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Monitoring of some chemical and biological pollutants in wastewater of Bahr El-Baqar, Bilbies and El-Qalyubia drains in East Delta, Egypt for Irrigation purposes.

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Abstract

Drains in Eastern Delta region were used for receiving sewage wastewater, drainage water of the fields and industrial effluents. Because of the shortage of irrigation water, such water, is sometimes, used in irrigation of agricultural crops. Therefore, it becomes a serious source of pollution as it contains different contaminants of chemical pollutants, namely, heavy metals and biological pollutants like *Salmonella* and *Shigella*. The aim of the present study was to monitor the presence of some serious heavy metals, pathogenic bacteria and nitrate in wastewater of the three drains of Eastern Delta region, in order to assess the degree of pollution in the water of these drains for agricultural purposes.

Data revealed that salinity and sodicity values of the studied drains water samples ranged between 0.98 to 2.53 dS/m and 3.27 to 9.64, respectively. According to USDA diagram, the studied samples are in class C_3S_1 and C_4S_2. The data, also, recorded high numbers of saprophytic bacteria (at 22 ºC) and parasitic group (at 37 ºC), *Salmonella* and *Shigella* which were present in three drains wastewater with estimates surpassed the permissible values. Except second branch of Bilbies drain *Salmonella* and *Shigella* note detectable. Estimates of BOD and COD, gave variable and high records. BOD values ranged from (70 ppm) for end Bilbies drain to (220 ppm) for third branch of El-Qalyubia drain. Concentrations of COD ranged from (118 ppm) for end El-Qalyubia drain to (262 ppm) for third branch of Bilbies drain, respectively.

Heavy metals concentrations of Ni, Co, Cd and Pb in three drains were varied from 0.07 to 0.18, 0.07 to 0.59, < 0.1 to < 0.2 and 0.1 to <1.5 ppm, respectively. The highest concentration levels were for Co and Cd in three drains comparing to maximum permissible levels stated by FAO (2017) 0.05 Co and 0.01 Cd ppm. While Pb and Ni levels were lowest than the maximum permissible levels stated by FAO (2017), (Pb, 5 ppm and Ni,0.2 ppm). Concentrations of NO_3^- were ranged 28.98 to 54.74 ppm in end Bilbies drain and first branch of El-Qalyubia drain. Nitrate nitrogen concentrations in three drains of Eastern Delta, Egypt exceed the U. S. Environmental Protection Agency (1991) maximum contaminant level for drinking water of 10 ppm.

Results of the present study, reveals that the wastewater of these drains are highly dangerous on human health and the environment, when used as it is without good treatment. So, these wastewaters must be remediated from such contaminants.

Keywords: *Salmonilla – Shigella*, heavy metals, nitrate, BOD and COD, wastewater, pollution, Eastern Delta.
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1. Introduction

Egypt is facing a major defiance of freshwater scarcity coupled with increasing population growth (El-Rawy et al., 2020). The major source for water supply in Egypt is River Nile, it provides 57.5 billion cubic meters (BCM) year-1 (FAO, 2016). Therefore, water shortage is one of the most serious problems in Egypt. To reduce the gap between water supply and demand, prevent pollution of water bodies, achieve sustainable development and provide a relief solution for water shortages and climate change, we should use the treated wastewater (Elbana et al., 2019). Nearly 43% of the total wastewater produced in Egypt are not treated (FAO, 2016). The use raw (untreated) or partially treated wastewater for irrigating crops is usually escorted by several environmental and health risks (Abuzaid, 2016 & 2018a) due to pathogens and toxic chemical bioaccumulation (Elbana et al., 2019). Consequently, assessment of water quality is of major concern to avoid potential risks (Farrag et al., 2017).

Heavy metals were the mean problem concerned with water pollution when polluted water, used for irrigation, it will contaminate and enrich soils and crops (Mireles et al., 2004). The mainly responsible for waterways and soil pollution with heavy metals is the increase in industrial activity, along with the residues from mineral fertilizers (Abdelrazek, 2019). Heavy metals could accumulate in tissues during aquatic organism growth (bioaccumulation) and often biomagnified up the food chain intervene with the health and reproduction of both wildlife and humans (Abd El-Razik, 2006). Commonly, metals such as cadmium, copper, molybdenum, nickel and zinc (all except molybdenum are also known as heavy metals) could cause grave health risks to human beings and animals. Seldom, these metals show toxicity to plants, but in most cases, they are accumulated in the plants and when the plant are consumed by humans or by domestic animals, the health hazard develops (FAO/RNEA, 1993). The toxicity of heavy metals most commonly involves the brain and the kidney, but other manifestations occur, and some metals, such as arsenic are capable of causing cancer (McCally, 2002 and El-Sanafawy et al., 2010).

Some municipalities use surface waters for human consumption, the NO^-_3 concentration in these waters must be <10 mg N/L. In the human body, nitrate can be readily converted to NO^-_2, and has been involved in two major health problems: Blue-baby syndrome (methaemoglobinaemi) and stomach cancer (Drury et al.,1993 and Antar et al., 2012).

Pathogens bacteria produce cytotoxines referred to as verocytotoxin (VT), which appears to play a major role in the pathogenesis of hemorrhagic colitis. *Salmonella* and *Shigella* are the leading agents causing gastrointestinal infections, especially in developing countries. These bacteria are transferred person to person by contaminated water and food. The sources causing diseases with these bacteria in human beings is water which was contaminated with human secretes. Pathogenic have been estimated to cause more than two million deaths and four billion cases of diarrhea annually. Every year 1.1 million people are estimated to die from shigella infection, and 580,000 cases of shigelloses are reported among travelers from industrialized countries (Hamidullah et al., 2008 and El-Sanafawy et al., 2010). BOD and COD are indicators indicate the quantity of oxygen in the water which is related to the content of organic matter in the water (Kustiasih, 2011). BOD and COD levels must be carried out to determine the level of pollution that occurs and is used as a quality standard for wastewater (Andika et al. 2020). In general, high BOD and COD levels can have a negative impact on the environment (Soukotta et al. 2019).

One of the most polluted drains in Egypt is Bahr El-Baqar drain (Abdel-Shafy and Aly, 2002). Bahr El-Baqar is located in the eastern part of the Nile Delta and runs for about 170 km from Cairo to Lake Manzala. The main drain collects water from the two secondary drains of Bilbeis and Qalyubya, which collect untreated wastewater from the two drains of Gabal El Asfar and Shebeen (DRI, 2005). The discharge of industrial, agricultural and municipal wastewaters in Bahr El-Baqar, Bilbeis and Qalyubya drain led to contamination of soils, which irrigated by water of this drains. The present study concentrates on the water quality of these drains in Eastern Delta for agricultural irrigation, to assessment pollution degree of this type of water compared to the international levels.

2. Materials and Methods

Eleven locations in Eastern delta, Egypt in El-Qalyubia, El- Sharkia and Ismailia governorate, between 30° 15′ 0.41″ and 30° 35′ 18.14″ N latitude and 31°13′ 50.14″and 31°38′ 22.55″ E longitude, starting from Qaha and El-Khanka towards Mediterranean Sea, in two directions then collected in the Bahr El-Baqar drain as shown in Table (1). Length is about 60 and 70 km long for Bilbeis and El-Qalyubia drain respectively, they are parallel at a distance of about 20 km.

Water samples were collected from El-Qalyubia, Bilbies and Bahr El-Baqar drains, which are located in East Eastern Delta, Egypt to evaluate water quality for use in agricultural irrigation. Samples were collected from the beginning, middle and end of each drain. The samples were stored in plastic bottles and filtrated using filter paper No.1 then analyzed immediately after arrival to the laboratory for heavy metals (Ni, Co, Cd and Pb), chemical analysis, nitrate and ammonia determinations. Microbial analysis of saprophytic bacteria (at 22 ^{o}C), parasitic group (at 37 ^{o}C) and *Salmonella & Shigella* were counted.

Table (1): The locations of the studied drains.

Drains		Latitude	Longitude
El-Qalyubia drain	First branch	30° 18′ 57.26″	31°13′ 50.14″
	Second branch	30° 30′ 28.50″	31°25′ 32.32″
	Third branch	30° 31′ 28.40″	31°29′ 33.16″
	Fourth branch	30° 33′ 19.39″	31°36′ 0.73″
End El-Qalyubia drain		30° 33′ 37.23″	31°36′ 11.04″
Bilbies drain	First branch	30° 15′ 0.41″	31°20′ 47.64″
	Second branch	30° 18′ 47.04″	31°22′ 12.74″
	Third branch	30° 25′ 47.84″	31°34′ 16.42″
	Fourth branch	30° 31′ 30.19″	31°36′ 30.74″
End Bilbies drain		30° 33′ 40.15″	31°36′ 6.01″
Bahr El-Baqar drain		30° 35′ 18.14″	31°38′ 22.55″

Chemical analysis: EC, SAR, adj.SAR and pH were determined as described by (Rowell 1994).

Sodium adsorption ratio (SAR): Sodium adsorption ratio is a measure of the sodicity of the water. The SAR was calculated using the following equation: $SAR = Na^+ / ([Ca^{2+} + Mg^{2+}]/2)^{1/2}$ (USDA, 1954).

Adjusted sodium adsorption ratio: The adj.SAR was calculated using the following equation: $adj.SAR = Na^+ / ([Ca^{2+} + Mg^{2+}]/2)^{1/2} (1+(8.4\text{-}pHc))$ (USDA, 1954).

Residual sodium carbonate (RSC): Increase carbonate and bicarbonate ions over calcium and magnesium ions lead to presence of sodium carbonate, its ion is higher than calcium ions which is considered undesirable, because after evaporation leads to sodicity. The equation is as follows: $RSC = (CO^{2-}_3 + HCO^-_3) - (Ca^{2+} + Mg^{2+})$ (USDA, 1954).

Heavy metals analysis: Soluble heavy metals (Ni, Co, Cd and Pb) were determined using the standard method described by American Public Health Association (APHA, 1971). The collected water samples were filtered and evacuated under vacuum in a water path until analysis. The residues were socked with 10 ml of Aquai regia then digested and analyzed using Atomic Adsorption Spectrophotometer Penkin Elmer 3300.

Nitrate analysis: Nitrate and ammoniacal nitrogen in water samples were analyzed using Kjeldahl method (Cottenie et al., 1982).

Biological oxygen demand (BOD): is the amount of oxygen used over five days period by microorganisms as they decomposed the organic matter at a temperature of 20ºC (68ºF), BOD was determined according to the method described by American Public Health Association (APHA, 1992).

Chemical oxygen demand (COD): is the amount of oxygen required to oxidize the organic matter by the use of dichromate in acid solution and convert it to carbon dioxide and water. COD was determined by using closed reflex colorimetric method according to APHA (1992).

Bacterial analysis:

1- SS agar medium was used for detecting Salmonella and Shigella. It consists of beef extract, 5.0 g; peptone, 5.0 g; lactose, 10g; bile salts, 5.5g; sodium citrate, 10g; sodium thiosulfate, 8.5g; ferric citrate, 1.0g; brilliant grain, 0.033g; neutral red, 0.25g; agar, 15g. The media were suspended in 1L of distilled water, boiled with frequent agitation to dissolve agar, cooled to about 50ºC and distributed in test tubes, then sterilized by autoclaving.
2- Plate count agar was used to determine saprophytic bacteria (at 22 ºC) and parasitic group (at 37 ºC) by APHA (1980). The medium composed of yeast extract, 2.5g; tryptone, 5g; glucose, 1g; agar, 20 g; distilled water, 1L.

3. Results and discussion

Chemical characteristics:

Cations and anions of the studied wastewater drains. The concentrations of Na, K, Ca, and Mg ions ranged from 5.01 to 18.54; 0.6 to 1.16; 2.07 to 4.42 and 1.25 to 4.43 meq/l, respectively, while anions were 5.48 to 18.24; 0;0.4to 2.1 and 2.92 to6.91 meq/l for Cl, CO3, HCO_3 and SO_4 ions drain, respectively. Bahr El-Baqar drain showed the highest value of Mg^{++} (4.43) and $SO4^{=}$ (5.45) ions.

Water pH:

The normal pH for irrigation water is range from 6.5 to 8.4. The values of pH outside the normal range in irrigation water may cause a nutritional imbalance or may contain a toxic ion **(FAO, 1985)**. Table (2) shows that pH of water is within the acceptable range in all sites, as there was no much variations.

Water salinity and sodicity:

Data in Table (2) revealed that the salinity (EC dS/m), sodicity (SAR) values of the studied drains water samples ranged from 0.98 to 2.53 dS/m and 3.27 to 9.64, respectively in all studied locations. The lowest were in Second and third branch of El-Qalyubia drain and the highest was in fourth branch of Bilbies drain. The highest SAR was in fourth branch of Bilbies drain (9.64) and the lowest SAR were in fourth branch of El-Qalyubia drain (3.27) respectively. Therefore, since such values are < 10, this indicates little restriction on the use of this water in irrigation (USDA, 1954).

The concentrations of salinity and sodicity in the studied drains water were mostly considered slight to moderate according to international guideline concentrations mentioned by FAO/RNEA (1993) which are EC_w, 0.7 - 3 dS/m and SAR, 3 - 9 %. Water in Bahr El-Baqar, Bilbies and El-Qalyubia drains is considered normal waters (C-1) and can be used for irrigation with most crops on most soils with little possible that soil salinity to increase (Abdel-Fattah and Helmy, 2015). According to USDA (1954) three drains waters could be used safely for irrigation purposes where residual sodium carbonate RSC values are less than 1.25.

According to USDA diagram, the studied samples of all studied drains are in class C_3S_1, classification C_3S_1 Class water is high saline and low sodium content according to U.S. Salinity Laboratory (1954). This water can be used with restricted drainage, special management for salinity control may be required, and salt tolerant plants must be selected. Therefore, such water is considered slightly dangerous for irrigation purposes.

Table (2): The chemical characteristics; salinity, SAR, Adj.SAR, RSC and pH of Bahr El-Baqar, Bilbies and El-Qalyubia drains water.,

Drains		ECe	Cations meq / L				Anions meq / L				SAR	Adj. SAR	pH	RSC
		dS/m	Na^+	K^+	Ca^{++}	Mg^{++}	$CO_3^{=}$	HCO_3^-	Cl^-	$SO4^{=}$				
El-Qalyubia drain	First branch	1.17	6.20	0.79	3.17	1.25	0	2.0	5.76	3.65	4.17	6.67	6.89	-2.42
	Second branch	0.98	5.40	0.64	2.07	1.67	0	1.3	5.48	3.00	3.95	5.93	6.89	-2.44
	Third branch	0.98	5.12	0.64	2.87	1.32	0	1.3	5.48	3.17	3.54	5.31	6.85	-2.89
	Fourth branch	1.06	5.01	0.66	3.00	1.70	0	1.4	6.05	2.92	3.27	5.56	6.78	-3.30
End El-Qalyubia drain		1.12	5.80	0.75	2.76	2.00	0	1.2	6.05	4.06	3.76	6.02	6.81	-3.56
Bilbies drain	First branch	1.30	7.53	0.60	3.04	2.10	0	0.4	5.95	6.91	4.70	4.7	7.8	-4.74
	Second branch	1.31	7.20	0.62	3.10	2.60	0	1.2	6.72	5.60	4.27	6.41	7.35	-4.50
	Third branch	1.33	7.50	0.68	2.80	2.30	0	1.1	8.06	4.12	4.70	6.11	7.83	-4.00
	Fourth branch	2.53	18.54	1.16	4.42	2.98	0	2.1	18.24	6.75	9.64	18.32	7.86	-5.30
End Bilbies		1.28	6.40	0.68	3.36	2.25	0	1.1	6.14	5.45	3.82	6.11	6.7	-4.51
Bahr El-Baqar		1.30	9.40	0.68	3.73	4.43	0	1.2	5.76	11.28	4.65	7.91	6.73	-6.96

SAR sodium adsorption ratio, RSC residual sodium carbonate

Nitrate and ammonia:

Drainage water nitrogen are mainly in the form of nitrate but may also in the form of ammonium because although ammonium readily adsorbed by the colloids is rapidly oxidized into nitrates. Concentration of NO^{-}_{3}-N in drain waters of studied area (Table, 3) was more than the NH^{+}_{4}-N. Duxbury and Peverly (1978); Antar (2005) and Ramadan et al. (2009) showed that the concentration of NH^{+}_{4}-N in drainage water was less than the NO^{-}_{3}-N. Nitrate and ammonia concentrations of sewage water samples collected from studied drains (Table,3) varied in a relatively wide range. Whereas the concentrations of NO^{-}_{3} and NH^{+}_{4} were from 28.98 to 54.74 and 3.22 to 28.98 ppm, respectively. Nitrate nitrogen concentrations in Eastern delta drains, Egypt exceed the U. S. Environmental Protection Agency (1991) maximum contaminant level for drinking water of 10 ppm. Nitrate (ppm) concentrations (Table,3) in El-Qalyubia drain, first branch (54.74 ppm) were higher than other drains. On the contrary NH^{+}_{4} 28.98 ppm, in fourth branch of Bilbies drain were the highest. This might be due to the pollution with the drainage water of the fields, industrial and sanitary in El-Qalyubia, El- Sharkia and Ismailia Governorates.

Nutrients (N, P and K):

Data in Table 3 revealed that the total N ranged 32.2 to 64.4 ppm in end and third, fourth branch of Bilbies drain respectively. Phosphors varied from 3.65 to 4.51 ppm in third branch of Bilbies and El-Qalyubia drains, while potassium varied from 23.4 to 45.24 ppm in first and fourth branch of Bilbies drain, respectively. The sewage water can be used as alternative to freshwater irrigation and as a source of fertilizers, since it has high contents of both organic matter and nutrients (N, P and K), so suggesting using sewage water as a low-grade cheap fertilizer in agriculture which can markedly reduce the cost due to substitution of chemical fertilizers (Weggler-Beaton et al., 2000 and Kharche et al., 2011). Based on more detailed guidelines which were given by Ayers and Westcot, (1994) the concentrations of nitrogen species like ammonium and nitrate, phosphate-phosphorus and potassium are outside the limits for irrigation water.

Table (3): The ammonia, nitrate, phosphors, and potassium of Bahr El-Baqar, Bilbies and El-Qalyubia drains water.

Darins		N (ppm)	NH_3 (ppm)	NO_3 (ppm)	P (ppm)	K (ppm)
El-Qalyubia drain	First branch	62.79	8.05	54.74	4.00	30.81
	Second branch	41.86	6.44	35.42	4.36	24.96
	Third branch	38.64	3.22	35.42	4.51	24.96
	Fourth branch	41.86	6.44	35.42	4.30	25.74
End El-Qalyubia drain		41.86	9.66	32.20	4.28	29.25
Bilbies drain	First branch	54.74	12.88	41.86	4.01	23.40
	Second branch	48.30	14.49	33.81	3.76	24.18
	Third branch	64.40	25.76	38.64	3.65	26.52
	Fourth branch	64.40	28.98	35.42	3.84	45.24
End Bilbies drain		32.20	3.22	28.98	4.40	26.52
Bahr El-Baqar drain		35.42	3.32	32.20	4.22	26.52

Heavy metals

Heavy metals concentrations in wastewater of the studied drains varied from one metal to another, and also from one drain to another. The estimated heavy metals of Ni, Co, Cd and Pb in the wastewater of the studied drains (Table 4). Their concentrations ranged from 0.07 to 0.18, 0.07 to 0.59, < 0.1 to < 0.2 and 0.1 to <1.5 ppm respectively. Therefore, these concentrations were below the recommended maximum concentrations of trace elements in irrigation water (FAO, 2017), except Co and Cd in all studied drains sewage water that exceeded the permissible levels of 0.2, 0.05, 0.01 and 5.0 ppm, respectively. The use of these wastewater without good treatment makes these toxic elements accumulated in soil with time (AbdEl-Fattah and Helmy 2015), leading to increase of their concentrations in soils and plants and therefore, inter into the food chain causing dangerous complications to man and another biota. These toxic metals may cause kidney and liver failure, anemia, cancer, in addition to chromosomal aberrations (El-Sanafawy et al., 2010).

Table (4): Average of heavy metal concentrations (ppm) of El-Qalyubia, Bilbies and Bahr El-Baqar drains water.

Darins		Ni	Co	Cd	Pb
El-Qalyubia drain	First branch	0.075	<0.2	<0.1	<1.5
	Second branch	0.100	<0.071	<0.1	<1.5
	Third branch	0.150	<0.09	<0.1	<1.5
	Fourth branch	0.1606	<0.071	<0.1	<0.17
End El-Qalyubia drain		<0.2	<0.2	<0.1	<1.5
Bilbies drain	First branch	<0.2	<0.2	<0.1	<1.5
	Second branch	0.12	0.102	0.1	0.1
	Third branch	<0.089	0.591	<0.2	<0.2
	Fourth branch	0.1	0.3	<0.2	<0.2
End Bilbies drain		0.18	<0.2	<0.1	<1.5
Bahr El-Baqar drain		0.14	<0.2	<0.1	<1.5

BOD and COD levels:

BOD and COD levels have been used as indicators for water body pollution. The studied drains wastewater moderately high levels of BOD and COD (Table 5). The highest BOD and COD levels were recorded in third branch of El-Qalyubia (220 ppm) and Bilbies (262 ppm) drains, respectively. The samples of End Bilbies and El-Qalyubia drains exhibited the lowest levels (70 and 118 ppm) respectively.

BOD is a measure of dissolved oxygen consumed by the microorganisms to stabilize any degradable organic material (Abd-El-Hamid, 2009). COD test is useful in identifying toxic condition and presence of biological resistant substances. The COD is a test which is used to measure pollution of domestic and industrial waste (Nelius et al., 2021). The standard COD level is 20 mg/l (FAO, 1992). The standard BOD and COD level is < 30 and < 120 ppm respectively (Danone 2015). The BOD and COD of the present study are high, this may be due to the industrial, domestic and sewage effluents which discharged in these drains, without any pre-treatment (El-Sanafawy et al., 2010). The water of these drains must take more interest for good treatment before used in irrigation.

Table (5): BOD and COD levels of El-Qalyubia, Bilbies and Bahr El-Baqar drains water.

Darins		BOD (ppm)	COD (ppm)
El-Qalyubia drain	First branch	190	215
	Second branch	165	274
	Third branch	220	220
	Fourth branch	200	252
End El-Qalyubia drain		170	118
Bilbies drain	First branch	200	120
	Second branch	110	140
	Third branch	100	262
	Fourth branch	100	120
End Bilbies drain		70	160
Bahr El-Baqar drain		80	180

Pathogen:

Some pathogens were determined in wastewater samples collected from polluted drains contains mixture of sewage water, industrial effluents and agricultural drainage water in East Delta region (Table 6). The results showed a huge number of pathogens (Parasitic group (at 37 ºC), Saprophytic bacteria (at 22 ºC), *Salmonella* sp. and *Shigella* sp.). Most of these estimated numbers exceeded the permissible counts. The highest number of *Parasitic* groups was detected in effluent wastewater of fourth branch of bilbies drain followed by sample of Bahr El-Baqar drain, while the lowest counts were recorded in end Bilbies drain wastewater (4 x10^6 cell/ml). On the other hand, *Saprophytic* bacteria counts ranged from 1 x10^6 cell/ml for water sample end Bilbies drain to 205 x10^7 cell/ml for Bahr El-Baqar drain. *Salmonella* sp. and *Shigella* sp. counts were not detected in Second branch of bilbies drain, while fourth branch of bilbies drain gave the highest 2 x10^3 cell/ml followed by sample of Fourth branch of El-Qalyubia drain 10 x10^3 cell/ml. The water sample of Second branch of El-Qalyubia drain recorded the lowest count of 100 cell/ml. WHO (1997) showed that the permissible counts of *Salmonella* sp. and *Shigella* sp. in wastewater used in agriculture were 7000 and 7000 cells/100ml, respectively.

Abd El-Aal (2002) estimated *Salmonella* sp. and *Shigella* sp. in Kafr-El-Sheikh plant were up to 1.1x10^9 and 3.5x10^6 cell/ml for untreated and treated sewage respectively. And she estimated saprophytic bacteria (at 22 ºC) and parasitic group (at 37 ºC) main value were 2.6x10^{10} and 2.78x10^{10} cell/ml for untreated sewage sample compared to 3.75x10^6 and 3.25x10^7 cell /ml for treated sample respectively. FAO (2003) report indicated that the temperature range of 20-30 ºC for nearly all excreted pathogens can survive in water, soil, and crops for a sufficient length of time to pose potential risks to farm and pond workers. These huge microbial concentrations may be due to the absence of enough sanitation for these waste waters. So, these waters must obtain better treatment to get rid from all pathogenic microbes in order to be safe before use El-Sanafawy et al. 2010).

Table (6): Counts of saprophytic bacteria (at 22 ºC), parasitic group (at 37 ºC) and salmonella & shigella (cell/ml) in sewage samples of Bahr El-Baqar, Bilbies and El-Qalyubia drains.

Drains		Salmonella & shigella (cell/ml)	Parasitic group at 37 ºC (Cell/ml)	Saprophytic goup at 22 ºC (Cell/ml)
El-Qalyubia drain	First branch	2 x10^3	22 x10^6	27 x10^6
	Second branch	100	6 x10^6	34 x10^6
	Third branch	2 x10^3	3 x10^8	4 x10^7
	Fourth branch	10 x10^3	1 x10^8	30 x10^7

End El-Qalyubia drain		2 x10^{3}	17 x10^{7}	168 x10^{7}
Bilbies drain	First branch	1 x10^{3}	7 x10^{8}	2 x10^{7}
	Second branch	0	1 x10^{8}	3 x10^{8}
	Third branch	1 x10^{3}	54 x10^{7}	2 x10^{7}
	Fourth branch	2 x10^{4}	20 x10^{8}	126 x10^{7}
End Bilbies drain		2 x10^{2}	4 x10^{6}	1 x10^{6}
Bahr El-Baqar drain		2 x10^{3}	15 x10^{8}	205 x10^{7}

4. Conclusion

The wastewater of Bahr El-Baqar drain, Bilbies and El-Qalyubia drains are considered slight to moderate according to international guideline concentrations mentioned by FAO/RNEA (1993) and could be used on soils with some precautions. As, special management for salinity control may be required, adequate drainage and plants with good tolerance should be selected.

Heavy metals contents revealed lower concentrations blow maximum permissible levels except for Co and Cd. Saprophytic, Parasitic and *Salmonella* sp. and *Shigella* sp. showed huge numbers in these wastewaters except for *Salmonella* sp. and *Shigella* sp in second branch of Bilbies drain not detected. Therefore, these drains of wastewater could not use in irrigation till subjected to secondary treatment.

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الملخص العربي

رصد بعض الملوثات الكيميائية والبيولوجية فى المياه العادمة لمصارف بحر البقر، القليوبية وبلبيس في شرق الدلتا - مصر لاستخدامها في أغراض الري

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مصارف القليوبية وبلبيس وبحر البقر من اهم المصارف الموجودة بمنطقة شرق الدلتا التي تستخدم في صرف مياه المجاري و/أو الصرف الصناعي والزراعي مما يجعلها شديدة التلوث أحيانا, و نظرا لقلة مياه الري بهذه المنطقة غالبا ما تستخدم هذه المياة في ري المزروعات المختلفة بما تحويه من ملوثات عدة منها ملوثات كيماوية , اخطرها العناصر الثقيلة و اخرى بيولوجية مثل بكتريا االسلمونيلا. هذه الدراسة ركزت على عمل رصد لهذه الملوثات الموجودة في مياه مصارف القليوبية وبلبيس وبحر البقر للوقوف على درجة تلوث هذه المياة العادمة مقارنة بالمعايير الدولية لتحديد مدى صلاحية التعامل البشري مع هذه المياة و استخدامها في ري المحاصيل الزراعية.

تم تقدير تركيزات أخطر العناصر الثقيلة مثل النيكل والكوبلت و الكادميوم وكذلك الرصاص و أيضا تم عد بعض الكائنات الممرضة مثل السالمونيلا و الشيجيلا و الممرضات والمترممات, مع تقدير النيترات, الامونيا ,COD, EC, SAR, RSC. Adj.SAR, ,NPK, BOD. هذه القياسات تعتبر دليل لعدم صلاحية هذه المياة ان وجدة بتركيزات تفوق المسموح بها دوليا.

أوضحت النتائج المتحصل عليها أن هذه المياه واقعة ضمن فئة C3S1 وهي مياه عالية **في** الملوحة ومنخفضة في الصودية وذلك طبقا لتقسيم معمل الملوحة الامريكي فئة C3S1 . وتوضح النتائج أن قيم الملوحة في عينات مياه الصرف المدروسة تتراوح من 0.98إلي 2.53 ديسيسمنز /المتر وSAR من 3.27 إلي 9.64% وهي تقع في القسمين (C3 -S1 ; C4-S2) تبعا لتقسيم معمل الملوحة الأمريكي لصلاحية مياه الري. والنتائج توضح زيادة كبيرة في تركيز النترات في مياه المصارف المدروسة تفوق بكثير الحدود المسموح بها (10جزء في المليون) تبعا للوكالة الدولية لحماية البيئة حيث تراوحت تركيز النترات من 28.78 إلي 54.74 جزء في المليون.

تراوحت تركيزات العناصر الثقيلة (بالجزء بالمليون) من 0.07الي 0.18 للنيكل و من 0.07 الى 0.59 للكوبلت ومن اقل من 0.1 الى اقل من 0.2 للكادميوم كما أظهرت التقديرات تركيزات من 0.1 الى اقل من 1.5 للرصاص. كانت تركيزات كل العناصر الثقيلة قيد الدراسة بمياه الثلاث مصارف بالمعدلات المسموح بها ماعدا عنصري الكادميوم والكوبلت الذان وجدان أعلى من اقصى معدل مسموح به لمنظمة الفاو.

كما سجلت النتائج أعداد كبيرة من والسلمونيلا والشيجيلا و الممرضات والمترممات و التي وجدت بمعظم المصارف محل الدراسة وفاقت هذه التقديرات الأعداد المسموح بها ما عدا والسلمونيلا والشيجيلا في القرع الثاني لمصرف بلبيس لم توجد. كذلك أعطت تقديرات BOD و COD أرقاما مرتفعة ومتفاوتة , تراوحت تركيزات BOD من 70 لعينة نهاية مصرف بلبيس الى 220 لعينة الفرع الثالث لمصرف القليوبية. بينما تراوحت تركيزات COD من 118 لعينة نهاية مصرف القليوبية الى 262 لعينة الفرع الثالث لمصرف بلبيس.

من خلال نتائج هذه الدراسة يمكن الاشارة الى أن هذه المياه ملوثة وهى شديدة الخطورة على الانسان والبيئة عند استعمالها بهذه الصورة، ويجب معالجتها معالجة جيدة قبل استعمالها.