Al-Azhar Bulletin of Science

Volume 25 | Issue 2 Article 11

12-1-2014
Section: Botany, Microbiology and Zoology

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How to Cite This Article

Ramadan, Mustafa; Abdol-Raouf, Usama; and Bakhiet, Elsayed (2014) "MICROBIAL AND PHYSICOCHEMICAL EVALUATION OF GROUNDWATER RESOURCES FOR HUMAN DOMESTIC CONSUMPTION IN ALFATH URBAN, ASSUIT, EGYPT," *Al-Azhar Bulletin of Science*: Vol. 25: Iss. 2, Article 11.
DOI: https://doi.org/10.21608/absb.2014.23791

Al Azhar Buletin of Science Vol.(25) No.2, December, 31-41, 2014,.

MICROBIAL AND PHYSICOCHEMICAL EVALUATION OF GROUNDWATER RESOURCES FOR HUMAN DOMESTIC CONSUMPTION IN ALFATH URBAN, ASSUIT, EGYPT

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ABSTRACT

Sewage is the primary source of faecal contamination of groundwater with pathogenic bacteria. Protecting groundwater from microbial contamination is a top public health priority, This study deals with evaluation of groundwater wells, ground water well based-plants, in Alfath lying in Eastern area of Nile Basin, Assuit at summer 2014 with assessment of presence of thermotolerant faecal coliform and thermotolerant faecal streptococci bacteria as a potent indicators for faecal contamination, we used a multiple-tube fermentation or membrane filtration for enumerating themotolerant faecal coliform and thermotolerant faecal streptococci using most-probable-number (MPN) index. This study consisted of a total of 75 water samples obtained for routine testing at summer 2014, there are 5 water wells not suitable consuming as drinking water for human, 3 expulsion of water well plants (Alfath-Alkadema, Bani-Talib and Arab-Moteer) need to sterilization or replacement and renovation. Physicochemical parameters were determined for these water samples.

Keywords: *Groundwater, Themotolerant faecal Coliform, Thermotolerant faecal streptococci, and physicochemical parameters.*

INTRODUCTION

Groundwater has always been essential for human survival throughout Africa, and this is the case in the Nile River Basin, [32]. The groundwater represents the second source for the fresh water. It is mainly originated in Upper Egypt from the local surface water body, [1]. Using of groundwater has gradually increased because of the increase of water demand and the shortage of surface water during growth of population, in many cases groundwater is polluted by the inflow of pollutants such as sewage and industrial wastewater, [15]. [13] Stated that two types of organisms found in faeces, one of which he named *Bacterium coli* (*B. coli*, which is now called *Escherichia coli*) and the concept that the presence of *B. coli* implied pollution of water was readily adopted. It is recorded that the concept of "indicators" had already been suggested in 1880 by van Fritsch based on his observations of *Klebsiellae* in human faeces that were also present in water, [17]. Presence of *E. coli* in drinking water is still considered to indicate that faecal contamination of water has occurred, [23]. The World Health Organization (WHO), [35] recommended that the assessment of microbial water quality based on the detection of *E. coli* and total coliforms as well as [36] recommended the use of faecal streptococci (of which enterococci are a sub-group) as an additional indicator of faecal pollution. When combined with the measurement of *E. coli*, the result is increased confidence in the absence or presence of faecal pollution. The large numbers of *E. coli* present in the gut of humans and other warm-blooded animals and the fact that they are not generally present in other environments support their continued use as the most sensitive indicator of faecal pollution available, [12]. [26] Stated that the recent research on the relevance of faecal streptococci as indicators of pollution showed that the majority of enterococci (84%) isolated from a variety of polluted water sources were "true faecal species". Total coliforms, thermotolerant coliforms, *E. coli* and *Enterococcus spp*. are bacteria whose presence indicates that the water may be contaminated by human or animal wastes [18], enterococci can also occur in different food commodities, especially those of animal origin [8]. Raw water may contain a wide variety of harmless heterotrophic microorganisms such as *Flavobacterium spp*., *Pseudomonas spp*., *Acinetobacter spp*., *Moraxella spp*., *Chromobacterium*, *Achromobacter* spp. and Alcaligenes *spp*., as well as numerous unidentified or unidentifiable bacteria that depending on the source [5].

The Aim

This study aimed to evaluation of ground water resources for human domestic consumption with microbial analysis using thermotolerant faecal coliform and streptococci as indicators of faecal contamination as well as using most important physicochemical parameters to find out the extent of compliance with the Egyptian standard specifications and permissible limits according to APHA [4].

Fig. 1: Location map of Alfath Urban, Assuit, Egypt showing study area and sampling locations

MATERIALS AND METHODS

1- Sampling

Seventy five samples were collected in clean and sterile polypropylene plastic bottles from groundwater wells, expulsion of groundwater well plants, and normal tap water (Table 1); these bottles were covered with aluminum foil, and sterilized in an autoclave at 121ºC for 20 minutes. Sodium thiosulfate was used as a satisfactory dechlorinating agent that neutralized any residual halogen and prevented continuation of the bactericidal action during the sample transit. The time between sampling and analysis was not more than 6 hours [4].

2- Laboratory examination (microbial analysis)

a. Estimation of Coliform Group by Multiple Tube Fermentation Technique (MPN)

i- Presumptive Phase:

Lauryl Tryptose Broth, abbreviated as LTB, was used in the presumptive phase of the Standard Total Coliform Fermentation Technique in the examination of water [11].

Table (1): Sample locations; water wells, water well plants, or drinking water network

Sample Code	Location	Sample Code	Location
1	Well no.1 Alfath-Alkadima water well plant	14	Well no.2 of Bani-Mor Alkadima
2	Well No.4 Alfath-Alkadima water well plant	15	Well no.3 of Bani-Mor Alkadima water well plant
3	Expulsion of water well plant of Alfath -Alkadima	16	Expulsion of Bani-Mor Alkadima Station
4	Water network of Alfath-Alkadima (Hossam Aldin juice cafee)	17	Water network of Bani-Mor Alkadima (Alshahid Sayed Omar school)
5	Water network of Alfath-Alkadima (Alfath Mosqiue)	18	Water network of Bani-Mor Alkadima (Alsafa for trading)
6	Water network of Alfath-Alkadima (Police Resort Club)	19	Well no.2 Bani-Talib water well plant
7	Well no.1 of Bani-Mor, water treatment station	20	Well no.3 Bani-Talib water well plant
8	Well no.2 of Bani-Mor treatment station	21	Well no.4 Bani-Talib water well plant
9	Expulsion of Bani-Mor treatment Station	22	Expulsion of Bani-Talib water well plant
10	Water network of Bani-Mor water treatment station (Mr.Mohye Home)	23	Water network of Bani-Talib water well plant
11	Water network of Bani-Mor treatment station (Alwalid supermarket)	24	Well no.1 Arab-Moteer water well plant
12	Water network of Bani-Mor treatment station (Alzaeem Restaurant)	25	Expulsion of Arab-Moteer drinking water station
13	Well no.1 of Bani-Mor Alkadima water well plant		

Lauryl tryptose broth medium: Tryptose 20.0 g, Lactose 5.0 g, K_2HPO_4 2.75 g, KH_2PO_4 2.75 g, NaCl 5.0 g, and Sodium lauryl sulfate 0.1 g. Reagent-grade water 1 L.

ii. Confirmed test:

Brilliant Green Bile Broth, 2% is formulated according to AOAC and APHA [10], specifications for use in the confirmation of the presumptive tests for coliforms. The Brilliant green bile broth, g/L, for Total Coliform contained: Peptone 10.0, Lactose 10.0, Oxgall 20.0, and Brilliant green 0.0133Reagent-grade water 1 L. The dehydrated ingredients were added to the water, mixed thoroughly, and heated to dissolve. The pH had to be 7.2 ± 0.2 after sterilization.

iii. Complete tests:

EC Medium [16] was developed by [14] was used for the detection of the coliform group and *E. coli*. This medium consisted of a buffered lactose broth with the addition of a 0.15% bile salt mixture. The growth of spore-forming bacteria was inhibited by the bile salts. The formation of gas in the Durham tube of the Brilliant green tubes, at any time within 48 ± 3 h, constituted a confirmed positive result. The formation of gas in the Durham tube of the EC tubes, at any time within 24 ± 2 h, constituted a confirmed positive result.

The MPN value of the number of positive Brilliant green lactose bile tubes and the EC tubes was calculate from the MPN index. In the case of inoculating one bottle with 100 ml of the sample portion, the report resulted as present or absent. The MPN values were for a variety of positive and negative tube combinations. The sample volumes indicated in the indexes illustrate the MPN values for the concentrations of Positive and Negative results when Five 20-ml or Ten 10-ml portions were used. This was a detailed procedure for the detection and enumeration of the Faecal *Streptococcus* group (FS) and Enterococcus group by using the Multiple Tube Technique in water samples in 48 hours or less on the basis of the reduction of Triphenyl Tetrazolium Chloride (TTC).

Eosine Methylene Blue agar (EMB) was used for the isolation of *E. coli* [6].

In this method, *E. coli* was defined as coliform bacteria that possessed the enzyme β-glucuronidase and were capable of cleaving the fluorogenic substrate 4-methylumbelliferyl-β-D-glucuronide (MUG) with the corresponding release of the fluorogen when grown in EC-MUG medium at 44.5°C within 24 ± 2 hrs or less. The procedure was used as a confirmatory test after the prior enrichment in a presumptive medium for the total coliform bacteria [2].

iv. Physiological and biochemical examination

Four to five suspected colonies from each bacterial plate were picked, cultured and then identified by the various biochemical tests. Biochemical tests were performed to confirm *E. coli* using Gram staining, Catalase test, Indole, Methyl red, Voges-Proskauer test, Nitrate reduction, Urease production, Simon citrate agar [37], and various sugar fermentation tests.

b. Isolation and identification of Themotolerant Faecal streptococci

i. Azide dextrose broth was used for the enumeration of faecal streptococci, [21]:

Azide dextrose broth (g/L): Beef extract 4.5, Tryptone or polypeptone 15.0 , Glucose 7.5, Sodium chloride, NaCl 7.5, Sodium azide, NaN_3 0.2 g. Reagent-grade water 1 L, the medium was heated to boiling with agitation and pH was adjusted at 7.2 before autoclaving at 121°C for 15 hours, cooled to 45°C.

A positive test is indicated by turbidity (cloudiness) in the broth. A negative test remains clear. Azide Dextrose Broth tubes showing turbidity after 24 – 48 hours incubation must be subjected to the Confirmed Test Procedure. Consult appropriate references for details of the Confirmed Test Procedure, [11].

ii. Pfizer selective enterococcus

Pfizer Selective Enterococcus Agar is used for the selective isolation and cultivation of Enterococci. This medium is formulated as per Isenberg, [19] by reducing the concentration of bile salts and sodium azide from the original formulation. The importance of esculin hydrolysis in differentiating Enterococci and streptococci

was first reported by Rochaix as streptococci do not exhibit esculin hydrolysis [30].

iii. Presumptive Test Procedure

Inoculate a series of tubes of azide dextrose broth with appropriate graduated quantities of sample, use sample of 10 mL portions or less, use double-strength broth for 10ml inoculum. The portions used will vary in size and number with the sample character. Use only decimal multiples of 1 ml. Incubate inoculated tubes at 35 ± 0.5°C. Examine each tube for turbidity at the end of 24 ± 2. If no definite turbidity is present, reinsulate, and read again at the end of 48 ±3 hrs.

iv. Confirmed Test Procedure

Subject all azide dextrose broth tubes showing turbidity after 24- or 48-h incubation to the confirmed test. Streak a portion of growth from each positive azide dextrose broth tube on PSE agar. Incubate the inverted dish at 35 ± 0.5°C for 24 ± 2 h. Brownish-black colonies with brown halos confirm the presence of faecal streptococci.

PSE agar (gL^{-1}): Peptone C 17.0, Peptone B 3.0, Yeast extract 5.0, Bacteriological bile 10.0, Sodium chloride, NaCl 5.0, Sodium citrate 1.0, esculin 1.0, Ferric ammonium citrate 0.5, Sodium azide, NaN3 0.25, Agar 15.0, reagent-grade water 1 L**,** pH should be 7.1 ± 0.2 after sterilization. Hold medium for not more than 4 h at 45 to 50°C before plates are poured.

Colonies showing esculin hydrolysis were analyzed for catalase activity. At least two catalase negative colonies from each plate were characterized by cultural and biochemical tests: Gram-staining reaction, growth in 6·5% NaCl broth, at 45 °C for 48 h and at 60 °C for 30 min, haemolysis on 5% blood agar, acid production from dextrose, mannitol, trehalose, arabinose.

Physicochemical analysis:

RESULTS AND DISCUSSION

Microbial analysis:

The results in Table 3 reveal that there is contamination with:

1-Thermotoleranr faecal coliform especially *E. coli* in the following locations: well no.1, 4 and expulsion of water well plant of Alfath-Alkadima respectively (MPN-Index/100ml = 8 < , 4 .6, and <8; Code no. 1, 2, and3); well no.4,expulsion and water tap of water network of Bani-Talib water well plant (MPN-Index/100ml=2.6 , 2.6, and 8<; code 21, 22 and 23); and well no. 1 and expulsion of Arab-Moteer drinking water station (MPN-Index/100ml= 8<; code no. 24, and 25).

Table (2): Physicochemical parameters of groundwater quality and analytical methods:

	Parameter	Method
1	pH	Digital pH meter.
2	Turbidity	Turbidimeter [10b]
3	Ca	Ethylene diaminetetraacetic acid (EDTA) titrimetric method
4	Total alkalinity.	Titrating with sulfuric acid [4]
5	Chlorides.	Silver nitrate titrimetric method [34]
6	Ammonia & Nitrate.	Technicon Auto Analyzer. Total hardness EDTA Titrimetric Method ($CaCo_3$)
7	Total suspended solids (TDS)	COD. Titrimetric method (Spectrophotometer at 600 nm, [4]
8	Iron	The phenanthroline method [4]
9	Manganese	The persulfate method [4]

2-Faecal streptococci in the following locations: well no.1, 4 and expulsion of wa4 ter well plant of Alfath-Alkadima (MPN-Index/100ml=<8, 4.6 and <8 ; Code no. 1, 2 and 3) ; water tap of water network of Bani-Talib water well plant (MPN-Index/100ml=8<; code no.23) ; Well no. 1 and expulsion of Arab-Moteer water well plant (MPN-Index/100ml= 8<; code no. 24, and 25).

We found that thermotolerant faecal coliform bacteria in 8 locations of water samples (4 wells, 3 expulsion of water well plants, and 1 tap water samples) as indication for faecal contamination of these locations, and found thermotolerant faecal streptococci bacteria in 6 locations of water samples (3 wells, 2 expulsion of water well plants, and 1 tap water samples) as indication for faecal contamination of these locations. There are 17 locations of water samples correspond to the standard international specification and Egyptian standard; MPN-Index/100ml= >1.1. But they need to sterilization with chlorine system.

Note that the total number of allowable (MPN-Index/100ml of 95% samples = 2 colonies of coliform bacteria on condition that this number don't be recurrent more than one time in the same samples from the same location zero CFU of Streptococcus spp. (Egyptian standard for the quality of drinking water). Faecal contamination of ground water wells that resulting from animal contamination or wells deep domestic sewage in some houses near the location of ground water wells; As for the contaminant expulsion of some water well plants there is no sterilization for water wells with chlorine (chlorine system) and filtration of water is so bad.

The technique of enumerating coliforms by means of multiple-tube fermentation (MTF) has been used for over 80 years as a water quality monitoring method. The method consists of inoculating a series of tubes with appropriate decimal dilutions of the water sample. Production of gas and acid formation or abundant growth in the test tubes after 48 hrs of incubation at 35 °C

Table (3): Average of total viable count of indicator bacterial in groundwater, treated water, and tap water (MPN-Index/100ml) of different locations:

Sample Code	Indicator bacteria (MPN-Index/100ml)				Sample Code	Indicator bacteria (MPN-Index/100ml)			
	T-Coliform	Faecal Coliform	E. coli	Faecal Streptococci		T-Coliform	Faecal Coliform	E. coli	Faecal Streptococci
1	<8	<8	<8	<8	14	>1.1	>1.1	>1.1	>1.1
2	4.6	4.6	4.6	4.6	15	>1.1	>1.1	>1.1	>1.1
3	<8	<8	<8	<8	16	>1.1	>1.1	>1.1	>1.1
4	>1.1	>1.1	>1.1	>1.1	17	>1.1	>1.1	>1.1	>1.1
5	>1.1	>1.1	>1.1	>1.1	18	>1.1	>1.1	>1.1	>1.1
6	>1.1	>1.1	>1.1	>1.1	19	>1.1	>1.1	>1.1	>1.1
7	>1.1	>1.1	>1.1	>1.1	20	1.1	>1.1	>1.1	>1.1
8	>1.1	>1.1	>1.1	>1.1	21	2.6	2.6	2.6	>1.1
9	>1.1	>1.1	>1.1	>1.1	22	4.6	1.1	1.1	1.1
10	>1.1	>1.1	>1.1	>1.1	23	<8	<8	<8	<8
11	>1.1	>1.1	>1.1	>1.1	24	<8	<8	<8	<8
12	>1.1	>1.1	>1.1	>1.1	25	<8	<8	<8	<8
13	>1.1	>1.1	>1.1	>1.1					

constitutes a positive presumptive reaction. Both lactose and lauryl tryptose broths can be used as presumptive media, [3]. The indicator bacteria recorded in the study were thermotolerant coliforms and faecal streptococci. In temperate climates, it has been reported that 95% or more of thermotolerant coliforms are *E. coli*, which is the preferred faecal indicator bacteria [36].

Identification of *Escherichia coli* and *Streptococcus spp*.:

Isolation and identification of *E. coli* isolates confirmed by conventional laboratory tests; using Gram staining, Catalase test, indole, Methyl red, Voges-Proskauer test, Nitrate reduction, Urease production, Simon citrate agar, and various sugar fermentation tests. *Escherichia*, a member of Enterobacteriaceae, are oxidase-negative catalase-positive straight rods that ferment lactose. Cells are positive in the Methyl-Red test, but negative in the Voges-Proskauer assay. Cells do not use citrate, do not produce H_2S or lipase, and do not hydrolyze urea [9]. Most-Probable-Number (MPN) multiple-tube fermentation based on lactose fermentation with production of acid and gas within 48 hrs and a membrane filtration method also based on lactose fermentation. If the water sample yields presumptively positive results, confirmation taking an extra 24 to 48 hrs of incubation time is required. *E. coli* is detected with the same methods, but often by using elevated temperature, different medium formulations, and a test for indole production in the multiple-tube fomentation method, [20]. Faecal coliforms (or thermotolerant coliforms) are traditionally defined as coliforms that ferment lactose at 44.5 °C in a medium with bile salts [25]. Coliforms and E. coli possess the enzyme β-D-galactosidase.giving them the ability to degrade O-nitrophenyl·D-n-galactopyranoside (ONPG), producing yellow-colored product O-nitrophenol. *E. coli* also has the ability to cleave methylumhclliferyl-β-glucuronide (MUG), resulting in the formation of the fluorescent product 4-methylumbeeliferone, [24]. The detection of β-D-glucuronidase activity (at 44.5 °C) is, generally, a good marker for faecal coliforms in environmental polluted waters and very specific for *E. coli* [24, 28].

Faecal *streptococcus spp*. isolates confirmed by conventional laboratory tests. About 90% of the isolates from PSE agar positive characterized by cultural and biochemical tests: Gram-staining reaction, growth in 6·5% NaCl broth, at 45 °C for 48 hrs and at 60 °C for 30 min, haemolysis on 5% blood agar, acid production from dextrose, mannitol, trehalose, arabinose, sucrose, melezi-

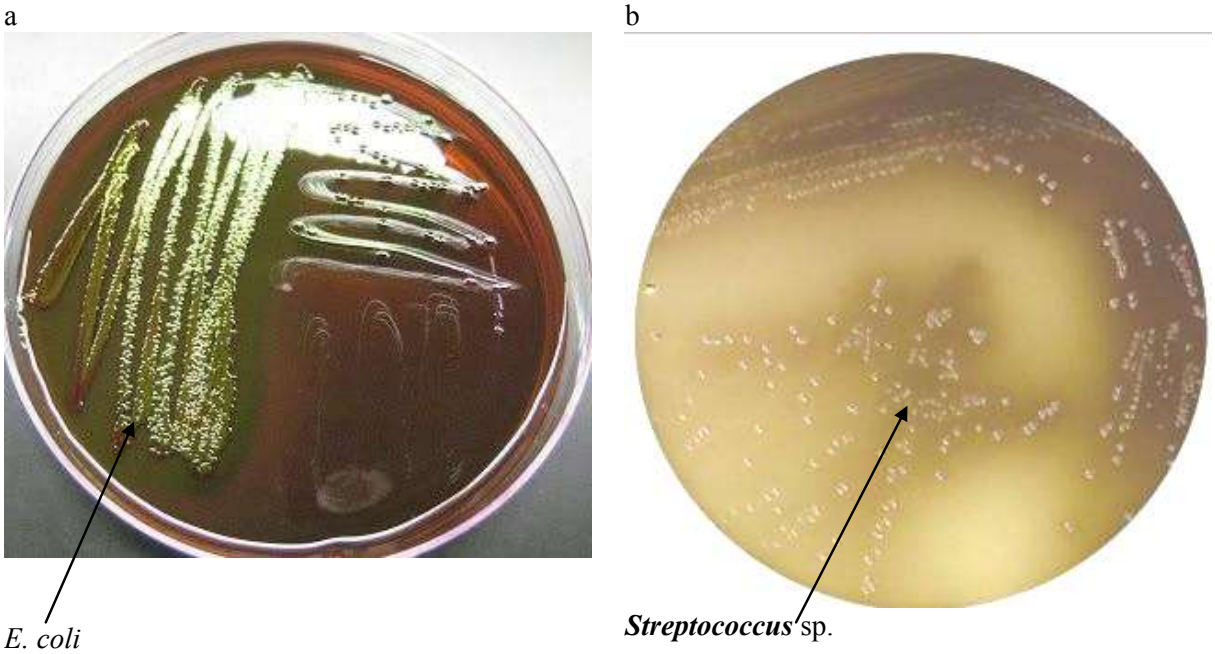

Fig (2): a= Green metallic shine colonies of *E. coli* in eosin methylene blue medium, b= Halobrown colonies of *Strepococcus spp*. on Pfizer Selective Enterococcus Agar medium.

tose; arginine decarboxylation; reduction of tellurite, pyrrolidonylarylamidase, phosphatase, susceptibility to optochin b-D-glucuronidase, b-D-glucoside a- D-galactoside; resistance to bacitracin, novobiocin, aztreonam. Some tests were carried out by an automatic system (SCEPTOR® System) [26].

Physicochemical analysis (Table 4)

Hydrogen Ion Concentration (pH): pH values in the present study showed slightly basic ranged about 7.39 in well no.1 Alfath-Alkadima and 8.35 in well no.1 Arab-Moteer, in all groundwater samples complies with the permissible limits(pH <8) except well no.4 Alfath-Alkadema, expulsion of Bani-Talib drinking water station, well no.1 Arab-Moteer water well plant and expulsion of Arab-Moteer drinking water station.

Turbidity: Nephelometric Turbidity Unit (NTU) at all groundwater samples were ranged from 0.38 Expulsion of Bani-Talib drinking water station and Water network of Bani-Talib (Mr. Ali Abdu home) to 15.9 well no.1 Arab-Moteer,

Total Alkalinity: The total alkalinity values were ranged from 170 mg/L at Expulsion of Arab-Moteer drinking water station and 510 mg/L at well no.4 Alfath-Alkadima.

Chlorides

The minimum value 40 mgL/L of chloride was observed at expulsion of Arab-Moteer drinking water station, whereas the maximum value 110 mg/L was noted at well no.1 of Bani-Mor treatment station and well no.2 of Bani-Mor Alkadima. The values were still within the permissible limits at both regions (< 250 mg/L).

Total Dissolved Solids (TDS): The minimum level was 167 mg/L observed at Expulsion of Arab-Moteer drinking water station, while the maximum level was 639 mg/L observed at Well no.2 of Bani-Mor Alkadima.

All TDS results were within the permissible limits (< 1000 mg/L)

Total Hardness (CaCO3): The maximum value was 426 mg/L observed at Well No.4 Alfath-Alkadima while the minimum value was 125 mg/L observed at expulsion of Arab-Moteer drinking water station, total hardness concentrations in all ground water samples were within the permissible limits (< 500 mg/L).

Ammonia: samples ranged from 0.1 in water network of Alfath-Alkadima (Alfath Mosqiue) and Water network of Alfath-Alkadima (Police Resort Club) to maximum value was 1.2mgL^{-1} in Water network of Bani-Mor treatment station (Alwalid supermarket). Results of ammonia in most the examined water samples were at the permissible limits (> 0.5 mg/L) except well no.1 of Bani-Mor treatment station , well no.2 of Bani-Mor treatment station , Water network of Bani-Mor treatment station (Alwalid supermarket) , well no.1 of Bani-Mor Alkadima , Well no.2 of Bani-Mor Alkadima , well no.3 of Bani-Mor Alkadima , Expulsion of Bani-Mor Alkadima Station , Water network of Bani-Mor Alkadima (Alshahid Sayed Omar school) , Water network of Bani-Mor Alkadima (Alsafa for trading) , wells no.3, and 4 Bani-Talib water well plant.

Iron: The minimum value is 0.05 mg/L of iron was recorded at Expulsion of Bani-Mor water treatment station whereas the maximum value was 2 in two locations at Well no.1 and expulsion of Arab-Moteer water well plant. Most samples at the permissible limits (> 0.3 mg/L).

Manganese : The minimum value is 0.4mgL^{1} of Manganese was recorded at Water network of Alfath-Alkadima (Hossam Aldin juice café), Water network of Alfath-Alkadima (Police Resort Club) and Water network of Bani-Mor treatment station (Alwalid supermarket), whereas the maximum value was 2.5 in Expulsion of Bani-Mor Alkadima Station and Water network of Bani-Mor Alkadima (Alsafa for trading).

Physical parameters such as pH, conductivity and TDs have a major influence on bacterial population growth, pH values ranging from 3 to 10.5 could favor both indicator and pathogenic microorganism growth, [38].

Total Hardness has no adverse effect on human health and water above hardness of 200 mg/L may cause scale deposition in the water distribution system and more soap consumption. Soft water below hardness less than 100 mg/L is more corrosive for water pipes [35]. Total

Table (4): Physicochemical parameters of groundwater samples:

Sample Code	Parameters										
	P.H	Turb (NTU)	T-Alk (mg/L)	Chloride (mg/L)	T-D-S (mg/L)	T-H (mg/L)	Ca-H (mg/L)	Mg-H (mg/L)	Ammonia (mg/L)	T-Iron (mg/L)	T-Manganese (mg/L)
1	7.39	3.91	294	60	579	416	266	150	0.3	0.6	0.7
2	8.02	4.79	510	55	590	426	267	159	0.24	0.45	0.8
3	7.79	2.03	290	60	419	236	165	71	0.16	0.35	0.6
4	7.95	1.18	290	75	424	248	147	101	0.16	0.15	0.4
5	7.92	1.18	296	80	424	268	161	107	0.1	0.08	0.5
6	7.92	1.03	290	75	421	262	151	111	0.1	0.08	0.4
7	7.85	1.79	350	110	536	263	183	80	0.56	0.35	0.65
8	7.83	0.48	296	75	441	186	159	27	0.5	0.2	0.6
9	7.82	0.9	300	70	450	187	151	36	0.4	0.05	0.45
10	7.91	0.95	290	90	467	200	152	48	0.3	0.08	0.5
11	7.81	0.9	284	75	445	197	144	53	1.2	0.08	0.4
12	7.97	0.75	284	80	462	186	130	56	0.36	0.2	0.6
13	7.94	0.67	280	55	410	183	158	25	0.6	0.08	1
14	7.91	3.12	466	110	639	409	304	105	0.68	0.5	2
15	7.77	9.85	570	55	638	400	329	71	0.8	0.6	4
16	7.82	2.05	398	75	526	293	202	91	0.74	0.3	2.5
17	7.87	1.21	390	55	484	285	191	94	0.7	0.15	2
18	7.87	1.76	430	70	520	310	211	99	0.74	0.3	2.5
19	7.7	0.47	390	63	522	296	176.4	119.4	0.34	0.13	N.D.
20	7.8.	9.97	360	66	492	206	192.6	13.4	0.75	0.05.	N.D.
21	7.8.	0.86	470	42	555	318	179.8	138.2	0.8	0.08	N.D.
22	8.	0.38	410	54	520	268	178.4	89.6	0.2	0.06.	N.D.
23	7.9.	0.38	420	60	531	276	198.6	77.4	0.26	0.1	N.D.
24	8.2	15.9	180	45	190	163	107	56	0.2	2	N.D.
25	8.3	5.34	170	40	167	125	87	38	0.2	2	N.D.
Standards	6.5 - 8.5	5	200	250	500	300	75	30	0.5	0.3	0.4

ND= non detectable

hardness (as CaCO3) ranged between 29 and 348mg/L with only 50% of the water samples studied being above the 100 mg/L optimum limit recommended , however, none of the studied water samples exceeded the 500 mgL^{-1} maximum permissible level recommended by SASO [31]. [27] Suggested that the high nitrates were the indicative of high pollution load, an Increasing level of nitrates by intrusion of sewage and industrial effluents into the natural water [22]. High levels of nitrate in water may cause serious illness and sometimes death. Nitrates have the potential to cause shortness of breath, "blue babies" syndrome in infant diuresis, an increase in starchy deposits and hemorrhaging at the spleen [33]. Iron is biologically an important element. It is essential to all organisms and present in hemoglobin system. A stringent taste is detectable by some persons at levels above 1 mg/L [29]. In the present study, the iron contents were slightly higher than the permissible limits. The high concentration may be due to dumping of wastes around the bore wells. TDS represents the amount of inorganic substances (salts and minerals). High TDS is commonly objectionable or offensive to taste. A higher concentration of TDS usually serves as no health threat to humans until the values exceed 10,000 mg/L [7].

Conclusion

Microbial analysis of water samples from ground water and water well plants and tap water showed that: Thermotolerant faecal coliform bacteria found in 8 locations of water samples (4 wells, 3 expulsion of water well plants, and 1 water network samples) that indication for faecal contamination of these locations and thermotolerant faecal streptococci bacteria found in 6 locations of water samples (3 wells, 2 expulsion of water well plants, and 1 tap water samples) that is more confidential evidence for faecal contamination of these locations. There are 17 locations of water samples correspond to the standard international specification and Egyptian standard at summer. So we found 4 water well plants need sterilization system and filtration system and 3 water well plants must be regenerated and 1 water network must be regenerated. Physicochemical parameters of most samples were found at the permissible limits.

Acknowledgment

We would like to express our sincere thanks to Mr. Chairman of drinking water and sewage company in Assiut governorate & New-valley governorate and sector of laboratories & quality control; specially Chemist Mr. Saleem Syed Saleem for facilitate water sampling and his agreeing to elaborate some bacterial analysis.

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التقييم الميكروبى والفيزيوكيميائى للمياة الجوفية المستخدمة للاستهلاك الآدمى فى منطقة الفتح, أسيوط , مصر

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تهدف هذة الراسة لتقييم التلوث البرازى لمياة الشرب الجوفية و كفاءة محطات المياة القائمة عليها وشبكات المياة فى مركز الفتح والقرى التابعة له والواقعة شرق النيل فى محافظة أسيوط بصعيد مصرو ذلك بالكشف عن وجود البكتريا القولونية وسيما بكتريا الإيشيريشيا كولاى البرازية و البكتريا السبحية البرازية والتى تستطيع جميعها النمو فى درجة حرارة 45 مئوية كدلائل قوية على التلوث البرازى ووجودها يدل على إمكانية تواجد اى ميكروبات ضارة اخرى قد تلوث المياة برازية المصدر كالبكتريا المرضة والفطريات والفيروسات الضارة بصحة الانسان وكذلك تقييم بعض العوامل الفيزيوكيميائية فى المواقع محل الدراسة.

أظهرت النتائج تواجد بكتريا القولون البرازية والتى تنمو فى درجة 45 مئوية بنسبة من 2.6 حتى اكبر من 8 (MPN-Index/100ml) وكلها بكتريا إيشيريشيا كولاى فى المواقع الاتية:

1- البئر رقم 1 و4 وكذلك طرد محطة الفتح القديمة .
2- بئر رقم 4 وطرد محطة بنى طالب وشبكة المياة التابعة لها.
3- بئر رقم 1 وطرد مجطة عرب مطير.

وكذلك تواجد بكتريا القولون السبحية والتى تنمو فى درجة 45 مئوية بنسبة من 4.6 حتى اكبر من 8 (MPN-Index/100ml) فى المواقع الاتية:

1- البئر رقم 1 و4 وكذلك طرد محطة الفتح القديمة .
2- شبكة مياة بنى طالب.
3- بئر رقم واحد وطرد محطة بنى طالب.

تواجد بكتريا القولون البرازية الإيشيريشيا كولاى والتى تنمو فى درجة 45 مئوية بنسبة (MPN-Index/100ml= >1.1) فى جميع المواقع الأخرى محل الدراسة.

تواجد بكتريا القولون السبحية والتى تنمو فى درجة 45سليزية بنسبة (MPN-Index/100ml= >1.1) فى جميع المواقع محل الدراسة.

و طبقا للمواصفة المصرية والتى تنص على رفض جميع العينات التى تتواجد بها البكتريا القولونية البرازية أكبر من 2 (MPN-Index/100ml >2) وبشرط ان لا تتكرر أكثر من مرة فى العينات من نفس الموقع كذلك رفض جميع العينات التى تتواجد بها بكتريا القولون أكبر من 1 (MPN-Index/100ml>1) فإننا نوصى بتعقيم كافة الآبار الجوفية والمستخدمة كمصادر لمياة الشرب محل الدراسة وكذلك تجديد وإحلال كل من محطة مياة محطة الفتح القديمة محطة بنى طالب ومحطة عرب مطير وكذلك شبكة مياة بنى طالب.

كما بينت الدراسة أن الخصائص الفيزيوكيميائية للمواقع محل الدراسة معظمها مطابق للنسب المسموح بها.