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Indices drinking water quality in four centers Qalyubia Governorate, Egypt

Emad, A. Sultan[1]; Rasha M. El-Meihy[2]; Hany M. Abdelrahman[2]; Rashed A. Zaghloul[2]

[1]Qalyubia Drinking Water Company, Benha, Qalyubia, Egypt.
[2]Department Agricultural Microbiology, Faculty Agriculture, Benha University, Moshtohor, Qalyubia, 13736, Egypt.

Corresponding author: rashaelmehy@fagr.bu.edu.eg

Abstract

This study was carried out four main centers in Qalyubia Governorate, Egypt namely Benha, Kafr Shukr, Toukh Qalyub before after treatment process drinking water. Each the four main sites included subsites along the distribution system namely Benha (Mit Asem Benha), Kafr Shukr (Isnit Kafr Shukr), Toukh (Toukh, Al Deir Qaha), Qalyub (Qalama Qalyub). Physical bacteriological examinations were carried out in both main subsites during winter summer 2017-2016. Turbidity pH values were ranged between (1.16-2.60) NTU (7.27-7.87) during two seasons after treatment process, respectively. Additionally, lower values electric conductivity (EC) Total hardness (T.H.) were recorded after treatment than before, the lowest values were observed in Qalyub Benha during summer, respectively. Moreover, total solids (dissolved TDS suspended TSS) values were in permissible limits indicate the efficiency treatment process. Respecting the changes in total bacterial counts in all main subsites under study, higher counts bacteria were observed in samples incubated 37℃ than 22℃ with highest count in Qalyub Toukh, respectively. While Salmonella fecal streptococci counts were reduced with considerable numbers after treatment than before most subsites didn't record any counts Salmonella during winter. The most prevalence bacteria were isolated testing their susceptibility against antibiotics found one them was multiple antibiotics resistant which finally identified by 16sDNA gene sequencing as Salmonella enterica. Various chlorine concentrations found be efficient against S. enterica 7.0 ppm was the best with save residual chlorine concentration.

Keywords: drinking water, bacteriological, physical, treatment process, chlorination, antibiotic susceptibility.

Introduction

Availability a safe clean water source is one the most important foundations establishing healthy communities, then reconstruction development **(El-Kowrany *et al*., 2016)**. Water quality is a matter global concern, based which water is classified into drinking water, water used in agriculture, or water used in industry **(Sargaonkar Deshpande, 2003)**. Water in nature is not pure enough make it drinkable because it acquires pollutants from the surrounding environment, so the right balance in the sensory, chemical, physical bacteriological qualities water makes it drinkable **(Hassanein *et al*., 2011)**. the other hand, drinking water is a major source microbial pathogens, especially those transmitted through the digestive system due its wastewater discharge, which causes the death many people annually (Alarousy et al., 2018). The better-known waterborne bacteria concern are *Salmonella* spp., *E. coli* Streptococci besides many opportunistic bacteria **(Ashbolt, 2004)**. It is easy purify water eliminate all microbial pathogens by chlorination, but the most serious problem is the re-contamination treated water during its transportation within water distribution systems (DWDSs) **(Ashbolt, 2015)**. Generally, water is susceptible contamination with microorganisms, among them the presence *E. coli* *Enterobacter* sp. in water is a likely indicator the presence pathogenic organisms such as *Salmonella* spp. **(Onyango *et al*., 2018).**

Qalyubia is one the ten Nile Delta governorates that contains eight centers included many cities villages. Its main water resources are the surface water, which the river Nile is the most important one **(EWQS, 2007).** Generally, the river Nile in Egypt is considered the lifeline, which represents the main source fresh water necessary most the water requirements, but it is exposed many sources pollution that represent a real threat obtaining a healthy safe water source **(Ali *et al*., 2014).**

Hence, this study was designed assess the suitability drinking water human use in four centers in Qalyubia Governorate via physical bacteriological examination samples before after treatment during two seasons (winter summer). Moreover, isolate the most abundant pathogens, then estimate their antibiotics-susceptibility finally, identify evaluate chlorination process against these pathogens.

Materials methods

This study was carried out assess drinking water in four centers Qalyubia Government, Egypt (latitude 30.3541° north longitude 31.201° east) during summer winter (2016 - 2017).

Source water samples

Drinking water samples were gathered from four main sites (before after treatment) namely Benha, Kafr Shukr, Toukh Qalyub included nine sub-sites (after treatment) from distribution net namely Mit Asem, Benha, Isnit, Kafr Shukr, Toumkh, Al Deir, Qaha, Qalama, Qalyub **(Fig. 1)**.

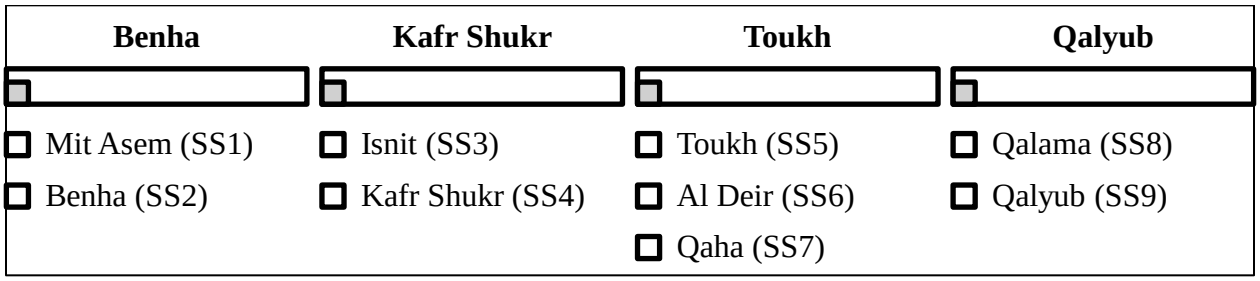

Figure 1. Main sub-sites under study.

Sampling

Samples were collected according the standard methods water wastewater examination **(APHA, 2005)** in sterilized plastic bottles (250 ml) transported in ice box, then kept 5℃ further examinations. The microbiological examination was conducted during the first 18 hours from sampling. One ml sodium thiosulphate solution (10%) was added 120 ml each sample that represent the chlorinated drinking water (sublocations samples).

- Before treatment samples were collected directly from the river Nile the station inlet 1.0 km from the Nile after removal suspended matter in main four sites.
- After treatment samples were collected from nine sub-sites belonging the main sites, within the distribution system in the government.

Examinations

Physical, microbiological analyses were performed according the standard methods examination water wastewater suggested by American Public Health Association **(APHA, 2005)**.

In situ parameters (at the same place time sampling)

Turbidity values (NTU) were determined using EPA 180.1 method by nephelometry. pH values were measured using EPA method 9040C pH electrometric measurement. Electric conductivity (E.C.) (µS/cm) was estimated using EPA Method 120.1: Conductance (Specific Conductance, µmhos 25°C) by conductivity meter.

Physical parameters

Total dissolved solids (T.D.S.) total suspended solids (T.S.S.) were measured together gravimetrically using EPA method 160.1. The water sample was filtered through 2.0 µm filter then evaporated drying in an oven 180ºC finally weighed recorded as mg/L. Total hardness (T.H.) is the sum cations concentrations, it measured by using EPA method 130.2: Hardness (Titrimetric, EDTA) expressed as mg/L $CaCO_3$.

Microbiological indicators

Collected drinking water samples were subjected microbiological analyses count total bacteria 22°C 37°C using tryptone glucose yeast agar. Furthermore, fecal streptococci *Salmonella* sp. were detected azide dextrose agar medium bismuth sulfite agar medium amended with 50 units/ml mycostatin, respectively. After incubation 37ºC 24-48 h, colonies showing red pink color were counted, isolated as fecal streptococci bacteria. While colonies producing diffusible black pigment with or without metallic sheen were counted isolated as salmonella.

Antibiotics susceptibility test

The recovered colonies both azide dextrose agar bismuth sulfite agar media were tested their susceptibility various antibiotics namely Ceftazidime, Cefaclor, Gentamicin, Imipenem, Nalidxic acid, Nitrofurantion, Levofloxacin, Cefotaxime, Ampicillin, Cefadroxil, Aztreonam, Clindamycin, Ampicillin, Cefoxitin, Cefamandole, Ceftriaxone, Trimethoprim, Amikacin, Norfloxacin using the standard Kirby-Bauer disk diffusion method **(Bauer *et al*., 1966).** The resulted interpreted according protocols standardized the assay antibiotic compounds as guided by National Committee Clinical Laboratory Standards "NCCLS", then categorized as: R (resistant), S (sensitive) **(NCCLS, 2007).**

Identification the most antibiotics-resistant isolate

The most antibiotics-resistant isolate was selected identification by 16SrDNA gene sequencing according **(Khedr *et al*., 2017)**. The resulted sequence was aligned with other identified strains in the Gene bank database using an online BLAST tool determine the similarity score (http://www.blast.ncbi.nlm.nih.gov/Blast). The phylogenetic tree with the more related bacterial strains BLAST NCBI was constructed using the MEGA-X program the neighbor-joining method.

Chlorination

Effect chlorine concentrations *Salmonella enterica* was achieved by growing *S. enterica* 37℃ 24h in TSB then centrifuged 8000xg 20 min., the formed pellet was washed twice with sterilized distilled water. Then, the pellet was resuspended in 10 ml sterilized distilled water directly counted. After that, various chloride concentrations (2.0, 3.0, 4.0, 5.0, 6.0, 7.0 ppm) have been added individually let 20 min then the pellets were transferred TSA incubated 37℃ 24h. Finally, the viable cells were counted estimate the chlorination effect upon the bacterial growth reduction rate as well as the residual chloride after each chloride dose 20 min contact time was carried out by N, N-diethyl-p-phenylenediamine (DPD) titration method.

Statical analysis

Analysis variation or dispersion values set was carried out by standard deviation (SD) using CoStat version 6.400 (CoHort software, Monterey, CA, 93940, USA). Mean values among treatments were presented as the mean values ± SD. A low standard deviation indicates that the values tend be close the mean (also called the expected value) the set, while a high standard deviation indicates that the values are spread out over a wider range.

Results discussion

Physical examination

Turbidity pH values ى

Turbidity is the measure fine suspended matter in water, mostly caused by colloidal particles such as clay, silt, living non-living organisms. course, it is possible estimate turbidity or transparency variable degrees depending location, efficiency distribution system, hence the turbidity was estimated before after treatment as shown in **Table (1)**. Results indicated that high turbidity values were recorded in water samples before treatment (main sites), this was realistic logic. Furthermore, treatment process caused reduction in water turbidity in all sub-sites under study. Generally, turbidity was higher during summer than winter in most main sites, this trend was reversible results by **Abdel-Satar *et al*. (2017)** who reported that transparency values were lower (turbidity was higher) during winter. Additionally, Qaha (SS7) all nine sub-sites was the most turbid site during winter followed by kafr Shukr, while during summer it was observed that Kafr Shukr was the most turbid site. Although Toukh considered from the more turbid main sites, but after treatment it observed among the least turbid sites, this due the efficiency treatment process in this plant.

Table 1. Turbidity and pH in drinking water during winter and summer seasons before and after treatment in various locations.

Main sites	Sub sites	Turbidity (NTU)				pH			
		Winter		Summer		Winter		Summer	
		Before	After	Before	After	Before	After	Before	After
Benha	SS1	11.35±0.78	1.36±0.03	12.05±0.35	1.36±0.03	7.95±0.21	7.79±0.07	8.48±0.07	7.34±0.05
	SS2		1.30±0.04		1.30±0.04		7.87±0.04		7.51±0.03
Kafr Shukr	SS3	10.55±0.21	1.33±0.58	10.70±0.28	1.33±0.58	7.75±0.21	7.32±0.20	7.55±0.35	7.38±0.08
	SS4		1.81±0.04		1.81±0.04		7.50±0.16		7.44±0.18
Toukh	SS5	10.55±0.35	1.23±0.15	11.55±0.35	1.20±0.34	7.95±0.21	7.57±0.06	8.45±0.07	7.33±0.12
	SS6		1.43±0.15		1.70±0.20		7.41±0.02		7.27±0.12
	SS7		2.60±0.43		1.13±0.30		7.27±0.16		7.35±0.06
Qalyub	SS8	10.85±0.07	1.30±0.02	10.70±0.28	1.16±0.11	7.70±0.28	7.52±0.04	7.65±0.21	7.42±0.04
	SS9		1.43±0.15		1.28±0.05		7.62±0.06		7.50±0.04

Regarding the effect treatment process pH, data presented in **Table (1)** indicated that pH values in main sites ranged between (7.70-7.95) (7.55-8.48) during winter summer, respectively. Whereas, in subsites the pH values ranged between (7.27-7.79) (7.27-7.7.51) during winter summer, respectively. Generally, the treatment process reduced the pH values in all subsites the highest value was recorded in Benha (SS2) during both winter summer whereas, the lowest value (pH 7.27) was recorded in both Al Deir (SS7) Qaha (SS6) during winter summer, respectively. Additionally, results showed that the two main sites Benha Toukh recorded higher pH values compared other main sites during two seasons. In this respect, **Soliman *et al*. (2018)** reported that pH values eight locations along Rosetta branch water, River Nile were ranged between 7.16-7.98 during four seasons. While, **El Gammal El Shazely (2008)** reported that pH values 24 sites along the Nile from Aswan Cairo ranged between (7.3-8.5) during winter between (7.6-8.3) during spring. While, during summer autumn pH values were ranged between (7.7-8.6) (7.7-9.0), respectively. Also, **Ezzat**

***et al*. (2012)** showed that pH values water samples collected from Rosetta branch in summer winter seasons were ranged from 7.45 7.9. Moreover, **Abdel-Satar *et al*. (2017)** said that pH in the Nile River was generally the alkaline side.

Electric conductivity (EC) Total hardness (T.H)

Regarding the changes in electric conductivity (EC) as a good indicator pollution in water, results indicated that EC in all sites before treatment exceed after treatment with considerable values which clearly indicated that water treatment reduced its content pollutants which already caused reduction in EC values **(Table 2)**. Additionally, EC values were higher during winter than summer in all main sites except in Toukh. After treatment, EC recorded the highest values in Qaha (SS7) Toukh (SS5) during winter summer, respectively with confirms the inefficiency the treatment process in Toukh. the other hand, the two sub-sites belonging Qalyub (Qalama Qalyub) recorded the lowest EC values during summer, while both subsites belonging Benha (Benha Mit Asem) recorded the lowest EC values after treatment during winter.

Table 2. Electric conductivity (EC) and total hardness (T.H.) changes in drinking water during winter and summer seasons before and after treatment in various locations.

Main sites	Sub sites	Electric conductivity (µS/cm)				T.H. (mg/L)			
		Winter		Summer		Winter		Summer	
		Before	After	Before	After	Before	After	Before	After
Benha	SS1	455.5±0.70	367.7±2.52	450.0±8.48	348.7±6.42	152.5±7.77	137.7±2.52	143.0±9.9	101.3±32.3
	SS2		351.7±3.51		335.7±6.50		141.7±3.06		102.7±18.8
Kafr Shukr	SS3	455.0±9.89	390.0±3.51	448.5±19.09	314.7±9.01	159.5±2.12	137.7±2.52	145.0±4.2	109.7±14.3
	SS4		396.0±3.00		308.0±7.21		132.7±2.52		113.7±14.9
	SS5		395.0±9.64		378.0±4.36		136.7±2.03		132.0±12.5
Toukh	SS6	432.0±22.6	403.7±13.2	434.5±4.95	323.0±4.58	153.5±10.63	138.0±2.00	144.5±4.9	116.0±5.13
	SS7		413.7±14.2		374.3±5.50		137.3±3.05		123.7±9.86
Qalyub	SS8	437.0±38.2	391.7±4.04	387.0±7.07	304.3±28.1	142.0±14.14	138.0±6.00	146.0±4.2	129.3±11.5
	SS9		373.3±6.11		301.3±35.4		132.7±3.06		119.3±6.11

Total hardness (T.H) is a test overall water quality, values near 150 mg/L are generally ideal human, while water less than 150 mg/L are considered soft water values greater than 200 mg/L are considered hard water. In this concern, the relation between treatment process total hardness content in water was shown in **Table (2)**. Results indicated that T.H. values in main sites before treatment were ranged between (159.5-142.0) and (146.0-143.0) during and winter summer, respectively. While in subsites the T.H. values were ranged between (141.7-132.7) (101.3-132.0) during winter summer, respectively. Moreover, T.H. values were lower during summer than winter in both cases before after treatment process. In general, water in all sites under study before or after treatment was fit human consumption.

Table 3. Total dissolved solids (TDS) and total suspended solids (TSS) in drinking water during summer and winter seasons before and after treatment in various locations.

Main sites	Sub sites	TDS (mg/L)				TSS (mg/L)			
		Winter		Summer		Winter		Summer	
		Before	After	Before	After	Before	After	Before	After
Benha	SS1	424.0±25.5	247.7±2.0	547.5±41.7	247.7±2.5	<1.0	ND	<1.0	ND
	SS2		247.7±2.5		247.7±2.5		ND		ND
Kafr Shukr	SS3	446.0±25.5	272.3±3.5	621.5±12.0	272.±3.51	<1.0	ND	<1.0	ND
	SS4		263.3±3.5		263.3±3.5		ND		ND
	SS5		392.3±4.5		276.7±11.5		ND		ND
Toukh	SS6	453.0±55.2	260.7±5.0	630.0±16.9	283.3±11.5	<1.0	ND	<1.0	ND
	SS7		281.3±3.5		290.0±5.3		ND		ND
Qalyub	SS8	436.5±30.4	262.7±5.0	578.0±49.5	273.0±8.3	<1.0	ND	<1.0	ND
	SS9		262.3±4.5		274.0±12.2		ND		ND

TDS and TSS

As TDS refers anything present in water cause water impurity, results in **Table (3)** showed the relation between TDS treatment process. Generally, TDS values in good quality water range from 0 600 mg/L while TDS over 1200 mg/L indicates water impurities. In this concern, results indicated that TDS values before or after treatment process during winter were within the safe permissible limits while in summer the TDS values in main sites exceed the permissible limits

Since the World Health Organization has set a provisional guideline a TSS value 10 µg/L in good drinking water, the results in **Table (3)** indicated that water in four main sites under study recorded less than 1.0 mg/L equivalent (1000 µg/L), while after treatment, no TSS values were recorded, which indicates the quality the treatment process in all the plants under study the suitability their water human consumption.

Microbiological examination

Regarding the correlations between the microbiological examination treatment process efficiency, the collected water samples were with small values. The highest TDS values in water before treatment were recorded in Toukh followed by Kafr Shukr, this trend was true during both seasons (winter summer). The highest TDS values in subsites were recorded in Toukh (SS5) Qaha during winter summer, respectively. While the lowest values during two seasons were recorded in both Benha subsites (Benha Mit Asem) by 247.7 mg/L. This trend results refers the efficiency treatment process in the Benha plant compared other plants under study.

microbiologically examined its content total bacterial counts 22°Cand 37°C, fecal streptococci, *Salmonella* sp. the obtained data were shown in **Tables (4 5)**.

Total bacterial counts

Generally, results indicated that the incubation water samples 37°C resulted in high growth count bacteria than incubation 22°C as similarly observed by **(Taha, 2019)**. Results also indicated that higher bacterial count was recorded in main sites before treatment compared subsites after treatment, Toukh Qalyub recorded higher bacterial counts 22 37°C during both winter summer **(Table 4)**.

Table 4. Total bacterial count (TBC) (log CFU/ml) at 22℃ and 37℃ in drinking water during summer and winter seasons before and after treatment in various locations.

Main sites	Sub sites	22℃				37℃			
		Winter		Summer		Winter		Summer	
		Before	After	Before	After	Before	After	Before	After
Benha	SS1	4.02±0.01	3.17±0.12	4.1±0.02	3.39±0.13	33.7±0.02	3.34±0.06	53.8±0.02	3.26±0.11
	SS2		3.05±0.14		3.73±0.07		3.43±9.06		3.67±0.04
Kafr Shukr	SS3	3.99±0.02	3.95±0.02	4.2±0.01	3.47±0.11	36.7±0.03	3.70±0.03	63.9±0.02	3.21±0.10
	SS4		2.26±0.24		3.64±0.10		2.23±0.40		3.10±0.05
Toukh	SS5	18.0±8.49	2.93±0.10	11.5±4.9	2.71±0.24	67.5±6.36	2.81±0.13	69.5±10.6	2.52±0.07
	SS6		2.49±0.10		2.16±0.28		2.46±0.15		2.26±0.24
	SS7		3.11±0.13		3.70±0.07		2.62±0.15		3.67±0.05
Qalyub	SS8	14.0±15.56	3.25±0.16	9.0±4.24	3.89±0.06	92.0±5.66	3.13±0.08	69.0±7.07	3.61±0.05
	SS9		3.12±0.34		3.87±0.07		2.79±0.20		3.59±0.05

While the lowest bacterial counts grown 22℃ were observed in Kafr Shukr Benha during winter summer, respectively vice versa in case bacteria grown 37℃. In case subsites, Kafr Shukr Al Deir recorded the lowest bacterial count during winter summer when samples were incubated 22℃ 37°C. The appearance bacteria high rate in drinking water refer problems in the water distribution system or storage which led contaminants entering the drinking water in several areas **(Saleh *et al*., 2001).** As well as, time temperature incubation are very significant variables, the incubation temperature lie in range 35 37℃ is very preferable growth bacteria that originated from animals human while, low incubation temperature (20-28℃) favor the growth water-based bacteria **(Allen *et al*., 2004).**

***Salmonella* and fecal Streptococci counts**

The use indicator bacteria such as faecal streptococci assessment faecal pollution possible water quality deterioration in fresh water sources is widely used **(Sabae Rabeh, 2007).** In this regard, results in **Table (5)** indicated that treatment process reduced both *Salmonella* fecal Streptococci counts in all subsites under study. It was observed that among the nine subsites under study, five sites appear free *Salmonella* during winter while the same sites recorded moderate counts during summer which indicate that the high temperature during summer was suitable bacterial growth especially human-borne pathogens. Similar results were observed by **Taha (2019)** who didn't

record any *Salmonella* counts in three target distribution regions during four seasons. the other hand, only two subsites Mit Asem (SS1) Isnit (SS3) observed free fecal Streptococci during winter, while Benha (SS2) Kafr Shukr (SS4) did not record any fecal streptococci during the summer. Additionally, Qalyub (SS9) recorded high *Salmonella* fecal Streptococci counts during both winter summer which refer an inadequate treatment process in Qalyub plant.

Table 5. *Salmonella* sp. and fecal Streptococci counts (log CFU/ml) in drinking water during summer and winter seasons before and after treatment in various locations.

Main sites	Sub sites	*Salmonella* sp.				fecal Streptococci			
		Winter		Summer		Winter		Summer	
		Before	After	Before	After	Before	After	Before	After
Benha	SS1	2.62±1.33	Nil	2.88±1.66	Nil	3.77±1.33	Nil	2.79±0.2	1.80±0.2
	SS2		Nil		1.87±0.1		1.87±0.2		Nil
Kafr Shukr	SS3	2.80±0.17	1.80±0.2	2.69±0.21	1.87±0.1	3.80±0.17	Nil	3.28±0.1	1.93±0.1
	SS4		Nil		1.93±0.1		2.00±0.0		Nil
Toukh	SS5	2.66±0.71	1.73±0.2	2.44±0.66	1.43±0.1	4.50±0.71	1.80±0.2	3.80±1.6	1.87±0.1
	SS6		Nil		1.50±0.1		1.87±0.1		1.87±0.1
	SS7		1.63±0.1		1.33±0.2		1.87±0.1		1.93±0.1
Qalyub	SS8	2.44±1.15	Nil	2.50±0.71	1.93±0.1	3.65±0.28	2.92±0.2	3.50±0.7	1.87±0.1
	SS9		1.87±0.1		1.87±0.1		2.40±0.2		2.16±0.3

Similar results by **Ezzat *et al*. (2014)** were confirmed the obtained results reported that fecal streptococci counts in Rosetta branch were ranged between (0.8-1.1)10^5 CFU/100 ml. Furthermore, **Abo-State *et al*. (2014)** found that the fecal streptococci count in eleven sites Rosetta branch ranged between (10 -7.0 x10^4 CFU/ml) during four seasons. Generally, sites in Rosetta branch exceeding 1000 CFU/100 ml were reported out international standard limits **(Abdo, 2013).** Also, **Soliman *et al*. (2018)** observed lower higher numbers fecal streptococci in eight locations along Rosetta branch during winter summer, respectively.

Isolation antibiotic susceptibility test the most prevalence pathogens in sites under study

The recovered colonies both azide dextrose agar bismuth sulfite agar media were isolated, purified then tested their susceptibility 19 antibiotics **(Table 6)**. Data indicated that colony (1) which recovered azide dextrose agar was resistant only four antibiotics sensitive others. the other hand, colony (2) which recovered bismuth sulfite agar medium appear its sensitivity only two antibiotics resistant 17 ones. Hence, colony (2) was selected identification as the most antibiotics-resistant isolate.

Table 6. Antibiotics susceptibility of two Gram-positive and Gram-negative bacteria isolated from drinking water treatment plant

	Ceftazidime	Cefaclor	Gentamicin	Imipenem	Nalidxic acid	Nitrofurantion	Levofloxacin	Cefotaxime	Ampicillin (1)	Cefadroxil	Aztreonam	Clindamycin	Ampicillin (2)	Cefoxitin	Cefamandole	Ceftriaxone	Trimethoprim	Amikacin	Norfloxacin
Isolate (1)	R	R	S	S	S	S	S	R	S	S	S	S	S	R	S	S	S	S	S
Isolate (2)	R	R	R	R	R	R	R	R	S	R	R	R	R	S	R	R	R	R	R

R: resistant ; S: sensitive ((Diameter of inhibition > 7 mm)

Isolate (1): recovered on azide dextrose agar medium; Isolate (2) recovered on bismuth sulfite agar medium

Similar results were recorded by **Abdo (2013)** who tested the antibiotic susceptibility *Salmonella choleraesuis* isolated from Ismailia canal water, Egypt found that this strain was resistant against 13

antibiotics. The overuse abuse antibiotics, whether in humans or animals, is one the main factors responsible the spread multi-antibiotic-resistant bacteria throughout the world, which is considered a public health threat **(Gootz, 2010).** Moreover, **Heikal (2000)** recorded a gradual increase in the incidence antibiotic resistant bacteria along the river Nile. Additionally, **Lateef (2004)** found a wide presence antibiotic resistant bacteria Rosetta Nile branch. The relatively high level resistance antimicrobial agents reflects misuse abuse these agents in the environment.

Identification the most resistant bacteria antibiotics

The selected isolate was identified by 16rDNA gene sequence analysis through BLAST. The FASTA homology demonstrated high similarity the 16S rDNA gene sequence with more than 99% *Salmonella enterica* strain FDAARGOS_711 *Salmonella enterica* strain FDAARGOS_718 **(Table 7 Fig. 2)**. The phylogenetic tree with the more related bacterial strains BLAST NCBI was constructed using the MEGA-X program the neighbor-joining method ascertain their taxonomic positions. Finally, the results were confirmed by the phylogenetic position the obtained isolates.

Table 7. Query coverage for the selected isolate PCR product sequence that identified via 16S rDNA as *Salmonella enterica strain* and the most related strains

Description	Scientific Name	Max Score	Total Score	Query Cover	Per. Identification	Accession
Salmonella enterica strain FDAARGOS_711 chromosome	*Salmonella enterica*	1349	9427	100%	99.86%	CP055130.1
Salmonella enterica strain FDAARGOS_718 chromosome	*Salmonella enterica*	1349	9394	100%	99.86%	CP054901.1
Salmonella enterica strain FDAARGOS_717 chromosome	*Salmonella enterica*	1349	9342	100%	99.86%	CP054897.1
Salmonella sp. strain Enteritidis_S85_04530 16S ribosomal RNA gene, partial sequence	*Salmonella sp.*	1349	1349	100%	99.86%	MT621365.1
Salmonella sp. strain Enteritidis_S78_04484 16S ribosomal RNA gene, partial sequence	*Salmonella sp.*	1349	1349	100%	99.86%	MT621358.1

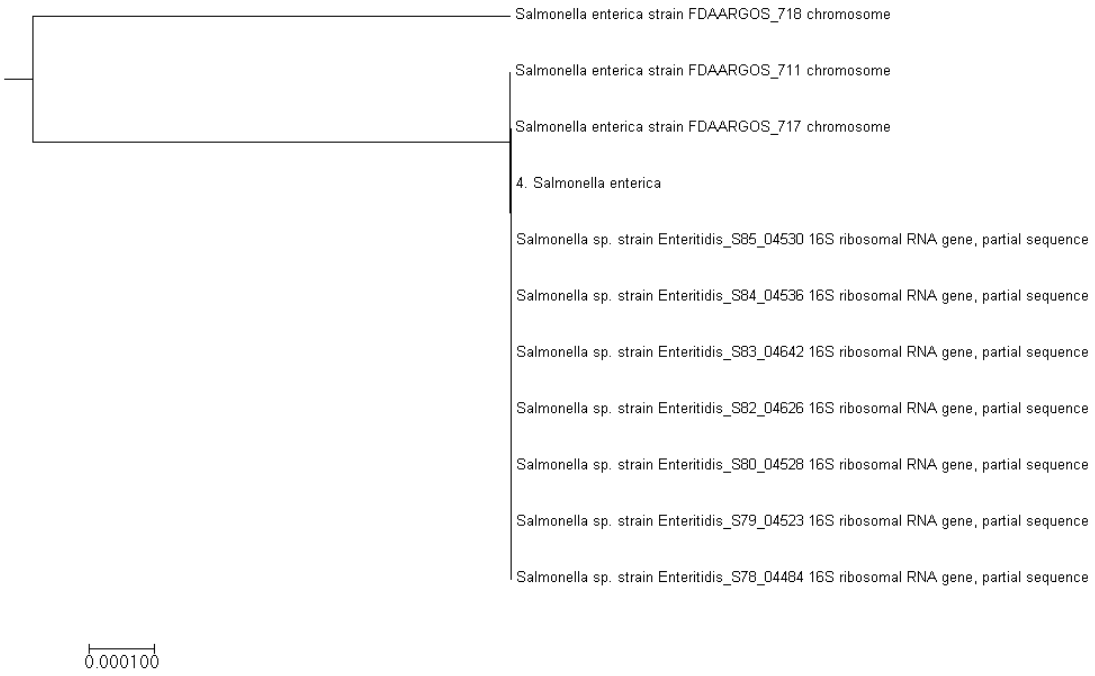

Figure 2. Phylogenetic tree of the recovered isolate with the more related bacterial strains on BLAST of NCBI.

Among the enteric pathogens, *Salmonella* spp. can be divided into two distinct groups: the typhoidal (*S. typhi S. paratyphi*) non-typhoidal (the remaining species serovars). *Salmonella* spp. are relatively sensitive disinfection. Many researchers concluded the overview local water situation indicated that the detection the abovementioned pathogen in water samples that were withdrawn from the distribution system explained as inefficiency the treatment process **(Ezzat *et al*., 2012).** Overuse sometimes misuse antibiotics in human veterinary medicine are major promoters the development spread multi-resistant bacteria worldwide **(Gootz, 2010)**.

Chlorination residual chlorine

Chlorination water is a process which chlorine was added water in any chlorine compounds form. This method is used kill bacteria, viruses other water-borne microbes especially cholera, dysentery, typhoid **(WHO, 2011)**.

In this experiment, six concentrations chlorine as sodium hypochlorite namely 2.0, 3.0, 4.0, 5.0, 6.0 7.0 ppm were applied select the most suitable one reduction bacterial counts residual chloride in water. Results in **Table (8)** indicated that the reduction *S. enterica* count was gradually increased with the increasing chlorine concentration. No bacterial colonies were detected 7.0 ppm.

Table 8. Effect of chloride concentrations (ppm) on *Salmonella* sp. after 24 h of incubation.

Chloride (ppm)	Bacterial count ($x10^3$)	Residual chloride (ppm)
Control *	289	--
2.0	191	< 0.1
3.0	98	< 0.1
4.0	19	0.1
5.0	2	0.3
6.0	1	0.5
7.0	Nil	0.6

* Without chloride Nil: No growth

According the antibiotic susceptibility test result, the identified Salmonella enterica strain was resistant a wide range them, confirming the previous findings **Okeke Edelman (2001)** that the high prevalence antibiotic-resistant bacteria in aquatic environments has become a global problem requires significant international attention. Additionally, **Lateef (2004)** recorded wide distribution antibiotic resistant bacteria in Egyptian Nile which reflect the misuse abuse these antibiotics in the environment.

Hence, the use water disinfectants considered a very important step in water treatment process, the most important traditional disinfectants are halogens, the most prevalent which is chlorine **(CDC, 2020).** Chlorine as an oxidizing agent kills microorganisms in water via the oxidation organic molecules as well as its hydrolysis product (hypochlorous acid) which un-charged therefore easily penetrate the negatively charged surface pathogens **(Calderon, 2000).** Moreover, it is able disintegrate the lipids that compose the cell wall react with intracellular enzymes proteins, making them nonfunctional finally the microorganisms die. Also, results in **Table (8)** also showed that the residual chloride was increased with the increasing the applied chloride concentration, this was realistic logic result. The residual chlorine was ranged between (< 0.1 0.6 ppm) this lies in the permissible limits which considered the residual chlorine levels up 4.0 mg/L or 4.0 ppm are safe in drinking water, besides this level, no harmful health effects can be occur.

Conclusion

From the obtained results this study, it can be concluded that the treatment process drinking water in four centers Qalyubia governorate was sufficient water is drinkable regarding the physical bacteriological examinations. Furthermore, Salmonella fecal streptococci are the most abundant bacterial groups found in water before treatment which indicates that the surface water supply in Qalyuia is affected with the sewage drainage, but after treatment these bacteria found in the permissible limits which indicates that the water is safe human use. Additionally, *Salmonella enterica* found be more susceptible wide range antibiotics, but generally, the chlorine concentration used disinfect drinking water is sufficient kill pathogenic bacteria.

References

Abdel-Satar, A.M.; Ali, M.H. Goher, M.E. (2017) Indices water quality metal pollution Nile River, Egypt. Egypt. J. Aqua. Res., 43:21-29.

Abdo, M.H. 2013. Physicochemical studies the pollutants effect in the aquatic environment Rosetta branch River Nile, Egypt. Life Sci. J., 10:493-501.

Abo-State, M.A.; El-Gamal, M.S.; El-Danasory, A. Mabrouk, M.A. 2014). Prevalence Enterobacteriaceae *Streptococcus faecalis* in surface water Rosetta branch its drains River Nile, Egypt. World Appl. Sci. J., 31(11):1873-1880.

Abo-State, M.A.; El-Gamal, M.S.; El-Danasory, A. Mabrouk, M.A. (2014) Prevalence Enterobacteriaceae *Streptococcus faecalis* in surface water Rosetta branch its drains River Nile, Egypt. World Appl. Sci. J., 31(11):1873-1880.

Alarousy, R.M., Eraqi, M.M., Khalaf, D. (2018) Pollution Drinking Water in Different Localities in KSA. Int. J. Pharm. Sci. Rev. Res., 51(1), 166-172.

Ali, E.M., Shabaan-Dessouki, S.A., Soliman, A.I., El Shenawy, A.S., 2014. Characterization chemical water quality in the Nile River. Egypt. Int. J. Pure Appl. Biosci. 2 (3), 35–53.

Allen, M. J.; S. C. Edberg D. J. Reasoner (2004). Heterotrophic plate count bacteria, what is their significance in drinking water. International Journal Food Microbiology, 92: 265 – 274.

APHA, (2005). American Public Health Association, Standard methods the examination water wastewater (21st ed.), Washington, D.C.

Ashbolt N.J. (2004) Microbial contamination drinking water disease outcomes in developing regions. Toxicology, 891(1-3), 229-238.

Ashbolt, N.J. (2015). Microbial Contamination Drinking Water Human Health from Community Water Systems. Curr. Envir. Health Rpt., 2:95-106.

Bauer, A.W.; Kirby, W.M.; Sherris, J.C. Turck, M. (1966) Antibiotic susceptibility testing by a standardized single disk method. Am. J. Clin. Pathol., 45:493-496.

Calderon, R. L. (2000). The epidemiology chemical contaminants drinking water. Food Chemical Toxicology, 38, S13-S20.

CDC (2020). www.cdc.gov. **Error! Hyperlink reference not valid.**

El-Gammal, H.A. El-Shazely H.S. (2008) Water quality management scenarios in Rosetta River Nile branch, Egypt. 12th Int. water technology Conf., Alex., Egypt, pp:901-912.

El-Kowrany, S.I., El- Zamarany, E.A., El-Nouby, K.A., El-Mehy, D.A., Abo Ali, E.A., Othman, A.A., Salah, W., El-Ebiary A.A. (2016). Water pollution in the Middle Nile Delta, Egypt: An environmental study. Journal Advanced Research 7, 781–794.

EWQS (Egyptian drinking water quality standards) (2007). Ministry Health, Population Decision number 458.

Ezzat, S.M.; Abo-Astate, M.A.; Mahdy, H.M.; Abd El Shakour, E.H. El-Bahnasawy, M.A. 2014. The effect ionizing radiation multi-drug resistant *P. aeruginosa* isolated from aquatic environments in Egypt. Brit. Micro. Res. J., 4:856-868.

Ezzat, S.M.; Mahdy, H.M.; Abo-Astate, M.A.; Abd El Shakour, E.H. El-Bahnasawy, M.A. 2012. Water quality assessment River Nile Rosetta branch: Impact drains discharge. Middle-East J. Sci. Res., 12:413- 423.

Gootz, T.D. (2010). The global problem antibiotic resistance. Critical Rev. Immuni, 30, 79-93.

Hassanein A. M., AbdelRahim K.A.A., Sabry, Y.M., Ismael, M., Heikal, A. (2013). Physicochemical microbiological studies River Nile water in Sohag governorate. Journal Environmental Studies [JES]. 10: 47-61

Heikal, M. (2000) Environmental studies antibiotic resistant bacteria in some locations along the River Nile. Ph.D. In Environmental Biological Science. Inst. Environ. Stud. Res., Ain Shams Univ., Cairo, Egypt.

Khedr, M. A., Emad, E. A., & Khalil, K. M. A. (2017). Overproduction thermophilic α-amylase productivity Amy E gene sequence novel Egyptian strain *Bacillus licheniformis* MK9 two induced mutants. Curr Sci Int 2017b, 6, 364-376.

Lateef, A. (2004). The microbiology a pharmaceutical effluent its public health implications. World J. Microbial. Biotechnol., 20: 167-171.

National Committee Clinical Laboratory Standards "NCCLS" (2007). Performance standards antimicrobial disk susceptibility tests. Approved standard M2-A6. Wayne, Pa: National Committee Clinical Laboratory Standards.

Okeke, I. Edelman, R. (2001) Dissemination antibiotic resistant bacteria across geographic borders. Clin. Infect. Dis., 33:364-369.

Onyango, A.E., Okoth, M.W., Kunyanga, C.N., Aliwa, B.O. (2018) Microbiological Quality Contamination Level Water Sources in Isiolo County in Kenya. Journal Environmental Public Health, Vol. 2018, Article ID 2139867, 10 pages.

Sabae, S.Z. Rabeh, S.A. (2007) Evaluation the microbial quality the River Nile waters Damietta branch, Egypt. Egypt. J. Aqua. Res., 33:301-311.

Saleh, M. A.; E. Ewane; J. Jones B. L. Wilson (2001). Chemical evaluation commercial bottled drinking water from Egypt. Journal Food Composition Analysis. 14: 127 – 152.

Sargaonkar, A., Deshpande, V., 2003. Development an overall index pollution surface water based a general classification scheme in Indian context. Environ. Monit. Assess. 89, 43–67.

Soliman, A.E., Zaghloul, R.A., El-Meihy, R.M., Hanafy, E.A., Ali, H.M. (2018). Microbiological

physicochemical evaluation River Nile (Rosetta branch). 4th International Conference Biotechnology Applications in Agriculture (ICBAA), Benha University, Moshtohor Hurghada, 4-7 April, Egypt, Biochemistry Microbiology, 217-226

Taha, M. M.; Neweigy, N. A.; El-Husseiny, T. M.; Makboul, H. E.; and Salem, A. A. (2019). Microbiological Studies during the Different Treatments of Drinking Water in Road El-Farag Station. Annals of Agricultural Science, Moshtohor, 57(2), 483-492.

World Health Organization. Guidelines drinking-water quality. 4th ed. Geneva: World Health Organization; 2011.

مؤشرات جودة مياه الشرب في أربعة مراكز بمحافظة القليوبية ، مصر

عماد عبدالفتاح سلطان [1] ؛ رشا محمد المهي [2] ؛ هاني محمد عبد الرحمن [2] ؛ راشد عبدالفتاح زغلول [2]

[1] شركة مياه الشرب القليوبية ، بنها ، القليوبية ، مصر.

[2] قسم الميكروبيولوجيا الزراعية ، كلية الزراعة ، جامعة بنها ، مشتهر ، القليوبية ، 13736 ، مصر.

أجريت هذه الدراسة في أربعة مراكز رئيسية بمحافظة القليوبية بمصر وهي بنها وكفر شكر وطوخ وقليوب قبل وبعد عملية معالجة مياه الشرب. تضمن كل موقع من المواقع الأربعة الرئيسية مواقع فرعية على طول نظام التوزيع وهي بنها (ميت عاصم وبنها) وكفر شكر (إيسنيت وكفر شكر) وطوخ (طوخ والدير وقها) وقليوب (قلما وقليوب). تم إجراء الإختبارات الفيزيائية والبكتريولوجية في كل من المواقع الرئيسية والفرعية خلال الشتاء والصيف 2016–2017 وتراوحت قيم العكارة ودرجة الحموضة بين NTU (1.16–2.60) و (7.87–7.27) خلال الموسمين بعد عملية المعالجة على التوالي. بالإضافة إلى ذلك ، تم تسجيل قيم أقل للتوصيل الكهربائي (EC) والصلابة الكلية (T.H) بعد المعالجة عن ذي قبل، ولوحظت أقل القيم في قليوب وبنها خلال فصل الصيف على التوالي. علاوة على ذلك ، كانت قيم المواد الصلبة الكلية (المواد الصلبة الذائبة TDS و TSS المعلقة) في الحدود المسموح بها وبالتالى تشير إلى كفاءة عملية المعالجة. على الجانب الأخر ومع مراعاة التغيرات في التعداد البكتيري الكلي في جميع المواقع الرئيسية والفرعية قيد الدراسة، لوحظ وجود أعداد أعلى من البكتريا في العينات المحضنة عند 37°م عن 22°م مع أعلى تعداد في قليوب وطوخ على التوالي. بينما انخفض تعداد السالمونيلا والمكورات العقدية البرازية بأعداد كبيرة بعد العلاج أكثر من ذي قبل، ولم تسجل معظم المواقع الفرعية أي تعداد للسالمونيلا خلال فصل الشتاء. تلى ذلك عزل البكتيريا الأكثر انتشارًا واختبار مقاومتها للمضادات الحيوية ووجدت أن إحداها كانت مقاومة لعدد كبير من المضادات الحيوية المستخدمة والتي تم تعريفها على أنها *Salmonella enterica* ، ووجد أن تركيزات الكلور المختلفة فعالة ضد *S. enterica* وأن تركيز 7.0 جزء في المليون كانت الأفضل من حيث خفض تعدادا البكتريا وفى نفس الوقت تركيز الكلور المتبقي كان فى الحدود المسموحة والآمنة.

الكلمات الدالة: مياه الشرب ، البكتريولوجية، الفيزيائية ، عملية المعالجة ، الكلورة ، الحساسية للمضادات الحيوية.