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Evaluation of El-Seel drain water quality and their effect on river Nile pollution

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ABSTRACT

El-seel drain is one of the mainsources of pollution at Aswan, Egypt. Physico-chemical and bacteriological analyses indicated that the initial point of drain (the beginning of the wastewater flow) and the point after 4.5 km from the initial point recorded higher amount of pollution. Although the pollution depressed along way of drain, but the water quality at the drain end still higher than permissible limits. Furthermore,pathogenic bacteria (*Salmonella* sp, *Shigella* sp, and *E. coli*) were detected in more than 97 % of drain water samples. In addition, disposedEl-Seel effluents on River Nile water increased microbial load, BOD and COD, and then progressively decreased downstream except gathering place located after 450 m down-stream. Therefore, El-Seel drain causes high risks to human health and environmental problem.

KEYWORDS

Water pollution;
El-seel drain;
River nile.

INTRODUCTION

Fresh water resources in Egypt are limited to the River Nile, groundwater and rainfall. The Nile is the predominant source of fresh water in Egypt. Therefore, maintaining of the River Nile water quality is a major concern for Egyptian government. The major factors causing pollution of River Nile water quality are discharge of untreated or partially treated for industrial and domestic wastewater, leaching of pesticides and residues of fertilizers and disposal of solid wastes[11]. Therefore, River Nile water pollution is increasing from south (Aswan) to north (Cairo), where water quality is depending on population density, extent of industrialization, availability of sanitation systems, social and economic conditions[1].

Aswan governorate is not heavily industrialized and population density, but the existent activities (agricultural, industrial, tourism, mining and quarrying) causing a threat to the environment pollution, particularly in the form of air pollution, and water pollution from wastewater discharges.

In Aswan, El-Seel drain extending about 9 km north Aswan city to River Nile. It constructed for protecting Aswan City from the temporary floods, but nowadays it became harmful location (humanity and environmentally). Where the drain receives various types of wastewater (large flows of mostly untreated domestic, agricultural, and industrial wastewater), such as output of sewage treatment plant and kima I&II, as well as houses, shops and hospital. The wastewaters of El-Seel drain estimated with about 70.000 m^3/day, and directly disposal into the River Nile. El Seel drain is classified as very poor water quality. Where, the loads of organic and inorganic pollutants discharged into the Nile from El-seel drain estimated about 10.1 ton/day COD, 3.2 ton/day BOD and 0.03 ton/day heavy metals[12].

This study concerned with evaluates of El-seel drain water quality (along the drain waterway) and study the impact of discharging El-Seel drain wastewater on River Nile water (in the area around of El-Seel drain disposal). Data were done using physicochemical and bacteriological analyses.

MATERIAL AND METHODS

The experimental area

Six stations were selected at different locations

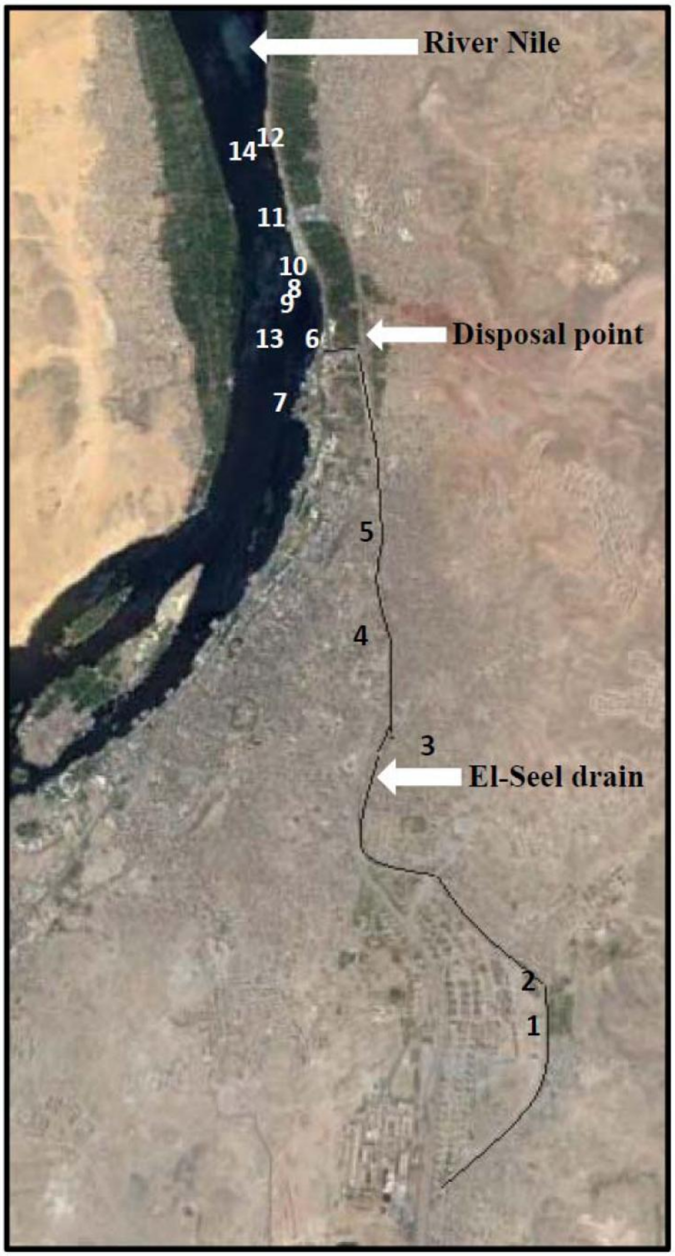

Figure 1 : Satellite image for El-Seel drain and River Nile sampling stations; the descriptions of the sampling sites and GPS position illustrated in TABLE (1)

TABLE 1 : Descriptions of the sampling sites and GPS positions for El-Seel drain and River Nile sampling stations

Sites no.	Sites code	Sites	GPS data	Description
		El-Seel drain sampling stations		
1	S_1	Initial point 0 m	N:24º 04` 18.23"; E: 32º 55` 30.12"	Exactly, the beginning of the wastewater flow, before this point, 3 km of the drain is drought.
2	S_2	254.4 m from Initial point	N:24º 04` 26.51"; E: 32º 55` 28.87"	Exactly, there are pipe discharge wastewater effluent, causing fast running of wastewater into the drain
3	S_3	1515.3 m from Initial point	N:24º 04` 49.96"; E: 32º 54` 52.98"	Exactly, the point after distance covered on the drain
4	S_4	2792.6 m from Initial point	N:24º 05` 16.42"; E: 32º 54` 36.57"	Exactly, the point beside Aswan university hospital
5	S_5	4461.8 m from Initial point	N:24º 06` 09.44"; E: 32º 54` 24.86"	Exactly, this point located before covered the termination part of the drain
6	S_6	6415.4 m from Initial point (Disposal point)	N:24º 06` 59.29"; E: 32º 53` 56.65"	Exactly, this point considered ending the drain and the disposal point on River Nile
		River Nile sampling stations		
7	L_1 (US)	Up-stream	N:24º 06` 54.94"; E: 32º 53` 54.74"	141.2 m south disposal point
8	L_2 (DP)	Disposal point	N:24º 06` 59.29"; E: 32º 53` 56.65"	Disposal point of El-Seel drain wastewaters
9	L_3 (DS_1)	Down - stream 1	N:24º 07` 05.14"; E: 32º 53` 50.33"	244.5 m north disposal point
10	L_4 (DS_2)	Down - stream 2	N:24º 07` 12.67"; E: 32º 53` 51.83"	421.2 m north disposal point (exactly at embayment)
11	L_5 (DS_3)	Down - stream 3	N:24º 07` 23.09"; E: 32º 53` 39.00"	789.8 m north disposal point (exactly at ships station)
12	L_6 (DS_4)	Down - stream 4	N:24º 08` 22.50"; E: 32º 53` 19.93"	2729.2 m north disposal point (exactly at Abo El-Reesh drinking water station)
13	L_7 (MS_1)	Mid - stream 1	N:24º 06` 58.93"; E: 32º 53` 46.12"	273.61 m from shore, 206.11 m north up-stream
14	L_8 (MS_2)	Mid - stream 2	N:24º 08` 19.66"; E: 32º 53` 10.64"	283.9 m from shore (opposite L_6 (DS4) 2801.3 m north disposal point.

along the drain (S_1, S_2, S_3, S_4, S_5 and S_6) and eight locations on River Nile (L_1, L_2, L_3, L_4, L_5, L_6, L_7 and L_8) under the potential effect of the effluent disposal at summer and winter 2013(Figure 1 and TABLE 1).

Sampling

Water samples were manually and aseptically collected from the surface water, (ca. <1 m ashore), in sterilized 500 ml glass bottles for bacteriological analysis and in 1000 ml bottles for chemical analysis.

Physico-Chemical analyses

Electrical conductivity (EC), pH and total dissolved solids (TDS) were measured using CRISON Multi meter (MM40$^+$). Dissolved oxygen (DO) was measured using the modified Winkler method and biochemical oxygen demand (BOD) with the five-day incubation method[6]. Chemical oxygen demand (COD) was carried out using the potassium permanganate method[15]. Colorimetric methods were used to determine ammonia, nitrite[6] and nitrate[20] as well as total phosphorus and orthophosphate[6]. Water alkalinity (CO_3^{-2} and HCO_3^-) was determined by titration against standard H_2SO_4 using phenolphthalein and methyl orange indicators[6]. Turbidmetric method is used for sulphate estimation[6]. Chloride ion was measured by titration method using standard $AgNO_3$ solution[6]. The amount of Calcium and Magnesium were measured by using EDTA titrimetric method[6]. Sodium and Potassium were measured using flame photometric method, direct-reading, using (JENWAY PFP 7),[6]. Heavy metals (Fe, Zn, Mn, Cu, Cd and Pb)) were measured atomic absorption on AA spectrometer (Solaar 969) after digestion by Nitric acid[6].

Bacteriological analyses

Major bacterial groups

The pour plate technique and the plate count agar[5] were used for the enumeration of total bacterial counts at both 22ºC and 37ºC incubation temperatures as well as total spore-forming bacteria at 30ºC (after pasteurization for 15 min at 80°C) and total thermophilic bacteria at 55ºC.

Bacterial indicators of sewage pollution

Bacterial indicators of sewage pollution included counting of total and faecal coliforms using MacConkey broth and faecal streptococci using azide-dextrose broth media[5].

Pathogenic bacteria

The surface plate technique and the Salmonella Shigella agar[5] were used for enumeration and isolation of *Salmonella* sp.,*Shigella* sp. and*E.coli* at 35 ºC and examine colonies after 24 and 48 hours. Where, *Salmonella* sp. and *Shigella* sp. are non-lactose fermenters and form colorless colonies on Salmonella Shigella agar and H_2S positive in the case *Salmonella* sp. produce black-center colonies. As well as*E.coli* produces pink to red colonies. Identification of these pathogenic bacteria depending on morphological, physiological and biochemical characters according to *Bergey's Manual of Systematic Bacteriology (2005)*.

Statistical analysis

Data were statistically analysed using analysis of variance (ANOVA)[13] using the STATISTICA (6.0) computer programs.

RESULTS

Twelveand sixteen water sampleswere collectedfrom El-Seel drain waterway and River Nile around El-Seel drain disposal point respectively at summer and winter seasons of the year2013for physico-chemical and bacteriological assessment.

Evaluation of El-Seel drain water quality

Physico-chemical analyses

Water temperatures, pH of water, electrical conductivity (EC)and total dissolved solids (TDS) were varied among the water sampling sites(Figure 2A,B). In general, the high amount of EC and TDS recoded in the beginning of drain (means853 mgl^{-1} and 546 mgl^{-1} respectively), then decreased to reach about768 mgl^{-1} and493 mgl^{-1}respectively in the end of drain. Dissolved oxygen (DO) was un-detected for more than 75% of samples, and other 25% DO recorded <1.3 mgl^{-1}. Contrarily, biological and chemical oxygen demand (BOD and COD) recorded high concentration in all samples (Figure 2C). The highest amount of BOD and COD noticed in the beginning of drain(means 43.3 $mgl^{-}1$ and 16.5 mgl^{-1} respectively). As well as the values of BOD/COD ratio ranged from 0.8 to 2.8.

In respect, nutrient content (ammonia, nitrate, nitrite, orthophosphate and total phosphate). Among the soluble forms of nitrogen, nitrate was particularly un-detected in all water samples. The beginning of drain showed high values of nitrite (means 1.4 mgl^{-1}) and ammonia (means 23 mgl^{-1}). Similarly, the higher levels of total and orthophosphates values recorded in the beginning of drain (Figure 2D).

The concentration of cations and anions (magnesium, sodium, potassium, calcium, sulphate, chloride, carbonate and bicarbonate) were differed according to sites (Figure 2E,F). The higher content of calcium and sodium was recorded in the end point of drain, while the higher content ofmagnesium and potassium was recorded in the beginning of drain. Sulphate value scored high levels compared to chloride value (Figure 2F). Carbonate was undetected in all the examined water samples. Bicarbonateshowed higher content in the beginning of drain.

The quantities of heavy metals (iron, zinc, manganese, copper, cadmium and lead) were variable values according to time of collection and location.

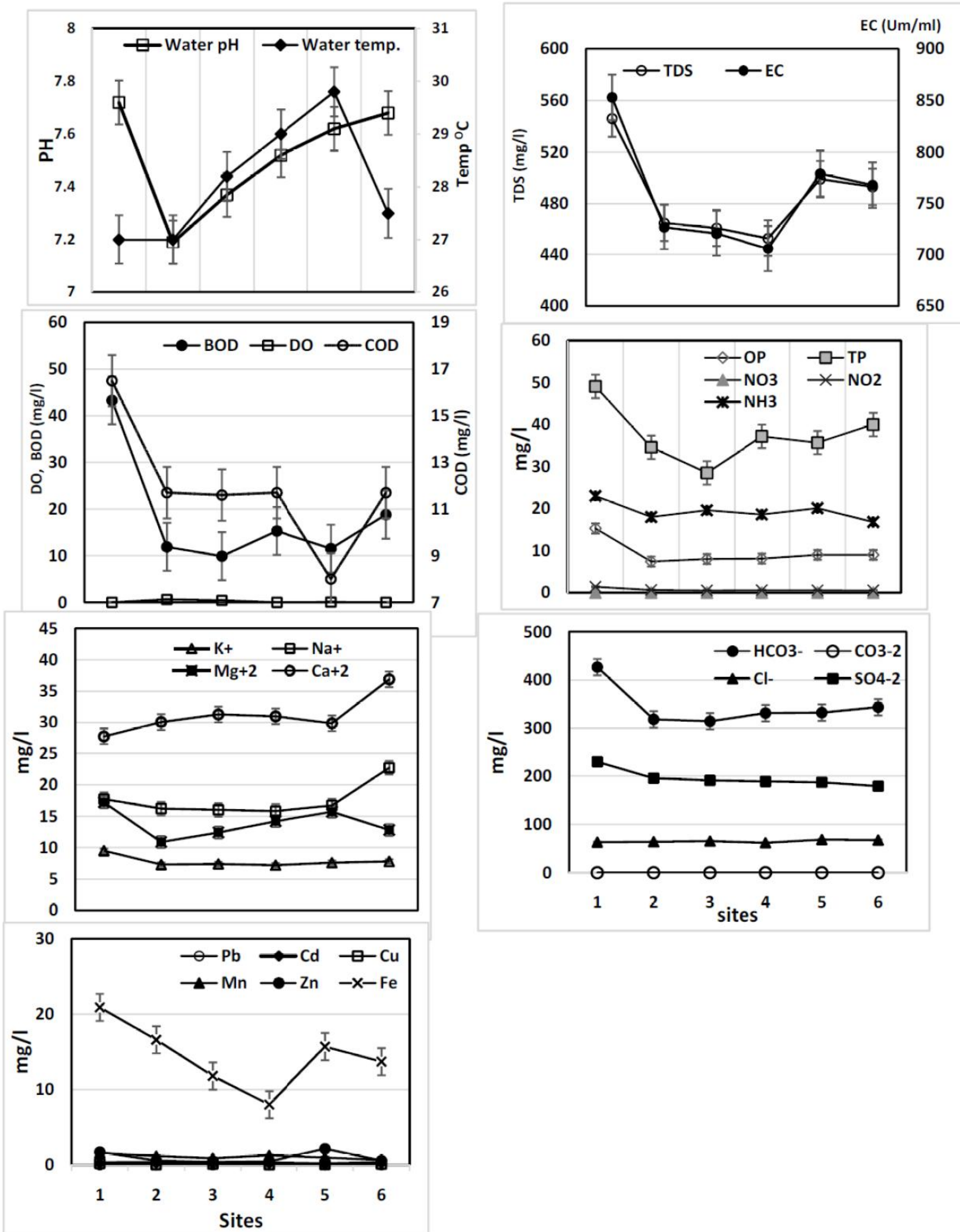

Figure 2 : Sites effect for physico-chemical analysis of El-Seel drain water. A, pH and water temperature; B, electrical conductivity and total dissolved solids; C, dissolved oxygen and oxygen demand; D, nutrient content; E, cationscontent; F, anions content; G, heavy metals content.Bar whiskers represent SE; their absence indicates negligible SE

In general, the highest concentrations reported for Fe (average14.4 mg l^{-1}) and the lowest concentrations was reported for both Cu and Cd (average 0.12 mg l^{-1} and 0.20 mg l^{-1}, respectively). All the collected water samples during two seasons were free in lead. As well as, around 25% of water samples were free in copper Figure 2G.

In general, the results of chemical analyses showed that, the values of the most tested parameters in the winter season werehigherthan summer seasons.

Microbiological analyses

The results of microbiological analyses showed that, total bacteria count at either 22 C and 37 C was more than 10^5cfu ml^{-1} Figure 3 and varied depending upon sampling site. The higher microbial load was recorded in the beginning of drainfor all water samples except water samples collected in summer

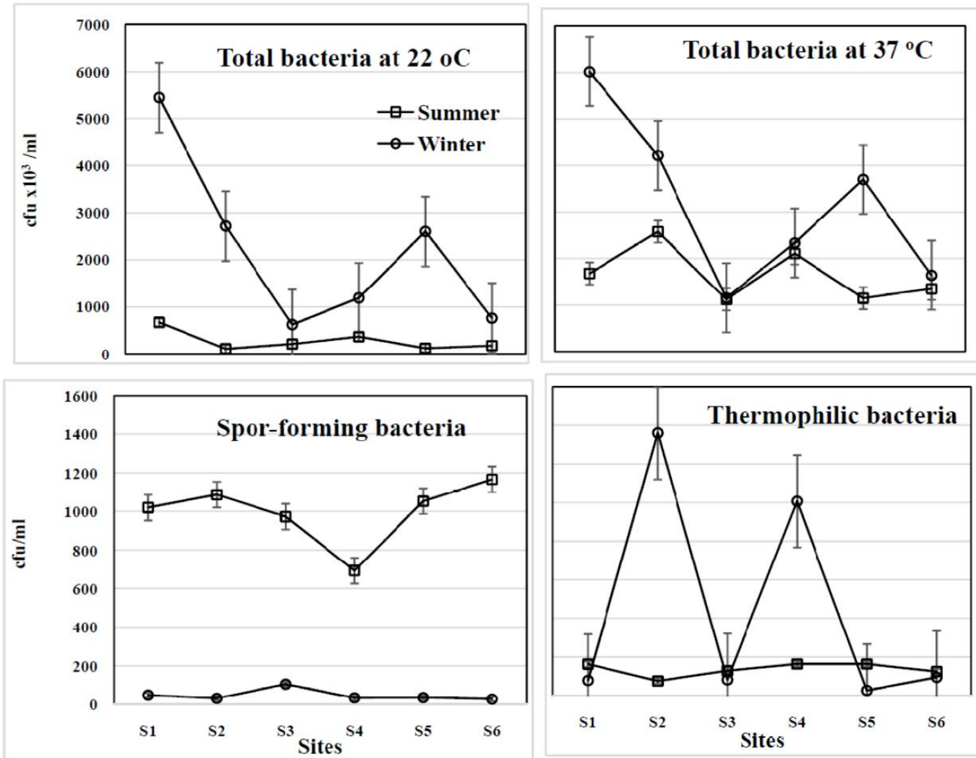

Figure 3 : Bacterial populations of water samples obtained at different sites along El-Seel drain waterway.Bar whiskers represent SE; their absence indicates negligible SE

season at 37°C Figure 3. Reduction of microbial load wasrecorded after 254.4 m. While, after 1515.3 m showed increase of microbial load by percent of 73-88% in summer samples and 91-102% in winter samples for 22 C and 37 C, respectively. In general, the ratio of total bacteria count at 22 C to 37 C ranged from 0.04 to 0.9. As unexpected, winter samples showed higher numbers of microbial load (22×10^5 cfu ml^{-1}) compared to summer samples (2.5×10^5 cfu ml^{-1}). In the contrary, summer samples recorded higher numbers of spore-forming bacteria count (999 cfu ml^{-1}) compared to winter samples (46 cfu ml^{-1}). Unexpected, the high numbers of thermophilic bacteria recorded in the winter samples (441 cfu ml^{-1}) compared to summer samples (137 cfu ml^{-1}).

Coliform bacteria were detected in all the water samples with different density. Total coliform bacteria increased with the long of drain in the summer, from 458 MPN/100 ml at the beginning of drainto 1983 MPN/100 ml at the ending of drain. While at the winter samples, the density of coliform bacteria decreased with the long of drain, ranging from 2093 MPN/100 ml at the beginning of drainto 1730 MPN/100 ml at the ending of drain Figure 4.

Faecal coliform bacteria counts ranged from15-1900 MPN/100 ml (Figure 4). The count of faecal coliform bacteria at summer season increased gradually with the long of drain except at site three. Also, site four in winter season, showed decreased of faecal coliform bacteria count compared with the beginning of drain. In general,winter season showed the highest faecal coliform bacteria count compared to summer season.

Faecal streptococci count ranging between 1350-2217 MPN/100 ml, with non-significant change with the long drain during two seasons. Clearly, faecal streptococci showed highly countcomparing with faecal coliform Figure 4, where, faecal coliform: Faecal streptococci ratio varied from 0.02 to 1.04. The high ratio recorded after 254.4 m (S_2) and 1515.3 m (S_3) from the beginning of drain.

Pathogenic bacteria (*Salmonella* sp, *Shigella* sp, and *E coli*) were detected in more than 97 % of water samplesduring two seasons (Figure 5). In general, the higher pathogenic bacteria count of *Salmonella* sp, *Shigella* sp, and *E coli* wererecorded in winter samples with about 7973, 9910 and 2209 cfu ml^{-1} respectively compared to 231, 872 and 341 cfu

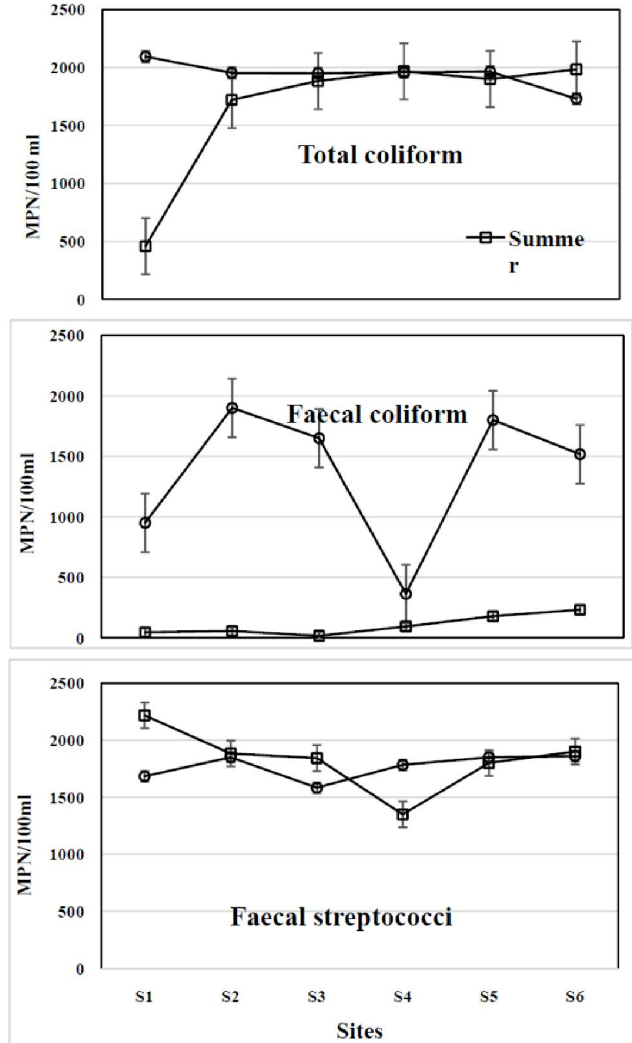

Figure 4 : Fluctuations in bacterial indicators of pollution for water samples obtained at different sites along El-Seel drain waterway.Bar whiskers represent SE; their absence indicates negligible SE

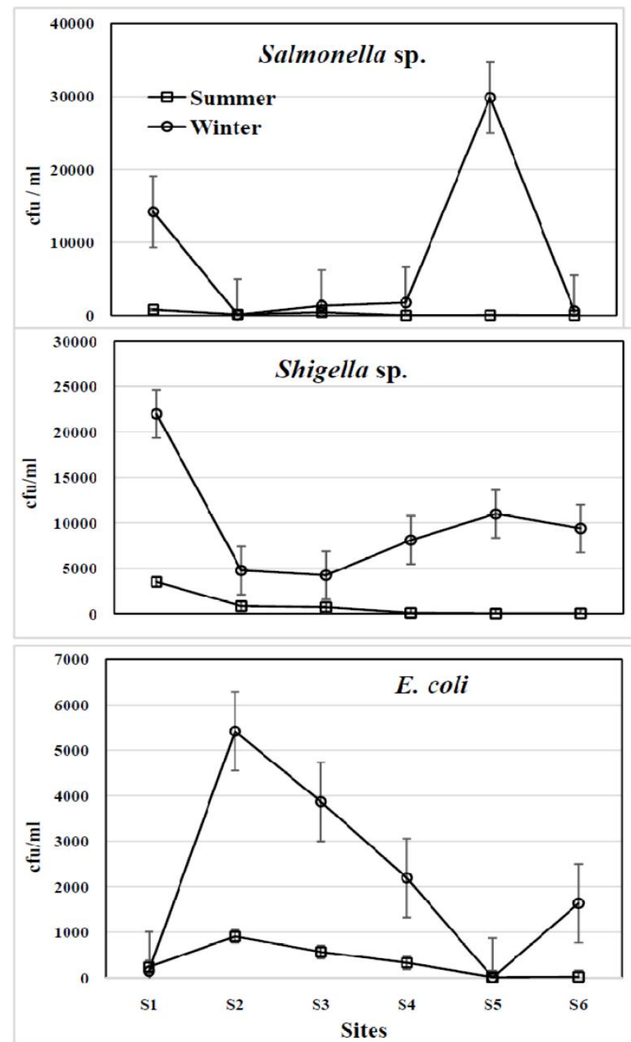

Figure 5 : *Salmonella* sp., *Shigella* sp. and *E. coli* count of water samples obtained at different sites along El-Seel drain waterway.Bar whiskers represent SE; their absence indicates negligible SE

ml^{-1}respectively in summer samples Figure 5. For confirmed identification of this pathogenic bacteria, physiological and biochemical test such as gram reaction, H_2S production, IMVIC (indole, Methyl red, vogas-proskour and citrate utilization) and nitrate reduction were done. These isolate identified as E. vcoli, Salmonella entrica and Shigella sp. according to Bergey's Manual of Systematic Bacteriology.

The effect of EL-Seel drain effluent on river nile waterquality

Physico-chemical analyses

River Nile water temperatures, pH of water and electrical conductivity values were differed according to sampling sites and seasons Figure 6A,B. The disposal site (DP) recorded lower pH values (means 7.7) and higher EC values (means 768 µs/cm) compared to other sites. Also, disposal site recorded the highest value for total dissolved solids, TDS, (means 493 mgl^{-1}). In the contrary, dissolved oxygen (DO) not detected in the disposal site andthe low values recorded in down-stream after 421.2 m (DS_2) north disposal point (means 1.6 mgl^{-1}) (Figure 6C). Biological oxygen demand (BOD) showed the highest values at down-stream after 421.2 m (DS_2) north disposal point (means 37.5 mgl^{-1}) followed by disposal point (means 18.8 mgl^{-1}) (Figure 6C). As well as, the highest amount of chemical oxygen demand (COD) was recorded in the disposal site (means 11.7 mgl^{-1}); followed by down-stream

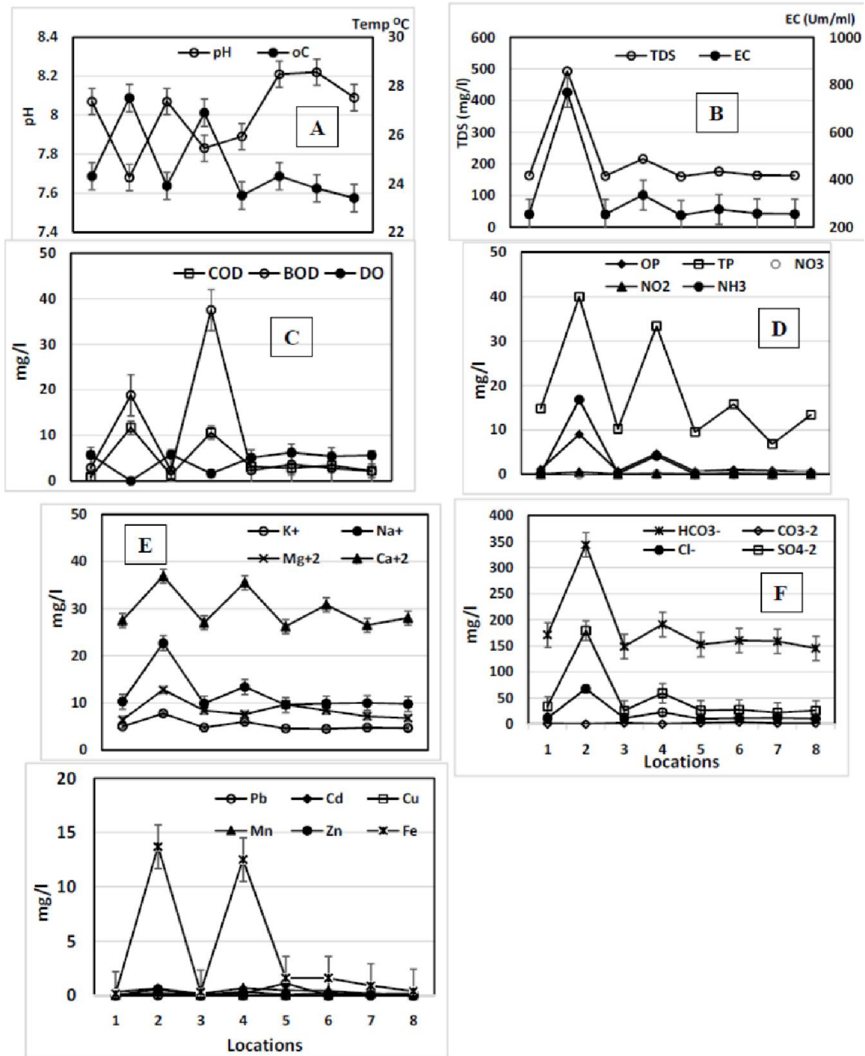

Figure 6 : Sites effect for physico-chemical analysis of River Nile water. A, pH and water temperature; B, electrical conductivity and total dissolved solids; C, dissolved oxygen and oxygen demand; D, nutrient content; E, cations content; F, anions content; G, heavy metals. For locations; 1, up-stream; 2, disposal point; 3, down-stream one; 4, down-stream two; 5, down-stream three; 6, down-stream four; 7, mid-stream one; 8,mid-stream two.Bar whiskers represent SE; their absence indicates negligible SE

two (means10.6 mgl^{-1}).

Regarding nutrient contents, disposal site recordedhighest nitrite and ammonia content (means 0.53 and 16.8 mgl^{-1} respectively) and undetected for nitrate. As well as, disposal site recorded the highest values for total phosphate and orthophosphate (means 40 and 9.5 mgl^{-1} respectively)(Figure 6D).

The results of cations and anions content (Ca^{+2}, Mg^{+2}, Na^{+}, K^{+}, SO_4^{-2}, Cl^{-}, CO_3^{-2}&HCO_3^{-}) illustrated that calcium amount was higher levels than magnesium, sodium and potassium Figure 6E. In addition, highest amounts of calcium, magnesium, sodium and potassium were found in the disposal site (means36.9, 12.8, 22.7 and 7.8 mg l^{-1} respectively). Similarly, the highest levels of sulphate and chloride recorded in the disposal site (means179.0and 67.4 mg l^{-1} respectively). Carbonate was undetected at about 63% of examined water samples (Figure 6F). While, the highest content of bicarbonate showed in the disposal site (means344 mg l^{-1}).

The heavy metals (iron, zinc, manganese, copper, cadmium and lead) were present in a variable quantities depending upon time of collecting samples and their location Figure 6G. The highest concentrations were reported for Fe (ranging between 0.02 - 24.8 mg l^{-1}) followed by Zn (0.0001-2.2 mg l^{-1}) then Mn (0.0001-1.05 mg l^{-1}); and lower concentrationswere reported for Cd (0.0002- 0.44

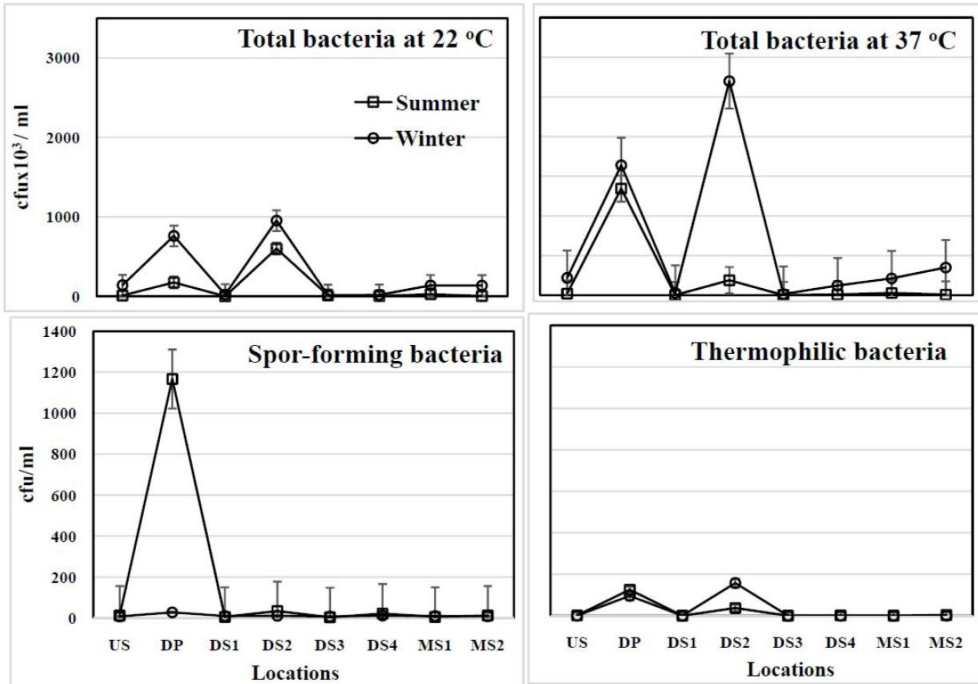

Figure 7 : Changes in microbial determinations of River Nile water samples obtained around El-Seel drain disposal point. US, up-stream; DP, disposal point; DS1, down-stream one; DS2, down-stream two; DS3, down-stream three; DS4, down-stream four; MS1, mid-stream one; MS2, mid-stream two.Bar whiskers represent SE; their absence indicates negligible SE

mg l^{-1}). Lead was undetected in all the water samples. As well as, around 81% of River Nile water samples recorded free in copper, and the highest level of Cu was detected at mid-stream (MS_1)opposite disposal point (means0.347 mgl^{-1}). Statistical analyses indicated that, the higher levels of Fe, Mn and Cd were present in disposal point and down-stream after 421.2 m (DS_2) north disposal point. The higher level of Zn present after 789.8 m (DS_3) north disposal point (means 1.12 mgl^{-1}) and higher than disposal point (means 0.58 mgl^{-1}).

Microbiological analyses

Microbial load of River Nile water samples which affected by El-Seel disposal in summer and winter 2013 were illustrated in Figure 7. The numeric of total bacterial count at 22 C and 37 C was varied according to distance of site and time of sample collection. Significantly, the highest number was recorded at down-stream after 421.2 m (DS_2) north disposal point in the winter either at 22 C or at 37 C Figure 7. El-Seel discarding increases microbial loads from 445% to 5978% comparing to up-stream. In general, higher number was recorded in winter season at all experimental sites. The ratio of total bacteria count at 22 C to 37 C ranging between 0.1 to 4.3. Spore-forming bacteria were detected in all water samples. Significantly, the highest number was recorded in the disposal site at summer (1167 cfu ml^{-1}). Thermophilic bacteria were detected in about 44% of water samples Figure 7, and the highest number were recorded at down-stream after 421.2 m (DS_2) north disposal point in the winter, followed by the disposal site (DP) in summer then winter.

Coliform bacteria in variable amounts were detected in the all water samples Figure 8. The highest coliform population recorded at disposal point, down-stream after 421.2 m (DS_2) north disposal point and up- stream (> 1200 MPN/100 ml) in each of two season samples. The site after 2729.2 m (DS_4) north disposal point and mid-stream opposite disposal point (MS_1) showed less coliform population density especially in summer sample (53 and 60 MPN/100ml respectively). In general, irrespective of sites, summer samples showed the lowest coliform population (748 MPN/100 ml in average) compared to (1426 MPN/100 ml in average) at winter.

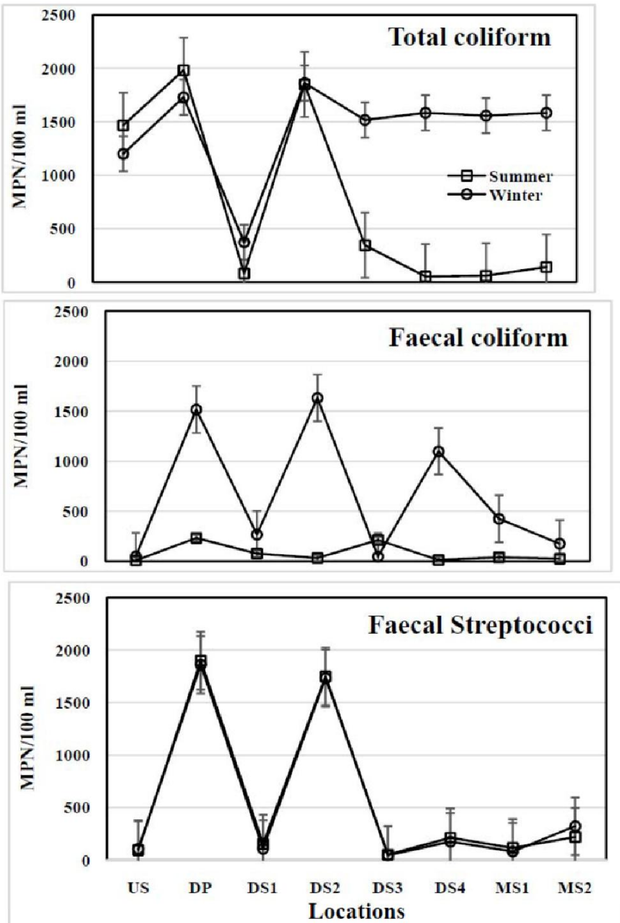

Figure 8 : Changes in bacterial indicators of pollution of River Nile water samples obtained around El-Seel drain disposal point. US, up-stream; DP, disposal point; DS1, down-stream one; DS2, down-stream two; DS3, down-stream three; DS4, down-stream four; MS1, mid-stream one; MS2, mid-stream two.Bar whiskers represent SE; their absence indicates negligible SE

Faecal coliform bacteria counts ranging between 9 MPN/100 ml to 1633MPN/100 ml. In general, highest number for faecal coliform bacteria were recorded at disposal site and down-stream after 421.2 m (DS_2) north disposal point (874 and 833 MPN/100 ml respectively). In general, the winter samples showed the higher faecal coliform population (652 MPN/100 ml) compared to summer samples (81 MPN/100 ml).

Faecal streptococci were found in all River Nile water samples. The higher number was found at the disposal sites (>1800 MPN/100 ml), followed by down-stream after 421.2 m (DS_2) north disposal point (>1700 MPN/100 ml). The lowest number recorded in down-stream after 789.8 m (DS_3) north disposal point (means 49 MPN/100 ml). There are not significant differences between two seasons (means 563 and 554 MPN/100 ml in summer and winter respectively).

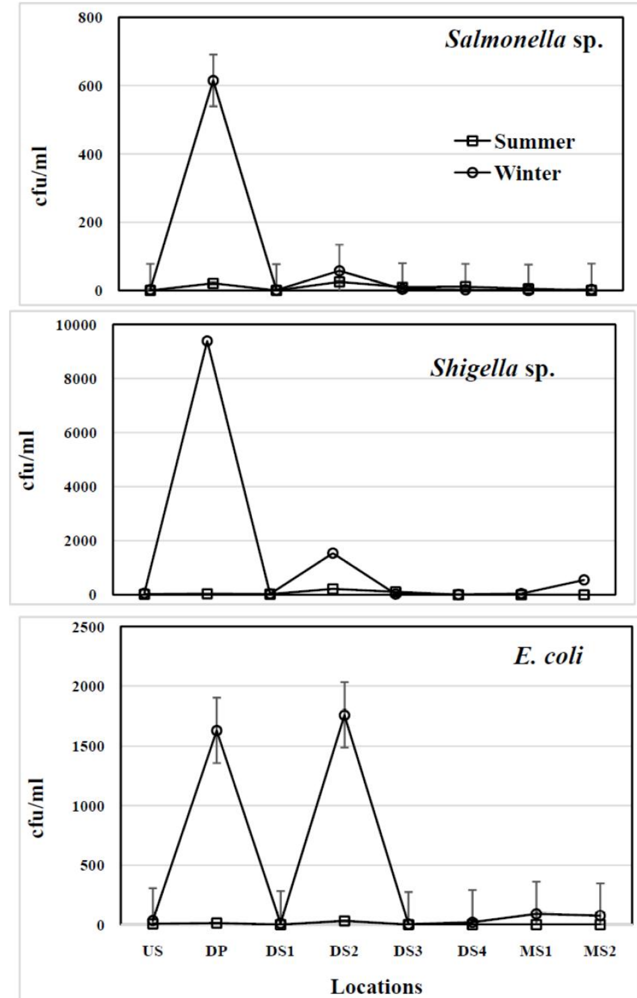

Figure 9 : *Salmonella* sp., *Shigella* sp. and *E. coli* determination of River Nile water samples obtained around El-Seel drain disposal point. US, up-stream; DP, disposal point; DS1, down-stream one; DS2, down-stream two; DS3, down-stream three; DS4, down-stream four; MS1, mid-stream one; MS2, mid-stream two.Bar whiskers represent SE; their absence indicates negligible SE

Faecal coliform: Faecal streptococci ratio ranged between 0.01 to 6.3. In general, winter water samples recorded highest ratio compared to summer water samples.

Pathogenic bacteria(*Salmonella* sp, *Shigella* sp, and *E. coli*) were detected in the all water samples at variable amounts. The higher numbers of *Salmonella* sp, *Shigella* sp, and *E. coli* were recorded in the winter samples at the disposal site (615, 9386 and 1631 cfu ml^{-1} respectively), followed by down-stream after 421.2 m (DS_2) north disposal point (58, 1538 and 1761 cfu ml^{-1} respectively). Pathogenic bacteria number was reduction at down-stream after 244.5 m (DS_1) north disposal point, where reach to approximately similar at up-stream Figure 9.

DISCUSSION

The results of El-seel drain water quality showed that,the initial point showed higher pollution compared to another sites along waterway, where the initial point recorded higher amount of TDS and EC this is reflected the quality of wastewater discharge (Abd el-Satar and Elewa, 2001). As well as, DO not detected in the initial and ending points for El-Seel drain and after 2.8 km from the initial point (in the front of Aswan hospital). This is due to its consumption by the oxidation of organic matter[16] and nitrogenous compounds[8], this reflectingthe high load of organic matter discharged into El-Seel drain. In addition, the highly BOD and COD values recorded in the initial point of drain. The values of BOD/COD ratio in El-Seel drain water ranged from 0.8 to 2.8, this indicates that water of El-Seel drain did biodegradable[14].

In respect nutrient content in El-Seel drain (nitrogen and phosphorus). Among nitrogen form, nitrate in particular was not detected. This might be attributed to the uptake of nitrate by phytoplankton and its reduction by denitrifying bacteria[21]. As well as NH_3^+ present with higher level than NO_2^-, this may be because high oxygen consumption by micro-organisms and the reduction of oxidizing form of nitrogen by denitrifying bacteria. Concerning of orthophosphate (PO_4^{-3}) and total phosphorus (TP) concentrations, clearly noticed that, total phosphorus more than 4 fold orthophosphate, this may be depression of oxygen content with high content in organic compound, lead to depression of oxidizing form of compound. In general, decrease levels of nutrient along the drainwaterway may be reverted to biological activity and sedimentation. Where, in this study NO_2^-, NH_3^+, PO_4^{-3} and TP are correlated with TBC at 22°C (0.72, 0.73, 0.66 and 0.73 respectively, n=12). In general, the high inputs of nutrient (nitrogen and phosphorus) lead to deteriorating water quality and cause serious problems.

The analysis of cations and anions showed that, carbonate was not detected in all water samples. This might be because the presence of high amount of organic matter with biological activity leads to depressed carbonate (Elewa and Ghallab, 2000). On the other hand, the high level of HCO_3^- recorded in the beginning of drain with the highly TDS and oxidation–reduction reactions, where, there are significant correlated between HCO_3^- with TDS, TBC at 22 °C and TBC at 37 °C (0.58, 0.72 and 0.65 respectively, n=12). The highest levels for chloride anion recorded in the ending of the drain. In contrast, highest levels for sulphate anions recorded in the initial point of the drain. Again, there are significant negative correlation between chloride and sulphate (- 0.84, n=12), this is may be related to nature and structure of wastewater. In respect major cations,the results indicated that Ca^{+2} recorded the highest concentrations compared with other cations concentrations. This might be attributed to the majority of Ca^{+2} over other cations in sedimentary rocks or wastewaters effluent[1].

Among heavy metals content, Pb was not detected in all analyses samples,while Fe recorded the highest amount of heavy metals compared others; this is reflect to nature and structure of wastewater effluents. Fe, Mn and Cu recorded higher amount in the beginning of drain, while, Zn recorded the highest amount after 4.5 km from initial point. This may be reflecting the effect of wastewaters composition, biological activity and sedimentation.

In respect to bacterial population, the various groups of bacterial population recorded highest population in the beginning of drain. Additionally, reduction of bacterial population were recorded with a long way of drain (exceptspor-forming bacteria), and recovery increased in the end of drain. All the obvious results did reflect the quantities and qualities of wastewaters effluents is the major factors effect of bacterial population and bacterial activities. In addition, differential temperature ratio test between total bacterial counts on 22 °C and on 37 °C, was recorded <0.9. Compared to the permissible standard of 10:1 according tominstry of health, 1939, this is reflecting the highly polluted of the drain.

In El-Seel drain, pollution indicators bacteria (total and faecal coliforms as well as faecal streptococci) detected with higher number in all water samples. Faecal coliform (FC): Faecal streptococci (FS) ratio varied from 0.02 to1.04, this is reflecting the pollution originating from animals and people[14].

In general pathogenic bacteria (*Salmonella* sp, *Shigella* sp and *E. coli*) recorded higher amount in the winter seasons. In addition, higher pathogenic bacteria count recorded in the beginning of drain (discharge effluent from treatment plant and kima I&II) and after 4.5 km from the initial point(discharge wastewater from Aswan hospital and other urban activities). This is demonstrate high healthy dangerous of people around El-Seel drain, as well as the in the disposal point at River Nile.

In respect to the results of evaluation the discharging of El-Seel wastewater on River Nile water quality. The results showed that higher temperature recorded in the disposal site and after 450 m down-stream exactly in the trough, (gathering place lagoon, DS_2) compared to others sides. As well as, the highest EC and TDS values were recorded in DP and DS_2. This is due to the high contents ofdissolved salts in discharge El-Seel drain wastewater effluent.

Dissolved oxygen (DO) consider the important parameters in the field of water management. Where, it appearance the evaluation of aerobic conditions of waterways. In this study, the absent DO concentration in the disposal site and low concentration in DS_2 indicates present high amount of chemicals capable of consuming the dissolved oxygen beside biodegradable organic matter (Von Sperling, 1996). The higher amount of BOD recorded in DS_2 and DP this could be attributed to increases organic matter which increase the microbial growth and metabolism (oxidation rates). Although, diminish water temperatures on cold seasons depressed the microbial growth and metabolism as well as oxidation rates (Abdel-Satar and Elewa, 2001), the means of BOD values in the winter (cold) seasons 11.6 mgl^{-1} compared summer (hot) seasons 6.4 mgl^{-1}, this reflects the effect of quality and quantity of wastewater effluent. Although, BOD deals only with the oxidation of biodegradable organic matter, the COD values for most water samples examined were lower than those obtained for BOD, especially in the DP and DS2. This is demonstrating, discharge of wastewater effluent contain heavy amount of biodegradable material. This statement is illustrated by calculated BOD/COD ratios of water samples, which ranged from 0.1 to 12.8 depending upon collecting season and site. This is means some water samples can be biodegradable (ratio more than two) and others are not (less than one).

Among the nutrient, nitrate was not detected in the disposal point and detected with low content in the DS_2. In contrary, the highest values for nitrite, ammonia, PO_4 and TP recorded in the disposal site, followed by $DS_{2,4}$. This is reflecting to decrease DO with increased oxidizing component lead to increase of reduction form of components.

Among anions and cations, CO_3^{-2} was not detected in the disposal point and DS_2, while the highest amount recorded in the DS_4, followed by $DS_{1,3}$. This is displayed, heavy organic pollution in the El-Seel drain disposal point depressed oxygen content in this area and with a long way down-stream, increased oxygen content in water, this is because dilution of wastewater effluent with Nile water, where there are significant positive correlation of CO_3^{-2} with DO (0.84, n=16). The highest HCO_3 values recorded in the disposal point followed by DS_2 where there are high amount of TDS (significant positive correlation of HCO_3 with TDS 0.97, n=16) and low DO (significant negative correlation of HCO_3 with DO -0.66, n=16). In general the highest cations (Ca^{2+}, Mg^{2+}, Na^+ and K^+) contents recorded in the disposal point and depressed with far away down-stream the point of disposal, where dilution effects with Nile water[9].

Among heavy metals, Pb was un-detected in all water samples, while Cu is detected only in the disposal site and mid-stream in the front of disposal site. Higher amount of Cd (0.339 mgl^{-1}) recorded after 421 m north El-seel drain disposal point (DS_2). Other heavy metals, Fe, Zn and Mn, the highest values recorded in the disposal point, DS_2 (accumulation the wastewater effluent) and DS_3(effect of ships wastes).

Higher microbial population (TBC at 22°C, TBC at 37°C, spore-forming bacteria and thermophilic bacteria) recorded in El-Seel effluent disposal site and DS_2, this is reflections exists increased of organic matter support growth of bacteria (Sayler *et al*., 1975). There are positive correlation between TDS and TBC at 22°C, TBC at 37°C, spore-forming bacteria and thermophilic bacteria (0.53, 0.65, 0.61 and 0.74 respectively, n=16). Increased Thermophilic bacteria in the disposal point reflect present thermal pollution. The ratio of TBC at 22°C: TBC at 37°C ranged from 0.1-3.2 (<10, according to Ministry of Health, 1939), this is obviously polluted Nile water in the studied area.

The higher number of indicator bacteria (total coliform, faecal coliform and faecal streptococci) in the disposal site and DS_2 reflects the severe pollution with sewage. In addition, ratio FC: FS ranged 0.01- 6.3 indicates animal and people feces pollution[14]. As well as, the highest number of pathogenic bacteria (*Salmonella* sp, *Shigella* sp and *E.coli*) recorded in the disposal point and DS_2.

In general, the results of this study revealed that, El-Seel drain received a different pollution resource such as industrial wastewater (Kima industry) and domestic (Aswan treatment plan and directly from houses and other human activities), as well as hospital wastewater (Aswan hospital), also households wastes. Although, this study of El-Seel drain demonstrated the higher amount of pollution recorded in the initial point, and depressed the pollution along way of drain; this is indicate of some improvement by sedimentation and biodegradation along the drain, but the water quality at the end point still higher than permissible limits (Law 48/1982), this is agreement with Soltan (1995). As well as the results revealed that there are recovery pollution after 4.5 km from the initial point this indicate there are another source of contamination were present (hospital and other urban activity). In addition to the higher amount of the organic loads and microbial counts recorded in the winter seasons compared to summer seasons, this reflect the effects of quantity and quality is more efficient than weather effect. In addition, the River Nile in the study area (around the disposal of El-seel drain) has been under pollution stress. Clearly, the effect of disposal wastewater on Nile water quality was lateralmore than vertical effect. Disposed effluents increased undesirable material and then progressively decreased downstream. This is agreement with El-Gohary (1994) who concluded that the Nile water of river banks are more polluted comparing to the midstream. This is because the effect of dilution and the rate of running water as well as degradation of the pollutants discharged. Furthermore, with the exception of a water trough (gathering place for wastewater) located at 421 m north disposal point. In addition, there are another sources of pollution (ships marina) located at 789.8 m north disposal point. Unfortunately, the location beside Abo El-Reesh drinking water station (located at 2729 m north disposal point) is polluted comparing with upstream and mid-stream, this is maybe there are other not apparent source of pollution or the natural of place (presence a lot of pipes or water trough) causing collect undesirable material.

CONCLUSION

In Aswan Governorate, El-Seel drain represents the main source of water contamination and causes high risks to human health and environmental problem, this leading to significant economic losses. Therefore, monitoring of Nile water quality considered an important tools for water managements, where monitoring provide some information about the source of pollution with quantity and quality of disposal wastewater. In addition, this reveals the important of management of water quality, control of water pollution and environmental protection for preserve living conditions for the future.

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