et al*., 2007; Marcheggiani *et al*., 2010). The World Health Organization (WHO) recognizes that access to adequate water supplies is a fundamental human right

(United Nations, 2010). Water-borne and water-related diseases are usually caused by enteric pathogens that are basically transmitted by the oral-fecal route (WHO, 2011). These are transmitted to people by inhalation, contact or ingestion of untreatedor inadequately treated water and are among the most serious threats to public health today (WHO, 2003). The various effects on human health caused by water borne diseases vary in severity from mild to severe, even fatal gastroenteritis, diarrhea, dysentery, hepatitis and typhoid fever. Several studies have confirmed that water-related diseases remain not only a leading cause of morbidity and mortality worldwide, but also the spectrum of disease is expanding and the incidence of many water-related microbial diseases is increasing (WHO, 2003). Diarrhea is one of the most common features of waterborne diseases and fecal pollution is one of its primary contributors (Copeland *et al*., 2009; ECDC, 2014). Most waterborne pathogens are introduced into surface water by human or animal feces and can initiate infection in the gastrointestinal tract following ingestion (Birkbecka and Ring, 2005).

The present study aimed to assessment of drink water microbiologically and physicochemically of Kafr El-Sheikh Governorate.

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). 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 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 site. Samples were subsequently stored at 4 °C, for as short time as possible, before analysis to minimize physicochemical changes (Anonymous, 1996).

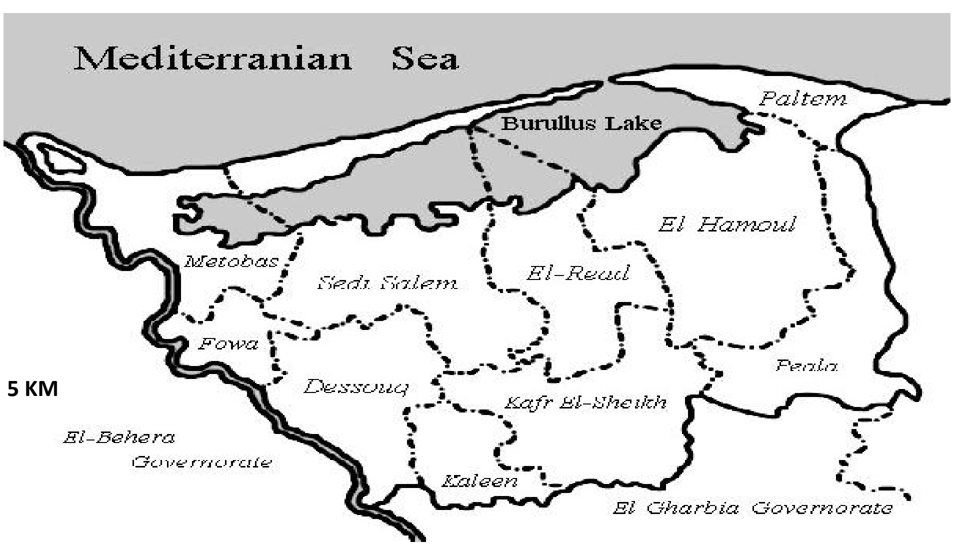

Figure 1: Sampling Sites of Kafr El-Sheikh Governorate.

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

S. 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	

2.3. Determination of Total bacterial Count:

According to APHA (2005) 1.0 ml of every water samples was inoculated into sterile Petri-dishe prior to pouring the molten (45ºC±1) on difico Tryptone Glucose Yeast Extract Agar (TGY) medium (APHA, 1948). The sample and medium were mixed gently with anti- clockwise movements. The plates were incubated at 30 cº for 24 h. After incubation the total bacterial count (CFU/ml) have been determine (APHA, 2005).

2.4. Bacterial count using Membrane Filtration Technique:

In 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, Germany) under partial vacuum.

The membrane filters were immediately removed with sterile forceps and placed on the following media with rolling motion to avoid entrapment of air then let plates stand for 30 minutes and Invert plates in incubation, according to APHA 2005, M-Endo agar (Difco, USA) was used for enumeration of total coliform in water and incubated for 48 hr at 35°C (APHA, 2005).

Also selective media used for isolation of pathogenic microorganisms (*Bacillus cereues* and S*taphylococcus* spp.) *Bacillus cereus* were isolated on selective specific agar plate medium Mannitol Egg Yolk Polymixin B-Sulphate (MYP) (Mossel *et al*.,1967; Abo-State, 1996). While S*taphylococcus* spp. were isolated on Baird Parker agar medium (Sawhney, 1986). The membrane filters was placed on the the surface of specific selective media an incubated at 37 ºC for 48 h.

2.5. Biochemical tests:

Identification and confirmation tests for isolated bacterial pathogens recovered from the surface of specific media plates were conducted according to (Quinn *et al*., 2000) and (Cheesbrough, 2006).

A battery of confirmation tasests including oxidase, catalase, O/F, Vogs-preskur, gelatin liquification, phospholipase C, and hemolysis have been determined.

2.6. Physical Parameter

2.6.1. 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 of the collected water samples were expressed as mg/L.

2.6.2. Total suspended solids:

The measurements of TSS in water samples were carried out according to the standard methods of (APHA, 1995; Sawyer *et al*., 1994) by the filtration process. A fixed volume of water sample was poured on a preweighed glass fiber filter of a specified pore size before starting the vacuum filtration process. The filter was removed after the completion of the filtration process and placed in an aluminium dish in an oven at 103°C to 105°C for 1 hours to completely dry off the remaining water. The filter was then weighed, and the gain in filter weight represented the TSS contents, expressed in mass per volume of sample filtered (mg/L).

3. Results and Discussion

In this study was conducted in Kafr El-Sheikh governorate in order to evaluate the quality of the drinking water in ten plants based on physical and bacteriological examinations, a total of 240 water samples were obtained from the ten plants.

3.1. Total aerobic count assessment:

Heterotrophic plate count (HPC) measures a range of bacteria that are naturally present in the environment (EPA , 2003; Shittu *et al*., 2008). Environmental Protection Agency (EPA), USA considers HPC as a primary standard based on health considerations.

Results show that the microbiological quality of the drinking water from ten plants in Kafr El-Sheikh governorate in the different sites especially total bacterial count are acceptable for human consumption except five sample of 120 samples from outlet of water plants, this disagree with World Health Organization (WHO ,2011). Referring to the bacterial count, the results have shown high level contamination of dirking water as 100 CFU/ml on 06/2012 in outlet of Fowa plant followed by 80 CFU/ml on 11/2011 in outlet of EL-read plant and also on 05/2012 in outlet of Ebshan plant followed by 70 CFU/ml and 60 CFU/ml on 02/2012 and 08/2012 in Metobas plant respectively.

The presence of counts exceeding the WHO limits indicates that the water samples contain high concentration of bacteria that could make the water unsafe for drinking.

Data presented in this study (Table 2) shows that the TVC of treated water was decreased when compared with untreated water. This is reflecting the chlorine action which, is the most effective water disinfectant and had a major impact on water treatment (Madigan *et al*., 1997). In addition, chlorine has virtually eliminated most waterborne diseases (USCDC, 1997).

Water is usually contaminated due to animal wastes, sewage water, bacteria contact, and various human activities (EPA, 2003 and Bitton, 1994).

These results in agreement with Dania, (2007) who reported that problems present in drinking water at Metobas.

These study in agreement with Fawzy *et al*., (2013) who observed that bacterial contamination was maximum in Kafr El-Sheikh (52.1%), followed by Alexandria (50%) and El-Kalyoubia (45.8%). This might be explained by the effect of domestic and agricultural wastes discharge from the urbanized surrounding area.

3.2. Total coliform assessment:

Another microbiological indicator for water quality is the total coliform bacteria (Hacioglu and Dulger, 2009; Abo-State *et al*., 2014). Counts higher than limits were obtained, in the current study, in different seasons and districts with the highest percentage in autumn.

According to Egyptian specification (WHO, 2011) 95% from samples in one year must be free from the coliform bacteria per 100 ml also count must be not more than 2 CFU/100 ml and 2 CFU/100 ml not repated in two samples respectively.

In this study shown in outlet of all plants, three samples out of 120 samples not accepted according to World Health Organization (WHO, 2011) as shown in Table (3) (3 CFU/100 ml in outlet of Metobas on 09/2012, 4 CFU/100 ml in Kaleen outlet plant on 05/2012 and 5 CFU/ml in Ebshan outlet.

The high total coliform counts are generally indicative of poor sanitary handling and/or environmental conditions (Dionisio *et al*., 2002; Ejechi *et al*., 2007).

The presence of coliforms bacteria in water indicates a potential public health problem, because faecal matter is a source of pathogenic bacteria and viruses.

Coliform bacteria may not cause disease, but used as one of the indicators of pathogenic contamination that can cause diseases such as intestinal infections, dysentery, hepatitis, typhoid fever, cholera and other illnesses (Emmanuel *et al*., 2009).

These study in agreement with Fawzy *et al*., (2013) who reported that feacal coliforms (FC) reached it's highest mean counts in Metobas (Rosetta Nile branch water) in September 2011 (274 CFU/100 ml).

Positive presence of coliforms in treated water which must be coliform-free may indicate treatment ineffectiveness in some treatment plants.

Total coliforms was detected in Nile water at Greater Cairo in 100% of the tested samples reaching 10^4 CFU/100 ml (Shash *et al*. ,2010).

Abo-Amer *et al*., (2008**)** reported that some drink water stations were polluted with coliform group, also Hassanein *et al*., (2013) detected total coliform as indicators for water contamination.

Table (2) Total bacterial Count (CFU/ml) from 01/10/2011 to 09/09/2012

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	160	160	210	120	130	310	700	190	190	190	190	170
Kafr El-Sheikh outlet	30	40	30	30	30	40	30	30	30	30	45	40
Ebshan interance	150	200	200	190	160	170	260	160	200	130	170	160
Ebshan outlet	30	30	30	30	20	30	30	80	30	40	30	30
Fowa interance	230	160	140	180	110	110	350	180	170	210	210	220
Fowa outlet	30	10	30	20	30	30	30	10	100	40	40	40
Metobas interance	180	170	190	170	200	210	450	140	200	80	160	150
Metobas outlet	30	30	30	20	70	30	30	30	40	30	30	60
Kaleen interance	130	130	140	130	130	120	260	170	180	80	190	180
Kaleen outlet	30	30	30	30	40	30	30	60	10	30	40	30
Dessouq interance	130	150	150	130	190	180	280	180	170	90	180	130
Dessouq outlet	30	30	30	40	30	40	30	40	30	40	30	20
EL-read interance	170	250	510	190	190	170	320	150	190	70	350	210
EL-read outlet	30	80	40	20	30	30	30	20	30	30	40	40
El-Hamoul interance	140	190	150	160	130	160	400	140	170	140	150	150
El-Hamoul outlet	30	30	30	30	40	30	30	30	30	30	30	40
Paltem interance	130	140	110	130	120	190	350	170	170	170	170	130
Paltem outlet	20	30	30	30	30	30	20	20	20	20	30	30
Sedi Salem interance	150	120	650	130	200	190	320	190	180	280	290	240
Sedi Salem outlet	30	20	40	20	30	30	30	30	40	40	40	40

Table (3) Total coliform Count (CFU/100ml) from 01/10/2011 to 09/09/2012

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	700	600	400	800	350	1080	500	700	650	800	1160	1100
Kafr El-Sheikh outlet	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>
Ebshan interance	600	360	940	1000	330	330	60	640	850	960	1150	1180
Ebshan outlet	1>	1>	1>	1>	1>	1>	1>	**5**	1>	1>	1>	1>
Fowa interance	250	360	200	400	390	190	35	320	360	1000	1120	1130
Fowa outlet	1>	1>	1>	1>	1>	1>	1>	1>	50	1>	1>	1>
Metobas interance	300	400	740	560	250	1700	900	900	890	500	1350	1120
Metobas outlet	1>	1>	1>	1>	**2**	1>	1>	1>	1>	1>	1>	**3**
Kaleen interance	180	800	160	800	190	90	50	420	1000	1000	1100	1100
Kaleen outlet	1>	1>	1>	1>	1>	1>	1>	**4**	1>	1>	1>	1>
Dessouq interance	450	270	320	180	500	480	700	520	950	420	1900	990
Dessouq outlet	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>
EL-read interance	800	280	380	1200	520	680	50	700	880	520	700	1900
EL-read outlet	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>
El-Hamoul interance	1100	1100	900	1000	400	300	700	920	160	900	1200	1000
El-Hamoul outlet	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>
Paltem interance	500	700	1200	1300	325	300	300	320	150	600	670	700
Paltem outlet	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>
Sedi Salem interance	420	515	130	600	810	280	700	600	620	390	380	390
Sedi Salem outlet	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>	1>

3.3. *Bacillus cereus* and *staphylococcus* assessment:

It is unfortunate in many developing countries water-related diseases are a problem's result from contaminated drinking water, so that it will be a high risk to human health, if it contains pathogens (WHO, 2006). It has been reported that the death of most of the children in Africa who die before the age of 5 is caused by inadequate and safe water supplies (Loucks,1996).

The main result revealed that 3 bacterial isolates (*Staphylococcus* co-agulase positive, *Bacillus cerues* and *Staphylococcus* co-agulase negative) were detected in drinking water outlet of three plants namely (Fowa, Paltem and Sedi Salem).

It is known that most of *Bacillus* spp are harmless and a few are pathogenic to humans and animals like *B.cereus* are often detected in drinking water supplies which have been treated and disinfected, this largely due to the resistance of spores to disinfection processes. *Bacillus* spores have been described as a good indicator of the treatment efficiency (Abo-State, 1991; Abo-State, 1996; Abo-State *et al*., 2014 b).

Staphylococcus are slightly more resistant to chlorine, the presence of *Bacillus cereus* and S*taphylococcus* spp. may be come from the contamination of water resources with fecal material, industrial sewage, domestic, agricultural waste still remains a serious problem in the developing countries and became a public health concern. The major problem of drinking water in Egypt and other developing countries is not just a lack of water availability, but in fact, that the people are not concerned with the water quality and pathogenic bacteria which, causes health risk (Ezzat *et al*., 2014).

S. aureus in the collected water samples were in agreement with many researchers reported by Pianetti *et al*, (1998) and Clark *et al*, (2003).

This might be due to that the surface water received high amounts of human sewage and/ or due to the presence of small animal farms. The seasonal variation in counts of pathogenic bacteria may be due to biological, physical and chemical factors which in turn correlate to many environmental and climatic factors. Many authors have reported correlations of physicochemical parameters in water meeting the bacterial regulations (Lotfy *et al*, 2011 and Khalil *et al*, 2013).

The consumption of drinking water contaminated with pathogenic microbes of faecal origin is a significant risk to human health in the developing world, especially in remote rural areas and industrial areas (Davies-Colley *et al*., 2001). Over 3 million deaths per year is attributed to water-borne diarrhoeal diseases, especially among infants and young children in poor communities in Africa, Asia and South America (Anon, 1997).

3.4. Conductivity (EC):

Electrical conductivity is a measure of water capability to transmit electric current and also it is a tool to assess the purity of water.

Conductivity is a measure of the ability of water to conduct electrical current. This depends on the ionic strength of the water sample. The conductivity of water is influenced by the concentration of ions and its nutrient status. The determination of the electrical conductivity provides a rapid and convenient way of estimating concentrations of electrolytes in solution.

Conductivity is a good measure of dissolved solids and excessive presence of sodium in water.

Electrical conductivity as shown in Table (4) found in the range from 318 µs/l in outlet of Paltem on 08/2012 to 831µs/l in Sedi Salem interance on 01/2012, the obtained results within permissible limit according to WHO (2007) guidelines.

3.5. Total Dissolved Solids (TDS):

Concentration of dissolved solids in water is an important parameter that determines the quality of drinking-water (Joline *et al*., 2015), The total dissolved solids in water indicate the nature of water quality for salinity. TDS are due to the presence of sodium, potassium, calcium, magnesium, manganese, carbonates, bicarbonates, chlorides, phosphate, organic matter and other particles, the level of total dissolved solids (TDS) within permissible limit according to WHO (2007) guidelines. The TDS of all the samples as shown in Table (5) were in range from 215 mg/l l in Paltem outlet on 08/2012 to 582 mg/l in Sedi Salem interance on 01/2012.

Similar values of TDS are reported by Rao *et al*., (2003) and Kirubavathi *et al*., (2005).

Above the permissible level of (TDS) may cause gastro intentional irritation (Nishtha *et al*, 2012).

Table (4) Conductivity (µs/cm) measure from 10/2011 to 09/09/2012

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	421	421	425	425	544	439	454	402	364	378	378	398
Kafr El-Sheikh outlet	413	413	467	467	549	444	476	418	389	398	394	422
Ebshan interance	435	435	545	545	490	490	422	364	340	332	338	364
Ebshan outlet	442	442	554	554	507	440	432	380	358	352	358	384
Fowa interance	616	616	710	710	623	662	487	552	500	452	466	498
Fowa outlet	628	628	722	722	630	694	598	568	515	465	485	508
Motobas interance	631	631	670	670	787	525	642	560	502	442	448	464
Motobas outlet	622	622	674	674	767	534	660	573	516	450	467	489
Kaleen interance	428	428	485	485	482	486	380	362	342	318	336	374
Kaleen outlet	430	430	491	491	490	502	393	377	364	334	344	388
Dessouq interance	583	583	778	778	693	430	478	352	352	418	428	418
Dessouq outlet	529	529	640	640	705	503	497	379	379	432	442	435
El-read interance	530	530	590	590	535	502	488	448	388	422	418	452
El-read outlet	325	325	603	603	551	513	506	463	400	438	432	468
El- Hamoul interance	430	430	510	510	492	472	448	402	364	364	364	364
El- Hamoul outlet	436	436	518	518	503	486	461	418	382	370	382	380
Paltem interance	419	419	476	476	450	407	364	352	322	334	**318**	328
Paltem outlet	430	430	485	485	469	416	382	371	343	343	336	352
Sedi Salem interance	620	620	820	820	512	496	576	532	400	472	472	548
Sedi Salem outlet	638	638	815	**831**	530	503	595	552	424	485	485	568

Table (5) Total Dissolved Solids (mg/L) measure from 10/2011 to 09/09/2012

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	286	289	289	316	380	298	309	273	247	257	257	271
Kafr El-Sheikh outlet	293	278	317	326	383	300	323	284	264	271	267	289
Ebshan interance	295	319	371	371	333	299	299	247	231	226	230	247
Ebshan outlet	300	326	377	377	345	305	287	258	243	239	243	261
Fowa interance	402	364	470	443	411	450	331	375	350	307	317	339
Fowa outlet	414	370	477	449	416	458	407	386	340	316	320	345
Motobas interance	417	440	442	555	535	358	436	381	341	300	305	315
Motobas outlet	423	415	444	551	544	364	449	390	351	306	317	332
Kaleen interance	290	294	330	328	329	330	258	246	232	216	228	254
Kaleen outlet	293	296	343	329	335	341	267	256	247	227	234	264
Dessouq interance	396	364	510	476	456	294	325	239	239	284	291	284
Dessouq outlet	359	355	422	431	465	297	337	258	258	294	300	296
El-read interance	353	353	410	401	364	343	332	305	264	237	284	307
El-read outlet	364	360	401	410	376	350	344	315	272	298	294	318
El- Hamoul interance	291	320	346	384	343	312	305	274	247	247	247	247
El- Hamoul outlet	296	325	352	391	334	332	313	284	266	252	260	258
Paltem interance	288	280	321	320	306	277	247	239	219	227	**215**	223
Paltem outlet	294	290	330	327	318	283	260	252	233	233	228	239
Sedi Salem interance	421	415	563	564	356	338	392	362	272	321	321	373
Sedi Salem outlet	436	430	565	**582**	362	344	405	375	288	333	333	386

Anadaparameswari *et al*., (2007) reports that the Presence of excess of TDS may cause gastrointestinal irritation and if used for cooking will form scales on the cooking vessels however it has been reported that drinking water with extremely lows concentration of TDS may be unacceptable because of its flat insipid taste (WHO, 1996; Bruvold and Ongerth, 1969).

3.6. Total suspended solids (TSS):

The most remarkable observation of investigation was the level of total dissolved solids (TSS) within permissible limit. The TSS of all the samples were in range from zero mg/l in all outlet of plants to 10 mg/l at inlet of El-Hamoul plant, as shown in Table (6). This is because the sample collection points in these plants had filtration systems, thus removing all the suspended particles such as silt, clay, and other inorganic particles.

Table (6) Total Suspended solid (mg/L) measure from 10/2011 to 09/09/2012

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	8	6	5	5	5	5	6	6	5	5	4	6
Kafr El-Sheikh outlet	0	0	0	0	0	0	0	0	0	0	0	0
Ebshan interance	8	8	8	6	5	6	5	8	5	6	6	5
Ebshan outlet	0	0	0	0	0	0	0	0	0	0	0	0
Fowa interance	6	5	8	8	6	5	5	6	5	5	5	8
Fowa outlet	0	0	0	0	0	0	0	0	0	0	0	0
Motobas interance	5	6	5	6	4	5	6	8	8	6	8	8
Motobas outlet	0	0	0	0	0	0	0	0	0	0	0	0
Kaleen interance	6	5	7	5	6	6	5	6	8	8	8	6
Kaleen outlet	0	0	0	0	0	0	0	0	0	0	0	0
Dessouq interance	8	8	5	4	6	5	4	4	4	4	5	6
Dessouq outlet	0	0	0	0	0	0	0	0	0	0	0	0
El-read interance	5	6	7	5	4	5	6	8	8	8	8	8
El-read outlet	0	0	0	0	0	0	0	0	0	0	0	0
El- Hamoul interance	10	5	5	0	4	4	4	6	8	8	8	6
El- Hamoul outlet	0	0	0	0	0	0	0	0	0	0	0	0
Paltem interance	6	8	6	0	6	6	6	8	8	6	8	6
Paltem outlet	0	0	0	0	0	0	0	0	0	0	0	0
Sedi Salem interance	6	6	5	6	4	5	6	8	8	6	6	6
Sedi Salem outlet	0	0	0	0	0	0	0	0	0	0	0	0

Conclusion

The treated water of the ten pants during 12 months were acceptable for drinking safety except at metobas outlet which exceed the permissible limits 70 CFU/ml and 2 CFU/100 ml at 2/2012 for total bacterial count (TBC) and total coliform (TCF) respectively. Also exceed the limits at 09/2012 (60 CFU/ml and 3 CFU/100 ml) for TBC and TCF respectively at the same plants. Also (TBC) exceed the permissible limit at (El-Read outlet at 11/2011, Ebshan outlet at 05/2012 and Fowa outlet at 06/2012) as (80 CFU/ml, 80 CFU/ml and 100 CFU/ml) respectively. Where also (TCF) at Kaleen outlet on 05/2012 exceed the permissible limit as 4 CFU/100 ml.

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