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Physicochemical and Microbiological Studies on Suez Fresh Water Canal

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SIX LOCALITIES along the Suez freshwater canal were studied. The characterization of water quality included physical, biochemical and microbiological analyses. The obtained results showed that the maximum turbidity was recorded at Abu Atwa station (70 NTU), while maximum electrical conductivity (EC) were recorded at two sites, Suez water station and Amir village (633 and 607 µS/cm). Results also indicated high level in the organic load represented by an increase in the biological oxygen demand (BOD) and chemical oxygen demand (COD) above the permissible levels at Amir village and Abu Atwa sites, while slight increase in (COD) was observed at Kobry El Saal and Sarabium water station. The total viable bacterial count (TVB) ranged from 4.7×10^2 to 20.2×10^2 cfu/ml, which greatly exceeded the permissible levels also the fecal coliform and fecal streptococci were detected in all investigated sites. The isolation of actinomycetes from Suez fresh water canal sediments by enrichment culture technique resulted in two isolates (N1 and N2) using DDT enrichment technique. The isolate N2 showed weak results in biodegradation of selected hydrocarbons, while N1 showed much more activity, so its identification was confirmed by phylogenic analyses and selected for further investigation. Conclusion, the water characteristics demonstrated water quality deterioration especially in the Amir village which may be due to industrial and domestic wastewater from human and agriculture activities.

Keywords: Suez fresh water canal, Pollution, Water analysis, Fecal Coliform, Fecal streptococci.

The sources and causes of water pollution in Suez Gulf Region can be categorized into: sewage, persistent organic solids, radioactive material, heavy metals, oils (hydrocarbons), nutrients, sediment mobilization, and litter (REMIP, 2008). Nutrient levels (ammonia, nitrate, phosphate and chlorophyll) were found to be highest in the area surrounding Suez city due to the discharge of untreated sewage and industrial wastewater as well as the wastes resulting from ships waiting to cross the Suez Canal. A fecal coliform is a facultative anaerobes, rod-shaped, gramnegative, non-sporulating bacterium. Coliform bacteria generally originate in the intestines of warm-blooded animals (Doyle and Erickson, 2006). The term "thermotolerant coliform" is more correct and is gaining acceptance over "fecal coliform" (Bartram and Richard, 1996). The presence of fecal

coliform in aquatic environments may indicate that the water has been contaminated with the fecal material of humans or other animals. Fecal coliform bacteria can enter rivers through direct discharge of waste from mammals and birds, from agricultural and storm runoff, and from human sewage (Doyle and Erickson, 2006). The fecal streptococci, has also been advocated as an indicator of fecal pollution (Lachica and Hartman, 1968).

Untreated organic matter that contains fecal coliform can be harmful to the environment. Aerobic decomposition of this material can reduce dissolved oxygen levels discharged into rivers or waterways. This may reduce the oxygen level enough to kill fish and other aquatic life. Reduction of fecal coliform in wastewater may require the use of chlorine and other disinfectant chemicals. Such materials may kill the fecal coliform and pathogenic bacteria. They also kill bacteria essential to the proper balance of the aquatic environment, endangering the survival of species dependent on those bacteria. So higher levels of fecal coliform require higher levels of chlorine, threatening those aquatic organisms (Fresno, 2009). The uses of organochlorine pesticides in Egypt began since 1950s and were extensively used until 1981 to protect crops from insects, fungi and weeds. Nonetheless, DDT and several other organochlorine pesticides are still being illegally used for agriculture in many developing countries and have led to the contamination of foodstuffs, especially those having a high fat content such as meat and meat products, (Abd Al-Rahman, 2010). Actinomycetes have a great potential for biodegradation of different organochlorines, even when other carbon sources are present in the medium as energy source (Benimeli *et al*., 2003). Several studies have shown the ability of *Streptomyces* strains to degrade a variety of chlorinated pesticides including aldrin, DDT, metolachlor, atrazine, lindane and chlordane (Liu *et al*., 1991; Radosevich *et al*., 1995; Fuentes *et al*., 2010 and Cuozzo *et al*., 2012). This study was designed for characterization of water quality, including (physical, chemical and microbiological parameters) in six study localities at Suez freshwater canal.

Materials and Methods

Suez Governorate is one of the urban canal regions. The Governorate is locating in the east Delta of Egypt. The city has been developed as a center as a mix of labor capital-intensive industries, using the existing base of petroleum and petrochemical plants. These industries discharge industrial factories, which may affect coastal waters in the Gulf of Suez and neighboring water bodies.

Collection of water samples

Water samples were collected in two sets of sterile 500 ml polyethylene bottles, in which turbulence was carefully avoided. Samples were stored immediately in icebox while transported to the laboratory. Physical, chemical, and microbiological analyses were carried out within 24 hr of sampling.

The study area

Suez freshwater canal was defined as fresh "Ismailia Canal.". It starts at the Nile near Shubra, north of Cairo, and up to the Suez Canal at Ismailia, then is subdivided into two branches, one going to the Suez and the other to Port Said. The length of this canal is 129 km from the mouth to "Nvich", and 89 km from Nvich to Suez. It is exposed to high levels of pollutants from domestic and agricultural sources, in addition to release of dead animals and other wastes into the canal.

Sampling sites

A total of 18 water samples, and 6 sediment samples were collected over two years from Suez fresh water canal. In total, six localities were covered in the present study (Fig. 1) Suez water station (sample 1), Amir Village (sample 2), Al Shalofa (sample 3), Kobry El Saal (sample 4), Sarabium water station (sample 5) and Abu Atwa (sample 6).

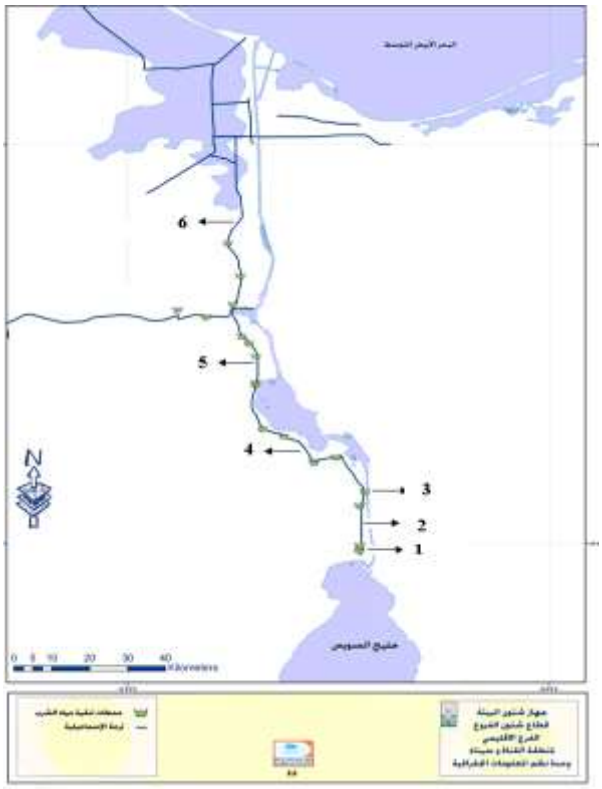

Fig. 1. Locations of sampling sites on suez freshwater canal: 1. Suez water station, 2. Amir Village, 3. Al Shalofa, 4. Kobry El Saal, 5. Sarabium water station, 6. Abu Atwa.

Water analysis

Physical analysis

All physical analysis were performed according to methods described in (APHA, 1992).

Temperature (°C)

Groundwater temperature was measured, in situ, using digital direct-reading thermometer once the sample was collected.

Turbidity (NTU)

Turbidity values were determined in the laboratory, using Orbeco-Hellig® digital direct-reading turbidimeter.

Electric conductivity (EC) µS/cm

EC was recorded using portable meter Testo® 240 at the laboratory.

Hydrogen ion concentration (pH)

pH values were measured, in situ, using pH ep® Pocket-sized pH meter.

Salinity (NaCl mg/l)

Salinity values were analyzed using portable meter Testo® 240 at the laboratory.

Chemical analysis

Dissolved Oxygen Demand (DOD) mg/l: Was measured in situ, using Winlab® Data line Oxygen-meter.

Biochemical Oxygen Demand (BOD) mg/l

BOD was determined following the method of 5 days biochemical oxygen demand, as described in APHA (1992).

Chemical Oxygen Demand (COD)

COD concentrations were determined calorimetrically according to the method described in (APHA, 1992).

Ions (PO_4, SO_4, NO_3 and NH_4)

Determined according to the methods described in (APHA, 1992).

Microbiological analysis

Total Viable Bacteria (TVB) were counted using plate count agar medium inoculated with 1ml water sample and incubated aerobically at 37°C for 48 hr. After incubation, all growing colonies were counted. Fecal Coliform (FC) were counted using m-FC agar medium (APHA, 1992). The medium composed of 10g proteose peptone, 3 g yeast extract, 5 g sodium chloride, 12.5 g lactose, 1.5 g bile salts, 0.1 g aniline blue, 10 ml rosolic acid solution, and 15 g agar were dissolved in 950 ml distilled water. The pH was adjusted to 7.4 ± 0.1and incubated aerobically at 44.5°C for 24 hr. After incubation, blue colonies were

counted. Fecal streptococci were enumerated using m-*Enterococcus* agar medium (APHA, 1992) which composed of 20 g casein peptone, 5 g yeast extract, 2 g dextrose, 4 g dipotassium hydrogen phosphate, 0.4 g sodium azide, 0.1 g triphenyl tetrazolium chloride, and 16 g agar. These component were dissolved in 1000 ml distilled water, the pH was adjusted to 7.15 ± 0.2. and incubated aerobically at 37°C for 48 hr. After incubation, small, flat, raised, light pink to dark red, glistening colonies with pink peripheries were counted.

Isolation of chlorinated hydrocarbons degrading actinomycetes from the sediments of Suez freshwater canal by enrichment technique

One gram of sediment samples were added to 250 ml flasks containing 50 ml M56 media supplemented with one ppm of Dichlorodiphenyltrichloroethane (DDT), Pentachlorophenol (PCP) and 2,4-Dichlorophenoxyacetic acid (2,4-D), then incubated at 28^{o}C on a rotary shaker (200 rpm) for 7days then 1 ml of each flask was transferred into new flask containing the same medium. The transfer process was repeated every 7 days for 28 days (4 succession times). Enrichment was performed in triplicates.

Subsequently, 1 ml of sample was withdrawn, serially diluted and streaked on M56 medium plates spiked with 100 ppm of DDT or 50 ppm of PCP. Typical actinomycete colonies were picked up and purified on starch casein medium and maintained as spore suspensions in 20 % glycerol at -20^{o}C for subsequent investigation. Biodegradation capability of the actinomycetes was determined by the method given by (Mills *et al*., 1978).

Degradation studies

Screening for degradation abilities of actinomycetes isolates

Actinomycete isolates were screened for the ability to degrade chlorinated aromatic hydrocarbons and organophosphorus pollutants. These were: (DDT), Pentachlorophenol (PCP) and 2,4 dichlorophenoxyacetic acid (2,4-D).

Phylogenetic identification of actinomycete isolates

Culture condition

The actinomycete isolates were grown in 100 ml starch casein broth medium (Kuster and Williams, 1964) composed of soluble starch, 10.0 g; Casein (vitamin-free), 0.3 g; KNO_3, 2 g; NaCl, 2.0 g; K_2HPO_4, 2.0 g; $MgSO_4.7H_2O$, 0.05 g; $CaCO_3$, 0.02 g; $FeSO_4.7H_2O$, 15.0 g; distilled water, 1000 ml. pH 7.0. Spore suspensions of each actinomycetes type (20 µl) were inoculated into the flasks and incubated at 28 ^{o}C on a rotary shaker (200 rpm) for 2-4 days, until young mycelial growth is obtained before sporulating stage. Cultures were harvested by centrifugation at 3000 rpm for 10 minutes, washed once with sterile distilled water, then centrifuged at 3000 rpm for 10 min. to collect mycelia.

DNA isolation and 16S rDNA sequencing was performed at Biotechnology Centre at Suez Canal University using Polymerase Chain Reaction (PCR) amplifications.

DNA was isolated according to (Kumar *et al*., 2010). One hundred mg of the harvested mycelia were transferred into fresh tube containing 500 µl of TE buffer supplemented with lysozyme (20 mg/ml). The tube was incubated at 37^{o}C for 30 minutes. Twenty µl of 10 % SDS (w/v) and 20 µl of proteinase k were added into the tube and incubated at 55 ^{o}C for 30 min. The lysate was cooled down and extracted once with equal volume of phenol: chloroform solution (v/v, 1:1) at 10,000rpm for 5 min. The aqueous phase was transferred carefully to a fresh tube and DNA was precipitated by adding70-90% ethanol and keeping at -20^{o}C for 30 min. The pellet was formed by centrifugation at 10,000 rpm for 10min. The pellet washed twice with 90 % ethanol and dissolved in TE buffer.

PCR amplification protocol

Total genomic DNA that isolated previously, was used as template for Polymerase Chain Reaction (PCR) amplifications according to protocol of (Hall *et al*., 1999).

16S rDNA Sequencing

Sequencing was carried out to confirm the identity of the isolates. The amplified PCR fragments were sequenced commercially (Macrogen Inc., south Korea) in both directions using an automatic DNA sequencer. The sequences obtained were compared with those deposited in the public databases and the sequences of the two isolates and those of their most closely related taxa retrieved from Gen Bank were aligned using the CLUSTALAW program (Thompson *et al*., 1997) and checked for alignment inconsistencies. Evolutionary trees were inferred using the neighbour-joining (Saitou and Nei, 1987).

Results

Physical and chemical characteristics of water from Suez freshwater canal during 2011-2012 are shown in Table 1, compared to the Egyptian standard (Law 48/ 1982). Physical analysis indicated that, temperature and pH of water samples of the area were all within the acceptable limits. Similarly, chemical analysis showed that sulfate and nitrate were within the acceptable limits, while phosphate concentration was within the permissible limit (1g/ l) in all samples except in Suez water station and Abu Atwa samples (1.5 and 1.75 respectively). (Table 1). COD values in Amir Village, Kobry El Saal, Sarabium water station and Abu Atwa exceeded the acceptable standard and BOD exceeded the acceptable standard in Amir Village and Abu Atwa while DO concentration in all investigated areas was within permissible limit (5mg/l) (Fig. 2).

TABLE 1. Physicochemical analysis of the investigated Suez freshwater localities, compared to the Egyptian standard for surface water.

Locality	COD mg/l	BOD mg/l	NO_3^- mg/l	NH_4^- mg/l	PO_4^- mg/l	SO_4^- mg/l	pH	DO mg/l	Salin. mg/l	EC µS/cm	Turb. NTU	Temp. °C
1- Suez water station	4.7 ± 2.3	4.8 ± 0.88	6.8 ± 3.5	0.1	1.5 1±	104 ± 12.8	8.5 ± 0.1	9.78 ± 0.9	514 ± 172.6	1439 ± 97.2	7.6 ± 0.9	20.2 ± 1.5
2-Amir village	37.58 ± 18.7	7.6 ± 2.5	6.03 ± 2.6	0.1	0.2	105.6 ± 20.4	8.5 ± 0.08	10.4 ± 0.66	632.6 ± 16	1286 ± 32.3	10.3 ± 0.9	20 ± 1.5
3- Al Shalofa	5.06 ± 2.5	4.69 ± 1.6	10.73 ± 4.6	0.05	0.15 ± 0.05	86 ± 13	8.4 ± 0.13	9.95 ± 0.85	607 ± 30	1233 ± 61.8	33.1 ± 13.8	19.6 ± 1.6
4- Kobry El-Saal	10.2 ± 5	4.4 ± 1.8	18.56 ± 12.6	0.15	0.15 ±0.05	88 ± 23	8.3 ± 0.18	9.6 ± 0.6	551 ± 36	749 ± 365	13.2 ± 4.6	19.6 ± 2.1
5-Sarabium water station	11.6 ± 5.8	4.9 ± 2	5.4 ± 2.3	0.1	0.5	70.6 ± 6	8.5 ± 0.13	10.1 ± 0.88	479 ± 30	980 ± 61.5	15 ± 9.2	20.6 ± 1.2
6- Abu Atwa	34.65 ± 17.3	6.7 ± 4	7.13 ± 0.7	0.2	1.75 ± 1.5	104.3 ± 29	8.5 ± 0.2	10.4 ± 0.9	470 ± 33.4	955 ± 63	70 ± 65.5	20.6 ± 1.2
Egyptian standard.[a]	10	6	45	0.5	1	200	7-8.5	More than 5	Not available	Not available	10	٢٢

Values exceeding standard levels are highlighted in grey. (n=3)
a. Egyptian standard according to Law 48/1982.

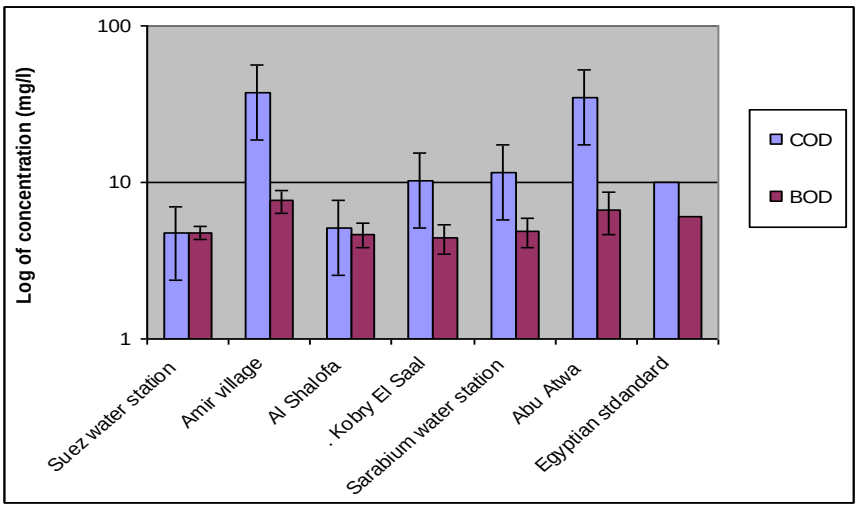

Fig. 2. BOD and COD values detected in Suez freshwater samples.

Microbiological analysis indicated that, TVB counts ranged from 4.7×10^2 to 20.2×10^2 cfu/ml, which greatly exceeded acceptable Egyptian standard for surface water (100 cfu/ml). Fecal coliform and fecal streptococci were detected

in all the investigated areas, with the maximum values at kobry El saal (27 and 9cfu /ml, respectively) and minimum average values at Al Shalofa (2 and 2 cfu /ml, respectively) (Table 2).

TABLE 2. Counts of TVB, fecal streptococci and fecal coliform in Suez freshwater samples, compared to the Egyptian standard for surface water. (No available standard for fecal streptococci).

Bacterial count (cfu)	Suez water station	Amir village	Al shalofa	Kobry El Saal	Sarabium water station	Abu Atwa
TVC (X 10)	81	47	70	79	167	202
Fecal coliform	6	2	2	27	5	11
Enterococcus	7	4	2	9	6	9

Screening for degradation ability of actionmycete isolates (N1 and N2):-

Two isolates (N1 and N2) were recovered from Suez fresh water canal sediments during the current study and were included in the degradation of (DDT), (2,4-D) and (PCP). The results indicated that, N1 gave very good activity in degradation of DDT and 2, 4, D at different concentrations. But the results with PCP showed similar growth in plates supplemented with 50 ppm and control plates, while gave negative results with higher concentrations. The isolate N2 showed activity only with the concentration 50 ppm of DDT and 2,4-D, while gave negative results with PCP (Table 3).

TABLE 3. Degradation of DDT, 2,4-D and PCP by selected actinomycetes isolates (N1 and N2). Activities were investigated on M56 medium supplemented with the chlorinated hydrocarbon pollutants.

Co. / Hydrocarbons	50	100	300	500	700	1000
DDT	+	+	+	+	+	+
2, 4- D	+	+	+	+	+	+
PCP	S	-	-	-	-	-
N2						
DDT	+	_	_	_	_	_
2,4-D	+	_	_	_	_	_
PCP	_	_	_	_	_	_

(+): indicates better growth, compared to control (unsupplemented) plates.
(S): indicates similar growth to that in control plates.
(-): no growth.

Phyllogenetic identification of actinomycete isolates (N1)

Sequence analysis for the partial 16S rRNA gene sequence of 206 base pairs of the isolate N1 revealed that this isolate had a sequence with 99 % similarity to *Streptomyces capoamus Y24-25*. A phylogenetic tree was constructed from a multiple sequences alignment of 16S rRNA gene sequences (Fig. 3).

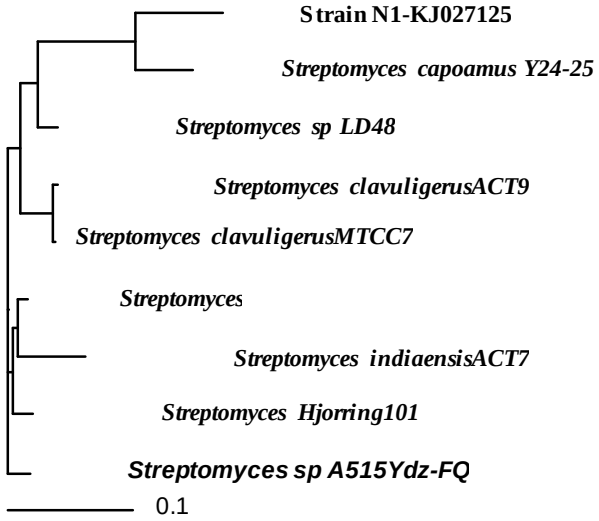

Fig. 3. Construction of phylogenatic trees for actinomycete isolate (N1). The evolutionary history was inferred using the neighbor-joining method.

Discussion

Water turbidity is caused by suspended matter such as clay, silts, organic and inorganic matters, soluble colored organic compounds, phytoplanktons and zooplanktons (APHA, 1998). The turbidity degree of stream water is an approximate measure of the intensity of the pollution (Siliem, 1995). The maximum turbidity was recorded at Abu atwa (70 NTU) that may be attributed to the industrial and domestic wastewater discharge from El-Mahsama drain into this site (Noha *et al*., 2013).

Electrical conductivity (EC) is a good indicator parameter on the total dissolved ions in aquatic ecosystem. The EC values ranged between 470-633 µS/cm. The maximum Ec values were recorded at two sites (Suez water station and Amir village) (633 and 607 µS/cm, respectively), which may be affected by discharge from El Ganayn and El Shalofa drains as the increase in EC values reflect the strong effect of industrial discharge at these areas (SEP, 2004).

Similarly, chemical analysis showed that sulfate and nitrate were all within the acceptable levels. The phosphate concentration was within the permissible limit (1mg/l) in all samples except in Suez water station and Abu Atwa samples (1.5 and 1.75, respectively). This may be attributed to the agricultural drainage that flows into Suez freshwater canal.

COD values in Amir Village, Kobry El Saal, Sarabium water station and Abu Atwa exceeded the acceptable standard and BOD exceeded the acceptable standard in Amir Village and Abu Atwa while DO concentration in all investigated areas was within permissible limit (5mg/l). Results indicated an increase in the organic load represented by the increase in the biological oxygen demand (BOD) and chemical oxygen demand (COD) above the permissible limits at Amir Village and Abu Atwa sites, while slight increase in (COD) was observed at Kobry El- Saal and Sarabium water station. These results revealed the water quality deterioration especially in the Amir village which may be due to industrial and domestic wastewater from human and agriculture activities. The impact of rural settlements in Al- Ganayn area and agricultural production in this area on the Suez freshwater canal is significant as reported in (SEP, 2004), which is in agreement with that obtained from the current study.

Microbiological analysis indicated that, total viable bacterial counts (TVB) ranged from 4.7×10^2 to 20.2×10^2 cfu/ml, which greatly exceeded acceptable Egyptian standard (100 cfu/ml) by about 5 to 20 times in all investigated sites. This may be explained by the effect of domestic waste discharged into these areas. The most widely accepted bacterial indicators of fecal pollution in water have been the coliform group of bacteria (WHO International Drinking Water Standards, 1963; Standard Methods, 1965). Fecal coliform and fecal streptococci were detected in all the investigated areas, with the maximum values at kobry El saal (27 and 9 cfu /ml, respectively) and minimum average values at Al Shalofa (2 and 2 cfu /ml, respectively). The detection of fecal indicators (fecal coliform and fecal eshcross the Suez Canal, (REMIP, 2008). Large quantities of fecal coliform bacteria in water are not harmful according to some authorities, but may indicate a higher risk of pathogens being present in the water. Some waterborne pathogenic diseases that may coincide with fecal coliform contamination include ear infections, dysentery, typhoid fever, viral and bacterial gastroenteritis, and hepatitis A. The presence of fecal coliform tends to affect humans more than it does aquatic creatures, though not exclusively (Fresno, 2009).

The Expansion in the industrial sector has resulted in an intensive increase in the use, disposal, and release of chlorohydrocarbons to various segments of environmental systems (Loutfy *et al*., 2007). For example, the most common sources for dioxins emission are solid waste and sludge burning, which is a common practice in Egypt. According to our study the actinomycete isolate N1 showed very good activity in degradation of DDT, 2,4-D at high concentrations, while gave negative results with high concentrations of PCP. The isolate N2 showed activity only with low concentration of DDT and 2,4-D while gave negative results with PCP. In previous studies, many actinomycete strains from

industrial wastewater environment applying selective procedures. Abilities of actinomycetes for degradation of a variety of chlorinated hydrocarbons (pentachlorophenol and organochlorine pesticides) have been extensively investigated (El-Shatoury *et al*., 2004). Petroleum and polycyclic aromatic hydrocarbons (PAHs) degrading *Streptomyces sp*. isolate ERI-CPDA-1 was recovered from oil contaminated soil in Chennai, India. The degradation efficiencies were examined by GC-FID and the results showed that the isolate could remove 98.25% diesel oil, 99.14% naphthalene and 17.5% phenanthrene in 7 days at 30°C (0.1%) (Balachandran *et al*., 2012). According to (Sette *et al*., 2005) genus *Streptomyces capoamus* isolated from soil and identified on genomic basis was able to grow in mineral salts medium contained the pesticide (Alchlor) (72 mg L-1) and also degrade it.

Sequences of 16S ribosomal DNA have provided actinomycetologists with a phylogenetic tree that allows the investigation of evolution of actinomycetes and also provides the basis for identification. Analysis of the 16S rDNA begins by isolating DNA (Hapwood *et al*., 1985) and amplifying the gene coding for 16S rRNA using the polymerase chain reaction (Siva Kumar, 2001). The purified DNA fragments are directly sequenced. The sequencing reactions are performed using DNA sequencer in order to determine the order in which the bases are arranged within the length of sample (Xu Li‐Hua *et al*., 1999) and a computer is then used for studying the sequence for identification using phylogenetic analysis procedures. The phylogenetic analysis of the isolate N1 revealed that this isolate had a sequence with 99% similarity to *Streptomyces capoamus* Y24-25.

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دراسات فيزيوكيميائية وميكروبيولوجية علي ترعة السويس

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تناولت هذة الدراسة اخذ عينات مياه من ٦ مواقع علي طول ترعة السويس وهذه المواقع هي: محطة مياه السويس، قرية عامر، كوبري السيل، محطة مياه سرابيوم وابو عطوه.
كماتم اجراء بعض الدراسات الفيزيائية، البيوكيميائية و الميكروبيولوجية علي عينات المياه.-
كشفت نتائج توصيف مياه ترعة السويس عن تدهور حالة المياه و خاصة في قرية عامر وربما يكون السبب في ذلك هو مياه الصرف الزراعي و الصناعي و كذلك الانشطة البشرية .
-تم عمل عد بكتيري فى عينات المياه وقد اوضحت النتائج ان معدل النمو البكتيري فى جميع المواقع يفوق المعدل المسموح به.
-كما تم تعيين بكتيريا القولون فى هذة العينات حيث وجدت بنسبة عالية مما يدل علي تلوث هذة المياه بمياه الصرف الصحي .
- كما انه تم عزل سلالتين من الاكتينوميسيتات N1, N2علي بيئة تحتوي علي DDT وتم اختبار قدرة هذة السلالات علي تكسير الهيدروكربونات الموجودة فى عينات المياه الملوثة ولوحظ ان N1 له القدرة علي تكسير بعض المركبات مثل PCP, 2, 4-D وينمو بشكل متوسط مع PCP بينما ينمو N2 في تركيز ٥٠ مللجرام فقط من DDT و2, 4-D ولا يستطيع النمو مع PCP .

تم اختيار N1 للتعريف بالطرق الوراثية القياسية وعرف علي انه *Streptomyces capoamus*

وبذلك تؤكد هذة الدراسة علي قدرة الاكتينوميسيتات علي تخليص البيئة من بعض المركبات السامة التي تستخدم فى الصناعة والزراعة وتصرف فى مياه الترع مثل ترعة السويس.